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Macrofungal Diversity of North East India and Development of Nanoparticle Based Detection of Mushroom Toxin

Assma Parveen

Mushrooms have been an important part of the diet for the people worldwide due to its nutritious and delectable taste since ancient times. The ethnic communities of the Northeast India have extensive traditional knowledge of the edible mushrooms which they forage from the wilds. Unfortunately, increasing population pressure and consumer demand for exotic mushrooms have led to indiscriminate collection and sale of unidentified varieties leading to lethal cases on several occasion. Development of diagnostic kits to detect toxins present in wild mushrooms *in situ* for prevention and detection of mushroom poisoning is therefore very important and can aid in rapid detection of the toxins in affected patients for early treatment.

A systematic collection of mushrooms and their detailed study of diversity and distribution of wild mushrooms in the state of Assam based on phenotypic and molecular characteristics led to a collection of 44 samples out of which, 17 mushrooms species were found predominantly during summer season, 11 species during autumn, nine species during monsoon, three species in winter and eight species during spring season. Soil was preferred habitat followed by tree/hardwood tree. Molecular characterization based on rDNA-ITS sequences revealed 16 macrofungal families. Out of the 44 samples, 23 samples were reported to be edible and for the other 21 non-edible strains, five strains had medicinal properties, six strains were earlier reported poisonous, two had industrial application while the properties of the rest are yet to be ascertained. Phallacidin, a bicyclic heptapeptide of the phallotoxin family is highly hepatotoxic and found in many of the poisonous mushrooms. This study generated antibodies against the Phallacidin (PCN) toxin present in poisonous mushrooms using Phallacidin-BSA conjugate in New Zealand white rabbit. The antibodies showed high sensitivity and detection limit of 11.89 ng/mL for phallacidin and 8.6 ng/mL for ?-Amanitin. The detection limits with reduced assay time for these two toxins were further improved to 10.87 ng/mL (Phallacidin) and 11.09 ng/mL (?-Amanitin) through generation of HRP-PCN conjugate. A lateral-flow-based dipstick immunoassay format using antibody-

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gold conjugate for rapid field screening of Phallacidin with a detection limit of 25 ng/mL was further developed. The present study reports development of three methods viz. ELISA, HRP-PCN and lateral flow immunoassay for detection of Phallacidin & ?-Amanitin. This is the first report of development of immunoassay to detect Phallacidin toxin. The immunoassays developed through this study can be convenient quantitative tool for screening of toxin in wild mushrooms.

Molecular cloning, characterization and tissue specific expression analysis of the gene encoding 3-hydroxy-3-methylglutaryl Coenzyme A (HMG-CoA) reductase in *Centella asiatica* to comprehend the regulation of tri-terpenoid biosynthesis using RNAi approach

Kritideepan Sarmah

Tea is one of the most popular beverages manufactured from the leaves or the young tender shoots of the tea plants, *Camellia sinensis* (L.) O. Kuntze. India, which is the highest producer of beverage tea, is not yet fully self sufficient in edible oil production. The present study was undertaken to study the potentiality of tree borne oilseeds like tea. The eight different bi-clonal tea seed stocks were collected, namely TS-378, TS-379, TS-462, TS-463, TS-464, TS-491, TS-506 and TS-520.

The crude fat (oil) was extracted from the dried cotyledons of matured tea seeds. On dry weight basis, the oil percentage ranged from 10.75-26.84. The acid values, iodine values, saponification values and specific gravity of different bi-clonal seed stocks were found to be in the range of 1.01-1.22 (mgKOH/g), 72.94-94.91 (gI_2/100g) ,177.56-200.45 (mgKOH/g) and 0.82-0.88g/cm^3, respectively. The percentage of saturated and unsaturated fatty acids in tea seed oil seven months and eight months after seed formation as determined by Gas chromatography ranged between 20.18-76.44 and 23.56-79.57 and 14.25-29.00 and 71.00-85.75 respectively. The percentage of saturated and unsaturated fatty acids in tea seed oil eight months after seed formation as determined by GC-MS ranged between 2.21-20.3 and 79.97-97.79, respectively. The IC_{50} values of oils of different bi-clonal seed stocks ranged from 60.3-81.52 mg/ml. The seed cake percentage by weight of different bi-clonal seed stocks ranged from 73.16-89.24. The saponin (%) , nitrogen (%), phosphorus (µg/g), potassium (µg/g) and starch (%) of the seed cake ranged between 2.41-6.52, 1.19-2.93, 2.42-3.68,0.11-0.18,27 and 29-70.77, respectively. The soluble protein content (%) of different bi-clonal seed stocks at 1st, 3rd, 5th and 8th months after seed formation ranged between 2.51-6.41, 3.34-10.23, 5.09-13.87 and 5.41-14.48, respectively.

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Department : Agricultural Biochemistry
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The protein bands of different biclonal seed stocks at various developmental stages as detected by SDS-PAGE ranged between 20-66 kDa. The oil (%) and starch (%) recovery from bi-clonal tea seeds by fermentation process ranged from 0.73-1.75 and 10.19-27.98, respectively. The oil could not be extracted successfully by the mechanical method using mustard oil expeller. Among the tea stocks studied, the oil content was found to be higher after eight months of fruit set. Identification of higher level of oleic acid and linoleic acid in most of the tea seed stocks revealed better nutritional quality of tea seed oil. Among the eight tea seed stocks studied, TS-379 was found to be the best considering the highest amount of oil content (23.3 %- 26.84 %), higher unsaturated fatty acid (90>%) and IC_{50} value at the lower side. The present study indicated the future scope of tea seed oils and its cake to be exploited commercially in India.

A proteogenomic study to elucidate acid tolerance mechanism in soil bacteria

Archana Deka

Acidification of soil is an important area of ecological and economic concern as it results in considerable losses in agricultural productivity leading to loss in economy of the country. Soil pH affects many aspects of crop production, including nutrient availability, possible metal toxicity, efficacy of soil-applied herbicides, and crop and microbial growth. Soils of Assam are in general acidic with a pH value ranging from 4.9 to 5.2 of which nearly 80% of the land is affected by soil acidity. Most of the microbes are highly susceptible to acidic condition with exception of acid tolerant microbes who have adapted to the acidic stress condition of the soil. The present study was aimed at understanding the bacterial responses to acid stress and identify the gene(s) that impart acid tolerance. A total of 101 numbers of soil samples were collected from Assam and Arunachal Pradesh, out of which 13% were non-acidic soil, 58% medium acidic and 29% strongly acidic soils. About 210 numbers of different bacterial isolates were isolated from the soil samples and screened for their acid stress tolerance ability followed by biochemical and molecular characterization. Out of the 35 bacterial isolates under consideration, 19 isolates belonged to the *Bacillus sp.* making Bacillus, the most predominant genera in collected acidic soil samples followed by the genera Aeromonas, Lysinibacillus, Burkholderia, Staphylococcus, Alcaligenes, Brevundimonas, Microbacterium, Nesterenkonia, Pseudomonas and Streptomyces. These were further assessed for their plant growth promoting activities at pH 7.0 and 4.5 and interestingly it was found that indole acetic acid, gibberelic acid and siderophore production ability and zinc solubilizing ability gets reduced in acid stress condition except for phosphate solubilization which showed increased solubilization activity at low pH. The study used proteomic approach to identify proteins and genes therein that are upregulated and showed increased expression in acid stress condition. The 3 genes, *viz., fad* (fatty acid desaturase type 1 (*fad*S1), *dgk* (diacyl glycerol kinase) and *metABC* (methionine ABC transporter ATP-binding protein) that showed increased expression in proteomic analysis, showed 56 fold, 48 fold and 928 fold increased expression respectively compared to the neutral condition

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(pH 7.0). The *metABC* gene showing higher expression in both protein and RNA level during acid stress condition was successfully cloned in pET-28b$^+$ vector and expressed in BL21 *E. coli* strain. The cloned gene was expressed highest when it was induced with 0.3mM IPTG at 27°C for 16hrs. A protein size of 33kD corresponding to the *metABC* protein was visible. Further the transformed cells had better survival rate in acid stress (pH 4.5) when compared to the untransformed cells in the same condition. Thus, it can be concluded that metABC plays a role in acid tolerance in *B. megaterium*.

"Screening of indigenous rice (*Oryza sativa* L.) germplasms of Assam for tolerance to anaerobic condition during germination"

Dhananjay Kumar

Rice is the staple food for the people of India and the major source of livelihood to the farmers. One of the most serious problems that adversely affect rice production in Assam is the recurrence of devastating floods. Even though more than 60% of summer rice is planted by the month of June, flooding after transplanting could completely devastate the crop. Furthermore, in the case of direct seeded rice, occurrence of flood delays sowing of seeds. Rice seeds can germinate under hypoxic conditions, but may fail to extend their coleoptiles and develop roots and leaves. Thus, there is an urgent need to provide farmers with rice varieties that besides being highly adoptive to local environment, also have the additional trait of tolerance to hypoxic condition. Breeding for hypoxic tolerance for germination was attempted but with limited success, because highly tolerant donors were unavailable and knowledge of the physiological and molecular basis of tolerance was inadequate.

The precise and stringent control of physiological responses of deep water germplasms to flooding indicates that plant must possess sensible oxygen sensing mechanisms. Despite the wealth of molecular and phenotypic data on plant responses to water logging, very less information about how declining oxygen levels are sensed, and how the complex and extensive expression changes are controlled. So, in this study deepwater germplasms from Assam were screened against the proven tolerant lines *KHO, MZ Red* and *Khaiyan* (obtained from IRRI).Phenotypic characterization of 160 germplasm from Assam, based on a set of physiological parameters identified Rangadhar Kekua Bao (RKB) with highest frequency of germination (78%) in anaerobic condition. Physiological basis of tolerance involved uninterrupted supply of energy through catabolism of starch offset in sugar homeostasis by increasing the sugar sink towards coleoptiles elongation. Biochemical analyses revealed, enzymes involved in starch catabolism, alcohol fermentation and ATP and PPi dependent substrate level energy generation were significantly higher under hypoxia in tolerant germplasm. Transcript studies conducted on tolerant rice germplasms using GADPH as

stable endogenous gene revealed that genes involved in sugar signaling such as TPP7, CIPK15 and SnRK1A that regulate Ramy3D transcription involving the transcription factor, MYBS1 under hypoxia were significantly upregulated in the RKB compared to proven tolerant line, KHO and susceptible line IR-64. 8

Group-VII members of Ethylene response factor family (ERFs) in rice namely ERF71 and ERF63 that are substrates for N-end rule of proteolysis also showed significant up regulation indicating towards an ethylene or low oxygen based hypoxia sensor that is yet to be identified in rice. Thus it could be inferred that hypoxia during germination of RKB is regulated by O2 sensing mechanisms involving ERFs that in turn activates sugar signalling pathways involving TPP7 a master regulator of sugar homeostatic, thus providing uninterrupted supply of energy, increasing the sugar sink towards coleoptile elongation possibly through action of EXPA7 and EXPA12.

Study and characterization of the DNA virus diseases in few important crops of Assam

Gajendra Mohan Baldodiya

Plant viruses cause many devastating diseases and are responsible for the huge loss in crop production and quality. The Infected plants may show a range of symptoms like leaf yellowing, leaf distortion, growth abnormalities and yield reduction. Although the majority of the plant viruses are RNA viruses, in the recent years, DNA viruses have emerged as a serious problem for vegetables and fiber crops, more specifically in tropical and subtropical regions of the world. In India, Begomoviruses are known for major yield loss in a variety of crops. So far, very few reports on DNA virus diseases are available from the northeastern region, including Assam. In the present study, three important single-stranded DNA viruses, banana bunchy top virus (BBTV), squash leaf curl China virus (SLCCNV) and tobacco curly shoot virus (TbCSV) were identified from Assam infecting banana, pumpkin, and chilli crops respectively. The crop cultivating areas were surveyed and 89 plant samples showing symptoms of geminivirus and BBTV infections were collected from 16 different crops. The broad-spectrum antibody combination, tomato yellow leaf curl virus (TYLCV) in DAS-ELISA (double antibody sandwich ELISA) assay revealed the all possible *Begomovirus* infections. The molecular detection method by using universal and gene-specific primers confirmed the presence of viral genome in positively screen samples through DAS-ELISA. The full-length genome amplification of detected viruses was achieved by designing walking primers from both ends of the partial genome and rolling circle amplification (RCA) followed by cloning process. The *in silico* analysis (genomic feature analysis, multiple sequence alignment and phylogenetic grouping) revealed the molecular properties of identified viruses. The BBTV-As-JOR was found closely related with BBTV-Lucknow isolate, although it stands out for few genomic features. Each genomic segment of the BBTV-As-JOR isolate was comprised of an ORF in sense orientation, encoding specific protein like other BBTV isolates. The common region major (CR-M) of DNA-R shows 26nt deletion like BBTV Lucknow but deletion of 36nt in DNA-U3 was found different. The BBTV-As-JOR clustered with PIO (Pacific Indian Ocean) isolates in the phylogenetic analysis based on the R-segment. Similarly, the clustering of other BBTV segments was also found with previously

reported BBTV isolates of PIO group. The genome of SLCCNV-As-JOR-G8 pumpkin shared high nucleotide sequences and proteins similarity with SLCCNV-pumpkin-Varanasi DNA-A. The phylogenetic clustering also conferred these findings. The sequence analysis confirmed the presence of seven ORFs *viz, AC1*, *AC2*, *AC3*, *AC4*, *AC5*, AV1/*CP* and *AV2* in SLCCNV-As-JOR-G8 pumpkin. The ORFs showed the typical begomoviral genome organization; however, they displayed similarity to different begomoviruses. The TbCSV-As was identified as a close relative of TbCSV)-[SC118] sharing the similarity of two major proteins, AL2 and AL3. The occurrence of TbCSV in chilli (*Capsicum frutescens*) host plant and causing upward curling of leaves is the first report from India in our knowledge. This study presents the first report of identification and characterization of BBTV, SLCCNV, and TbCSV from Assam which may open up a new insight into the understanding of DNA viruses infecting important crops of the state.

"Analysis of the putative promoter of Indian Cassava Mosaic Virus, a Geminivirus"

Geetanjali Baruah

Geminiviruses are single-stranded DNA viruses, considered as the largest group of plant pathogenic viruses having nine genera. Geminiviruses are considered as a rich source of promoter elements as the intergenic region (IR) of their genomes harbor a bi-directional promoter driving expression in the viral-sense and complementary-sense directions. *Indian cassava mosaic virus* (ICMV; genus: *Begomoviridae*) is a bipartite (having two circular genomes, DNA-A and DNA-B) geminivirus; and in this study, we tried to define and delineate its bi-directional promoter of the DNA-A. This promoter drives the expression of *Coat Protein* (*CP*) in the viral-sense and *Replication associated protein* (*Rep*) genes in complementary-sense direction. Four sequential deletion-constructs for each of these promoters were made, after a prior *in silico* analysis using plantCARE to ensure that no key regulatory motif such as TATA box get deleted, driving expression of *Gus* gene in *pBI*121. In transient expression assay in *Agrobacterium*, and tobacco, the deleted versions (del-1) showed higher expression than the full-length promoters of both *CP* and *Rep*. Transgenic *Nicotiana tabacum* plants were raised using the full-length *CP*, full-length *Rep* and their del-1 constructs and same observations were made. Besides, their phloem-specific activity of the *CP* promoter constructs was also observed. Subsequently, *Arabidopsis* transgenic plants were raised for all the constructs and a similar expression pattern was observed. However, visually higher Gus expression in *Arabidopsis* flowers was observed. *In silico* analyses showed that the transcription factor (TF), CDC5 (a known transcription enhancer), was over-represented in *CP* del-1 construct showing highest expression. Besides, another transcription factor, the MADS Box 13, was over-represented in the *CP* promoter constructs; this TF plays role in development of gametophytes and embryo. Copy number, as determined by quantitative PCR, was found to be 2, 1, 4 and 2 for CP, CP del-1, Rep and Rep del-1, respectively. The expression was also quantified, that showed a similar pattern. Based on the observations, putative positive and negative regulatory elements of the promoters were also identified. Two transcripts were mapped in the viral-sense direction; the longer starting at position 138, and the shorter at position 170; while the longer could express both the AV1 and AV2 ORFs, the shorter transcript could express only the AV1 ORF. It is the first report of a comparison of deletion constructs of viral-sense and complementary-sense cassava mosaic virus promoters and their phloem-limited expression.

Study on molecular mechanism of bruchid beetle (*Callosobruchus chinensis*) resistance in black gram (*Vigna mungo* L.)

Indrani Kakati

Bruchid beetles, (*Callosobruchus spp.*,) are a devastating stored grain pest of black gram. The interaction between bruchid and black gram genotype has not yet been demonstrated. In the present investigation, an attempt has been made to understand the molecular basis of resistance in a mild tolerant genotype (IC8219) of black gram through two molecular techniques, Suppression Subtractive Hybridization (SSH) library preparation and RNA Sequencing (RNASeq).

This is the first report on elucidation of the molecular basis of defense during black gram-bruchid interaction. The changes related to generation of ROS and expression of defense related genes in a mild tolerant (IC8219 genotype) of black gram was studied after releasing bruchids. After 7 days of releasing bruchids, RNA from developing seeds of the pods oviposited by bruchids were collected. The generation of ROS was detected by using 3, 3' diaminobenzidine (DAB) staining on the pods oviposited by bruchids. For suppression subtractive hybridization (SSH) the pods oviposited by bruchids were used as tester population, while RNA from seeds of control plants were used as driver population. A forward subtractive cDNA library was prepared from tester and driver population and subtracted cDNAs were cloned and transformed in JM109 competent cells. In all, 277 clones in an EST library were sequenced and analyzed. High quality ESTs (244) were submitted to the NCBI database (Acc. No. JZ917400-JZ917463). Based on CAP3 assembly, 134 genes were computationally annotated. The majority of the ESTs belonged to 'Biological Process' of gene ontology category. A total of 18 defense related genes were identified and were subjected to quantitative PCR analysis (qPCR). Of these 12 genes showed up-regulation in developing seeds. Few major defense genes like defensin, pathogenesis related protein (PR), lipoxygenase (LOX) showed high expression in the oviposited plants when compared with the non-oviposited plants.

In order to obtain a greater representation of defense genes, *de novo* transcriptome assembly of RNA extracted from the pods oviposited by bruchids was also performed.

RNASeq analysis revealed a total of 12,081 differentially expressed genes (DEGs) out of which 258 were up-regulated and 310 were down-regulated during black gram- bruchid interaction. In all, 20 defense related genes were identified of which 9 were represented both in the SSH library and RNASeq data. This is the first report on defense related gene expression study in developing seeds of black gram during upon egg laying by bruchid beetles.

Identification, isolation and characterization of flower and pod wall specific promoter from chickpea for tissue specific expression of transgene

Jagadale Mahesh Vasantrao

The transgene expression is, in part, a function of the promoter to which the coding region is fused. Constitutive over-expression of transgene occasionally interferes with normal growth and developmental processes in plants. Tissue-specific promoter can regulate transgene expression in a particular organ and developmental stage. In the present investigation, an attempt was made to isolate and characterize a flower and pod wall specific promoter from chickpea. The aim was to use the promoter to drive *Bacillus thuringiensis* (Bt) *Cry* gene in these organs of chickpea for enhanced resistance to a key pest, *Helicoverpa armigera*.

For isolation of flower and pod wall specific promoter, a forward Suppression Subtractive hybridization (SSH) library was prepared using flower and pod wall (tester) and leaves (driver). Subtracted cDNAs were amplified, cloned and transformed into *E. coli* competent cells. In all, 226 clones of SSH library were sequenced and analyzed. After removing adaptors, vector sequences (<100bp) and low quality sequences, 179 high quality ESTs sequences were deposited in the NCBI GenBank database under the Accession numbers JZ923200-JZ923378. Based on CAP3 assembly of 179 ESTS, 126 genes comprised of 97 singletons and 29 contigs were computationally annotated. The mapping of 88.26% ESTs (158 out of 179 ESTs) was done based on Gene Ontology (GO) annotation, which distributed 751 GO terms into three categories: cellular location, molecular function and biological process. Within the biological process category, the 158 ESTs were classified into seven primary functional categories, including metabolic process (113; 28%), cellular process (103; 26%), single organism process (77; 19%), biological regulation (38; 9%), regulation of biological process (33; 8%), response to stimulus (22; 6%) and cellular component organization or biogenesis (17; 4%). The Kyoto Encyclopedia of Genes and Genomes (KEGG) pathway analysis was also performed to understand functions and utilities of these ESTs in the biological system and a total of 45 ESTs involved in 49 different biological pathways were identified. Moreover, 67 ESTs were also identified encoding four different classes of enzymes such as oxidoreductases (29), transferase (20), hydrolases (16) and isomerese (2).

To identify the genes exclusively expressed in the flower and pod wall, the 179 EST sequences of the pod wall were searched using BLASTN of the Chickpea Transcriptome Database (CTDB) database to obtain CTBD ID. The CTDB IDs for pod wall ESTs were used to obtain the gene expression profile in the flower. The candidate genes were selected based on their high levels of expression in the flowers and pod wall. A total of eight (8) flower and pod wall specific genes were identified and subjected to quantitative PCR (qPCR) analysis. Of these, 3 genes (*FHG*: Floral homeotic AGAMOUS-like isoform X2*, MADS1*: MADS box transcription factor and *CEP*: chickpea expressed protein) showed significantly high levels of up-regulation in the flower and pod wall when compared with leaves. These are the differentially expressed genes in the chickpea pod wall that have been identified for the first time.

In order to obtain a regulatory sequence of selected flower and pod wall specific genes, 1000 bp region upstream of the start codon of *FHG* and *MADS1* gene was obtained by Genome Walking and subjected to *in-silico* analysis using PlantCARE promoter prediction database. Sequence analysis of these promoter regions revealed certain tissue specific cis-acting elements that may regulate transcript accumulation in the flower and pod wall. Finally, the isolated promoters were cloned in a binary vector, pBI121, harboring the *GUS* as a reporter gene in order to study the efficiency of the promoters.

Thus, for the first time the transcript dynamics of the chickpea pod wall were revealed and the transcript profile demonstrated various differentially expressed genes in the pod wall, which may be participating in metabolic build up of not only the pod wall but also seeds. The transcript library was useful to identify two novel promoter of genes that exclusively expressed in the flower and pod wall. These information of pod wall transcripts and isolated promoter may be valuable for chickpea improvement.

"Optimisation of ethnic fermented rice beer (*Xaj*) production of Assam, India"

Jyotshna Keot

"Xaj", the popular rice based alcoholic beverage is produced by the Ahom community of Assam using fermentation starter, *Xaj pitha*. The methodology of *Xaj* brewing is almost similar among the *Ahom* community residing in different localities of Assam, however, the concoction of the fermentation starters differ in terms of varieties and number of herbs or plant parts resulting in variation of the quality and acceptability of the final product. Fermentation starters are mixed cultures of fungi, yeasts and bacteria that are maintained on substrates like rice powder, supplemented with various herbs. Both fungi and yeasts present in the starter cultures are involved in rice based alcoholic beverage fermentation. Fungi are primarily involved in the initial liquefaction and saccharification process that breaks down the rice starch to fermentable sugars that is subsequently converted into alcohol by the yeasts. Based on traditional starter manufacturing method, defined fermentation starter culture was developed with the compatible microbial cultures consisting of fungus *Amylomyces rouxii* (NCBI accession number KP790015) *Wickerhomomyces anomalus* (NCBI accession number KX904346) and yeasts *Saccharomyces cerevisiae* (NCBI accession number KX904349) isolated from collected *Xaj pitha* samples. Selected plant extracts of *Leucas aspera* Spreng. *Lygodium flexosum* Vent. *Polygonum strigosum* L., *Centella asiatica* Urban and *Alstonia scholaris* (L.) R. Br. was added as representative herb for standard production of rice based alcoholic beverage based on their use value and frequency of use. Performance of defined starter culture in alcohol production and other biochemical properties of alcoholic beverage produced by defied starter culture were compared with that of *Xaj* produced using traditional starter culture, *Xaj pitha*. The rice based alcoholic beverage brewed using defined starter culture contained 10.23% (v/v) alcohol with 23.99% protein, 61.79% antioxidant activity, 0.48% acidity and a pH value of 3.79 after one month of fermentation whereas, the traditional starter culture was able to produce 12.3% alcohol, 22.27% protein, 60.23% antioxidant activity, 0.789% acidity and pH value of 3.33 after one month of fermentation. Fermentation was stabilised in the laboratory prepared rice based alcoholic beverage through the addition of sulphur dioxide (20ppm/L)

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and turbidity of standard alcoholic beverage was removed by filtration techniques that could be stored for 3 months without any major changes in the physical and chemical properties or taste. It also scored higher in Hedonic sensory attributes such as acidity, colour and overall acceptability. This study indicates the potential of defined starter to produce high quality standard *Xaj pani* which will pave the way to produce the product in commercial scale the near future.

Isolation and characterization of insecticidal genes of *Bacillus thuringiensis* strains from Assam soil

Mihir Rabha

Bacillus thuringiensis is a gram-positive, spore-forming bacterium which produces parasporal insecticidal crystal (Cry) proteins encoded by *cry* genes, during the stationary phase of its growth cycle. Cry toxins constitute a family of related proteins that are effective against Lepidoptera, Coleoptera, Diptera, Hymenoptera, Homoptera, Mallophaga and other invertebrates. Till date, more than 700 *cry* genes have been identified from different strains across the world. However, there is a need to isolate new strains having novel *cry* genes in order to find a new range of activities, higher level of toxicity and overcome the development of resistant insects.

In the present investigation, an attempt was made to isolate and characterize *B. thuringiensis* strains of Assam soil with an aim to identify novel *cry* gene(s). Assam has a unique climatic condition, huge biodiversity of microbe and lack of industrialization makes it a promising location to identify novel microbial strains including *B thuringiensis.* Soil samples were collected from 14 different locations of Assam. In all, 301 *Bacillus* type colonies were selected based on their colony morphology of rod shaped bacilli form. Of these, 42 isolates were found to have characteristics similar to *Bt* isolates on the basis of screening on MYP **(Mannitol Egg Yolk Polymyxin)** agar based medium and ERIC PCR (Enterobacterial Repetitive intergenic consensus sequences) analyses. Crystal endospores were observed in 37 isolates under the phase contrast microscopy, while 5 isolates were found to be acryetalliferous. All 42 isolates were subjected to PCR analysis for the amplification of *cry* gene using group specific primers. Of these, 40.47 % showed expected amplicon for *cry*1, 50% for *cry2*, 35.71% for *cry3*, 19.04% for *cry4*, and 42.85% *cry9*. Interestingly, 21.42% isolates showed the presence of combination of more than one *cry* genes. We also found that 11.90% of isolates had a nematode specific *cry* gene (Nem-gral).

In order to identify novel *Bt* genes, all 42 isolates were subjected to PCR amplification using universal primers and found two strains, BA04 and BA08 having a new type of *cry1I* gene with 82% and 85% sequence similarities, respectively. The protein sequence similarity of the *Cry1I* gene from BA04 was 74 %, while BA08 was 73%. The isolation of the full length genes from these two strains is in progress. This is the first report on successful identification and characterization of *Bt* strains from Assam soil.

Genetic transformation of chickpea (*Cicer arietinum* L.) using *Cry2Aa* gene driven by CaMV 35S promoter

Rashmi Rekha Boruah

Chickpea (*Cicer arietinum L.*) is a widely cultivated grain legume for nutritious protein rich seeds. In spite of its nutritional importance, its productivity has been constrained largely by a devastating insect pest *Helicoverpa armigera*. Conventional breeding is limited to impart resistance against *Helicoverpa* infestation due to lack of gene within the genepool. Genetic transformation has significantly contributed to develop insect resistant lines for better sustainability of this important food crop. Transgenic chickpea lines generated using a *cry2Aa* gene regulated by Arabidopsis Rubisco small sub unit (*AraSSU*) gene promoter conferred complete protection to *Helicoverpa* but with a phenotypic drag. Therefore, developing more transgenic lines with optimum levels of Cry2Aa protein and complete protection against pod borer is necessary to complement or replace the existing lines. In the present investigation, a *cry2Aa* gene driven by CaMV35S promoter or targeting the Cry2Aa protein to the chloroplasts using transit peptide linked to the gene was selected for optimal levels of expression. The binary vectors having chimeric *cry2Aa* genes were used for transformation of a model plant, tobacco to test the suitability of these constructs for their efficiency. In all, 51 transgenic tobacco lines were generated using these *cry2Aa* gene constructs and found that the level of expression ranged from 0.100 to 205 ng/mg of fresh weight (FW). The Cry2Aa tobacco lines with AraSSU and AraSSU-CTP promoter accumulated highest (>150 ng/mg FW tissue) levels of protein in the leaves. However, a tobacco line expressing about 202 ng/mg FW of Cry2Aa protein showed reduced plant growth. Using above constructs, 34 transgenic chickpea lines were generated. Molecular analyses revealed that the primary transgenic (T0) lines accumulated low levels (0.01 – 15.0 ng/mg FW) of Cry2Aa protein. The T1 progeny of these lines showed the transmission and expression of transgene into the next generation. The spatiotemporal expression of *cry2Aa* gene in these lines was compared with an existing high expressing line (BS6H) by immunohistochemical assay. The study revealed the expression of Cry2Aa protein in the non-green vascular tissues (vascular tissues) of the line BS6H which showed stunted

phenotype due to accumulation of high level of Cry2Aa protein. However, no variation in the level of expression was observed during various plant developmental stages. We also studied expression of stress related genes in two different light regimes. The expression of stress related gene was not observed in these light regimes except for the gene ABC transporter. A down-regulation of ABC transporter was observed in the plant grown under bright light. During the present investigation, tobacco transformation revealed that, these binary vectors were suitable for genetic transformation. However, efforts to generate more chickpea lines using these chimeric *cry2Aa* genes are to be made to identify lines with optimum level of expression with complete protection to target pest.

Enhancement of grain iron content of rice through genetic engineering approaches

Sangeeta Sarma

Micronutrient malnutrition affects about 3 billion people globally. Iron deficiency anaemia (IDA) is a common form of micronutrient deficiency effecting two billion people in the world. Three strategies have been employed to tackle micronutrient deficiency of which biofortification through transgenic approach is the most reliable one. Rice is a staple food for more half of the world's population of which India consumes about 97 million. But it is deficient in micronutrients and vitamins including dietary iron. Most of the nutrient rich aleurone layer is lost during milling (Boonyaves *et al*., 2017). So rice is one of the targeted crops in biofortification programs. Iron uptake in graminaceous plants including rice utilize chelation strategy (strategy II) and release phytosiderophores (PS) that form complex with Fe+3 (Boonyaves *et al*., 2017). Constitutive expression of *Nicotianamine synthase* (*Nas*), the most widely used gene in the synthesis of PS can increase iron levels by two to four folds in polished rice grains (Masuda *et al*., 2009). In the present study, *ferritin* genes of *Avicennia marina* and soybean driven by rice glutelin promoter, iron transporter genes *viz., IRT1* (*Arabidopsis*), *NAATB* (Barley) and *NAS1* (Barley), driven by maize ubiquitin promoter were used. Genetic transformation of indica rice cultivars *viz.,* Ranjit, Luit , IR64 and ASD16 was performed both through particle bombardment as well as *Agrobacterium* mediated methods using immature embryos as explants. Out of thirty T0 PCR positive transgenic lines, ten lines expressed varied levels of *Nas1* and six T0 transgenic lines of *A.mar.fer* transcripts as evident by semi-quantitative reverse transcription PCR (RT-PCR). The highest transformation efficiency (2.35%) was observed in IR64. Six T0 transgenic lines (BI 3/1, BR2/1, BR3/1, AI15/1, AI 19/1, and AI 21/1) were selected for further detailed analysis based on expression level of *Nas1* and *A.mar.fer* transcripts. Three lines (BI 3/1, BR2/1, and AI 19/1) showed single copy transgene integration as evident by quantitative real time PCR and the transgene followed standard Mandelian segregating ratio in subsequent progeny. These lines were subjected to iron estimation using inductively coupled plasma optical emission spectrometry (ICP-OES) at Sophisticated Analytical Instrumentation Facility, IIT, Madras. The highest concentration of Fe and Zn were observed to be 6.791 mg/l and 5.102 mg/l, respectively in transgenic line AI 19/1 which was about 3.9 and 2 fold increase as compared to control. Similarly, transgenic lines BI 3/1 and BR 2/1 showed about 2.5 fold increase in Fe and 1.5 and 1.4 fold increase respectively in Zn as compared to control.

Spatio-temporal Analysis of Transforming Assam Agriculture

Manashi Gogoi

The study seeks to explore spatio-temporal analysis of agricultural sector in Assam with specific objectives to analyze agricultural scenario over the pre and post liberalization periods, contribution of different factors influencing agricultural growth and development of the state over the years, instability and regional disparity in terms of agricultural development across the agro-climatic zones and finally put forward strategic model for prospective agricultural transformation. The study has covered entire Assam with a reference period of four decades (1975-76 to 2014-15). Data used for the study were entirely secondary and collected from various published and unpublished sources of government departments, agencies and institutions.

The results revealed slow pace of agricultural growth from 2.26 to 1.96 per cent accompanied by marginal increase in the yield of two of the major crops *viz.*, total rice-from 1.71 to 2.22 per cent and pulses from -0.18 to 0.9 per cent over the pre and post liberalization periods. However, the yield growth has decreased in case of rapeseed & mustard, from 1.44 to 1.00 per cent, jute from 1.80 to 0.63 per cent, wheat from 0.43 to 0.28 per cent, potato from 2.02 to -0.72 per cent and sugarcane from 0.92 to -0.48 per cent over the pre and post liberalization periods. Even after several plans and schemes, Assam agriculture has been confronted with ever declining small and fragmented operational holdings with average size of holding from 1.47 ha as per 1970-71census to 1.1 ha as per 2010-11 census. Besides, the state dealt with small amount of fertilizer consumption per hectare and a marginal role of irrigation over the study period. Nevertheless, during the recent decade (2004-05 to 2014-15), the scenario was found to be improved with increased area under high yielding varieties, availability of farm power per hectare, increased agricultural credit flow and also increase in yield of the major crops like, rice, rapeseed and mustard, pulses, potato, wheat etc. The overall cropping pattern was found to be shifting marginally towards horticultural crops during the last two decades.

Cropping intensity and share of HYV to total rice area had highly significant impact on Gross State Domestic Product of Agriculture (GSDPA) during pre liberalization

period. During post liberalization period, effectiveness of share of horticulture to total cropped area had substantially increased; it was due to the shift towards high valued horticultural crops that has been gaining momentum over the years. Even though cropping intensity had been increasing over time, no statistically significant impact was found on agricultural growth during post liberalization period. It implies that emphasis must be put towards double or triple cropping to utilize the land resource at an optimum level. Fertilizer consumption did not show any significant impact on agricultural growth over the years. It is noteworthy that area under irrigation was negatively associated with GSDPA. This was due to the declining trend of irrigation utilization ratio over the four decades. Capital investment played vital role in agricultural development all the way through the study period.

On account of rainfall variability and occasional occurrence of flood, the state has been confronted with considerable instability in area, production and yield of agricultural crops over the years. Majority of crops showed less instability during the post liberalization period as compared to pre liberalization period. Intra period instability for majority of crops was found below 25 per cent. Moreover, the state has also been confronted with regional disparity across the agro-climatic zones. As indicated by composite agricultural development index (2010-11 to 2014-15), Central Brahmaputra Valley Zone was ranked first, followed by Lower Brahmaputra Valley Zone, Upper Brahmaputra Valley Zone, North Bank Plain Zone, Barak Valley Zone and Hill Zone.

Finally, based on the outcomes of the study, schematic strategic model has been suggested for balanced agricultural growth and development. It is imperative to give more emphasis on infrastructure development, timely availability of modern inputs, frequent monitoring and evaluation of existing schemes and programmes, region and crop specific policies, efficient extension mechanism which would lead to balanced agricultural growth and development in the state for prospective agricultural transformation.

An Assessment of Priority Sector Lending in Jorhat district of Assam

Pallavi Deka

In a developing economy some sectors of society need special and priority attention as they are starved for capital. The Reserve Bank of India has clearly specified the sectors that are termed the priority sectors. The lending that is done to them is referred to as Priority Sector Lending (PSL). The philosophy behind the adoption of priority sector lending is mainly intended to bridge the lacuna of credit influx which was hitherto not timely and adequately dispensed. The sectors may be agriculture and allied activities, micro and small enterprises, non conventional, other low income groups and weaker sections. This is essentially meant for an all round development of the economy as opposed to focusing only on the financial sector.

As regards credit, in most of the cases, it was not in adequate quantity as also not received in time when it was needed. Under these circumstances there is strong justification to study the status of Priority Sector Lending with the specific objectives *viz.,* 1) Study the financial management practices of farmers and financial institutions under Priority Sector Lending, 2) Derive optimal solution of short term loan use to maximize net farm return in the existing financial environment and 3) Suggest alternative rural credit sources to different category of farmers for promoting financial inclusion under Priority Sector Lending.

The study was designed to carry out in the selected areas of Jorhat District. The study was based on both primary and secondary data. Primary source were the farmer borrowers and the bankers. The secondary sources were the District lead bank, Reserve Bank of India and NABARD (National Bank for Agriculture and Rural Development) publications and other relevant publications. The primary data were collected with the help of pre-tested schedule and questionnaire through personal interview.

The study found that the farmers adopted few strategies to manage their financial positions whereas financial institutions like banks focuses on credit risk management as a financial management practices and adopted numbers of strategies to mitigate those risks of return. The study also developed an optimal plan for short term loan use for the study area. Based on the problems cited by the farmers in accessing in rural credit and sources of credit, an alternative rural credit source was proposed in logical way.

Total factor productivity in Assam agriculture

Rinumoni Buragohain

Technical change in agriculture increases production at the same level of input-use and enables it to avoid trapping into Ricardo's law of diminishing returns to which the sector is more prone. Total Factor Productivity (TFP) is often seen as the real driver of growth within an economy. Many studies showed that, different factors of TFP like Policy support, production strategies, public investment in infrastructure, research and extension for crop, livestock and fisheries etc., have significantly helped in increasing the agricultural productivity, food production and its availability. Assam's economy is predominantly agrarian. Agriculture and its allied activities play an important role in the socio- economic development of the State of Assam as this sector is the major contributor to the State economy as well as providing livelihood to a significant proportion of the population of the State. Assam accounts for a fairly significant share of the country's acreage and output of many crops. In spite of having high inherent potentiality, Assam's agriculture is yet to experience modernization in real sense. Agriculture in Assam exhibits most of the characteristics of underdeveloped/ backward agriculture. During last few decades, Assam Government has made lots of investments in agricultural sector for the development of the sector. But, whether these investments have been contributing significantly towards the agricultural growth in the real scenes or not, it is very much important to know. Considering this, the present study was conducted with the three objectives to estimate the TFP growth and its contribution to Assam agriculture, to examine the determinants of TFP in Assam agriculture and to suggest policy measures for improving TFP in Assam agriculture.

The study was conducted for three crops rice, jute and rapeseed and mustard both individually and collectively termed as total crops for the time period of two decades from 1991-92 to 2010-11. Further, for more convenience, the entire study period was divided into two sub periods *viz.*, 1st period (191-92 to 2000-01) and 2nd period (2001-02 to 2010-11). The study was based on secondary data collected from different reputed published sources. Tornqvist Theil index was used for computing TFP indices of the three selected crops. The input, output and TFP indices were calculated both in current price and constant price (at price of 1991-92) of the inputs and outputs to find out whether there any nominal price effect was existed or not. Again, the indices were also computed for per hectare area and

total area under the selected crops in Assam to know how efficiently inputs were used under both situations. In order to evaluate the determinants of TFP in Assam, the TFP index was regressed against the variables *viz.*, rice area under flood, no. of villages electrified, rainfall, share of irrigated area to total cropped area, expenditure in Agricultural research and education, investment in Agriculture and allied activities, share of HYV area to total rice area, rural literacy and cropping intensity by using Cobb Douglas production function.

The results of the study revealed that, all the three crops rice, jute and rapeseed and mustard of the state had experienced negative TFP growth at current price, but at constant price, it was estimated to be positive in both per hectare area and total area for the study period. It revealed the presence of the nominal effect of increased input costs resulted in a lower (negative) TFP at current price pointing out the occurrence of gap between the farm harvest prices of the farm outputs and costs of inputs incurred in production of those three major crops in the state. Again, except rice, for other two crops, jute and rapeseed and mustard, TFP index were estimated to be higher in per hectare area rather than their total area. It implied that, in jute and rapeseed and mustard both, inputs were more efficiently allocated and utilized per hectare area rather than total area in the state. Only rice was found to have highly significant TFP growth (at constant price). Other two crops were reported to have positive TFP with very lower growth rate, but not significantly in Assam.

Expenditure in Agricultural research and education, rural literacy, irrigation and cropping intensity were found to have positive impact on TFP of all three crops both individually and collectively. However, none of the selected variables was found to have significant impact on TFP of jute as well as rapeseed and mustard. Investment in agriculture and allied activities also was an important source of TFP for all selected crops except jute. In rice, HYV area also contributed positively in TFP. Villages electrified and rainfall exhibited no any effect towards TFP growth of all selected crops individually as well as collectively also. The findings of the study have important policy implications for construction of proper price structure, improving input-use efficiency in total area under these crops, allocating scarce public resources to agricultural research, education, irrigation etc. and increasing HYV area and cropping intensity for enhancing the TFP in the state for better sustainable growth in agriculture.

Farm level Production technologies, Post harvest losses and marketing efficiency of major vegetables: A study in the Darrang district of Assam

Sumi Dutta

Vegetables are important supplements to the human diet. India ranks 2nd after China in the world with total production of 162.19 million tones. In Assam area under vegetable is about 2.73 lakh hectares with annual production of 49.79 lakh MT.Vegetables are highly perishable food products in nature and in the process of supply from the farm level to the market level. The seasonal gluts and lack of infrastructure and marketing facilities in the developing countries have significant effect on the extent of post harvest losses of vegetables. In Assam not much information is available regarding the farm level adoption of production technologies and quantum of post harvest loss of vegetables at various stages of marketing and its impact on marketing efficiency. The present study was conducted in the Darrang district of Assam and was designed to collect information regarding the level of production technologies, assessment of productivity, technology gaps of some major vegetables, physical and value loss at farm level and at various stages of marketing and to examine the impact of post harvest loss on farmer's net price, marketing costs, margins and efficiency of major vegetables.

The study was based on both primary and secondary data. Bechimari and Kharupetia two major vegetable growing areas were identified.Both tabular and functional analysis was done in analyzing data. Cost concepts used in farm management studies were applied to calculate costs in the present study and results indicated that cost of production increased with increase in size of the farm and regardingknowledge on different parameters of vegetable production it was observed that almost all farmers (99.33%) had the knowledge about the ploughing and application of organic manures (99.00%).The extent of adoption gaps for selected vegetables is estimated and 7 technology components were found. More than 30 percent of technology adoption gaps were observed in terms of technology components T4, T5 and T6 i.e. Manuring and fertilization, Number of irrigations applied & Intercultural and weed control.As vegetables are perishable in nature so during the process of distribution

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and marketing substantial losses are incurred. The post harvest loss was estimated first at farm level and then at market level and in case of market level it can be clearly observed that the physical loss was highest in itinerant level followed by wholesaler and retailer level. 4 major marketing channels of vegetables were identified namely Channel I:Producer–Consumer,Channel II:Producer–Retailer–Consumer,ChannelIII:Producer–Wholesaler–Retailer-Consumer,ChannelIV:Producer–Itineranttraders–Wholesaler-Retailer-Consumer. Marketing efficiency was estimated in different marketing channels and it was found that Channel II was the most efficient channel and Channel IV was the least efficient channel.ButChannel IV was considered as the most effective one because farmers sold majority of their marketed surplus through Channel IV.

Status of Indian Tea Industry and its Perspective Changes under Global Competitive Environment- A Quantitative Approach

Udeshna Talukdar

Tea industry in India plays an important role in the national economy and it is one of the oldest and well organized labour intensive, agro-based industries of the country. Recognition of tea cultivation as an industry in the country was done towards the end of nineteenth century and it took a phenomenal increase in area after China. Tea industry contributes more than Rs 33000 crores per annum to the Gross National Product (GNP). The total turnover from the tea industry in India alone is more than Rs 33000 crores, a mere 3.22 per cent of Gross Domestic Product (GDP) during 2014-15. The study was based mostly on secondary published data with effect from 1971 to 2015 with an objective to examine the trends of production and export of tea and growth in India. It was observed that tea sector plays an important role contributing more than 200 crores to the GNP of the country. The major three producing regions are Darjeeling, Assam and Nilgiri. In the recent years, the sector has witnessed a stiff competition in the international export market affecting domestic production. It was observed that China produces 39.00 per cent of world tea followed by India sharing 24.55 per cent with an annual change of 2.87 per cent during 1971-81 to 3.06 per cent during 2001-11. Production of tea in the country was mainly due to increase of area and productivity. Application of gravity model shows that population of India could not affect the bilateral trade. It was observed that relatively higher productivity of tea was exhibited by South Indian states like Karnataka and Tamil Nadu with NPC value ranging between 0.66 to 0.74. Tea export quantity was forecast with the help of the export quantity model, exponential smoothing and ARMA model. The Gini concentration ratio for different categories for producer-sellers and buyers was found to be 0.5171 and 0.7424 respectively and the prices of tea at GTAC were influenced more by number of buyers and the markets was monopolistic in nature. Marketing channels were studied to know the efficiency and effectiveness in the marketing system. The study also shows that output price has positive influence on factor prices and the output price with respect to labour and chemical was

more dominating. Export of value added tea was more erratic and unstable. It can be concluded that area could influence the production and it needs to be increased under replanting and replacement planting. Steps should also be taken to increase the export of value added tea in the country. The small tea sector should be organised and regulated to make it more productive. The linkage between small and big growers be strengthened and the price of green leaves needs to be raised. The processing of green leaves of small growers through cooperatives was therefore need to be strengthened.

Crop intensification in rice-based cropping system in Assam

Anju Mala Deka

A field experiment entitled was conducted at the Shillongani farm of Regional Agricultural Research Station, Nagaon, Assam during *kharif*, *rabi* and summer seasons in the year 2014-15 and 2015-16 to study the effect of dates of rice transplanting under different methods of cultivation on productivity of *Sali* rice and their effect on rice-relay system in *rabi* and thereafter on fodder maize + green gram intercropping system during summer. The treatments of the experiment comprised three dates of rice transplanting *viz.* 20 June, 5 July and 20 July, and two methods of rice cultivation *viz.* conventional method and SRI method with four relay crops *viz.* lentil, pea, *toria* and niger. The experiment was laid out in a factorial randomized block design for the treatments in rice during *kharif* season and a split plot design for treatments of relay crops in *rabi* season assigning dates of planting and method of cultivation in the main plots and relay crops in sub plots with three replications. During summer, fodder maize and green gram in 1:1 row ratio was grown as intercrop in each plot. The soil of the experimental field was medium low land, moderately well drained, sandy loam in texture having organic 'C' content of 0.82%, acidic in reaction (p^H 5.61), medium in available N (296 kg/ha) and K_2O (195 kg/ha), and low in available P_2O_5 (21 kg/ha). Bulk density of 0-15 cm soil layer was 1.33 g/cc and that of 15-30 cm layer was 1.36 g/cc while the particle density of the layers was 2.06 and 2.08g/cc, in the respective layers. Total porosity was 35.44 % and 34.61% in the respective soil layers. All the crops were fed with recommended doses of fertilizers.

The results revealed that among the different dates of rice transplanting, 20th June transplanted crop recorded significantly higher plant height, number of tillers/m^2, number of panicles/m^2, number of filled grains /panicles and grain yield of rice as compared to the later dates of transplanting and it was followed by 5 July transplanted rice. Rice transplanted on 20th June recorded higher values in respect of growth, yield attributes, yield of relay as well as summer intercrops, REY of rice-relay, intercropping and whole system; production efficiency of the whole system; N, P and K uptake by rice, relay and intercrops as well as soil fungal and bacterial populations after harvest of rice, relay and intercrops. However, the soil available N, P_2O_5 and K_2O content at the end of two year-crop cycle in 5th and 20th July transplanted rice were significantly higher than that of 20th June transplanted crop.

SRI method of rice cultivation recorded significantly higher values in respect of plant height, LAI, CGR, RGR, root: shoot ratio, panicles/m^2, panicle length and weight, filled grains/panicle and 1000-seed weight, grain yield and harvest index of rice as compared to conventional method. In relay cropping, higher values of all the growth and yield attributes, seed yield, REY and harvest index of lentil and niger relay crops were found under SRI method of rice cultivation as compared to conventional method, while, in case of pea and *toria* relay crops, these were found to be slightly higher under conventional method of rice cultivation. In summer, SRI method of rice cultivation recorded higher values of all the growth and yield attributes, land equivalent ratio and relative crowding co-efficient of fodder maize and greengram in intercropping system. Further, under SRI method, higher uptake of N, P and K by rice, relay and intercrops and higher soil fungal and bacterial populations after harvest of rice, relay and summer intercrops as well as REY and production efficiency of the whole cropping system were observed as compared to conventional method. However, conventional method of rice cultivation recorded significantly higher values of soil available N, P$_2$O$_5$ and K$_2$O content at the end of two year-crop cycle over that of SRI method.

Among the relay crops, pea and lentil relay recorded higher yield as compared to *toria* and niger. However, rice-lentil and rice-pea system were found most promising in respect of REY and economics of rice- relay system compared to rice-*toria* and rice-niger system.

In fodder maize and greengram intercropping system during summer, relay crops had significant effect on growth and yield attributes of fodder maize and greengram. Significantly higher values of plant height and green fodder yield of maize as well as competition index and competition ratio of intercropping system were recorded when summer intercrops were grown after rice-lentil and rice-pea relay crops as compared to rice-*toria* and rice-niger relay. However, significantly higher values in respect of number of pods/plant, seed yield and stover yield of greengram, higher land equivalent ratio and higher relative crowding co-efficient of intercropping system were found after rice-*toria* and rice-niger relay crops as compared to that of rice-lentil and rice-pea relay. Significantly higher values of REY and production efficiency of whole cropping sequence, and higher soil moisture content at 60 and 90 days after sowing of relay crops were found in rice-pea and rice-lentil system as compared to rice-*toria* and rice-niger. The soil fungal and bacterial populations after harvest of relay and summer intercrops were found more after lentil and pea relay crops as compared to *toria* and niger relay crops. However, lower values of residual available soil N, P$_2$O$_5$ and K$_2$O content at the end of two year-crop cycle were found under the system involving pea and lentil relay crop as compared to toria and niger relay.

Rice transplanted on 20th June under SRI method relayed by lentil and followed by summer intercrops of fodder maize and greengram recorded the highest REY, production efficiency and benefit: cost ratio of whole system in both the years. Rice transplanted on 20th June under SRI method relayed by pea and followed by summer intercrops of fodder maize and greengram was more efficient in utilizing the soil available N, P$_2$O$_5$ and K$_2$O resulting in the highest N, P and K uptake and thereby the lowest available soil N, P$_2$O$_5$ and K$_2$O was recorded under this system.

Weed management in ginger (*Zingiber officinale* Rosc.) based intercropping system

Aparna Baruah

A field experiment was conducted at the Instructional-Cum-Research (ICR) fram of Assam Agricultural University, Jorhat in 2013-14 and 2014-15 to study the "Weed management in ginger (Zingiber offcinale Rose.) based intercropping system" The treatments of intercropping systems viz., I_1: Ginger + Cowpea (2:1) and Cowpea incorporated at 40 DAS, I_2: Ginger+Cowpea (3:1) and Cowpea incorporated at 40 DAS, I_3: Cowpea in between rows of Ginger and incorporated at 40 DAS and four weed management practise viz., W1: Weedy (control), W_2: Hand weeding 40, 70, 100 and 140 DAP, W_3: Pre-emergence application of Oxadiargyl 90 g Ha^{-1}+hand weeding at 70, 100, DAP and W_4: Pre-emergence application of Metribuzin 500 g ha^{-1} + hand weeding at 70, 100, 140 DAP. Thus, sixteen treatment combinations along with two controls (sole crop of ginger and cowpea) were laid out in a factorial andomized block design with three replications. The surface soil of the experimental site was acidic in reaction, sandy loam in texture, low in organic carbon, medium in available nitrogen, low in available phosphorus and medium in available potassium.

Ginger growth and yield attributing parameters in both the years of experimentation, in terms of emergence count (Nos Ha^{-1}), plant heigh (cm), tillers per clump, shoot per rhizome, main shoot leaf, leaves per tiller, leaves per clump, fresh and dry weight of shoot, length and breadth of rhizome, length and breadth of finger, fingers per clump, crop groth rate (g m^{-2} day^{-1}), absolute growth rate (g plant^{-1} day^{-1}) and dry matter content (%) showed better results under the intercoropping treatment I_3: Cowpea in between rows of Giner and incorporated at 40 DAS. Among weed management treatments, these parameters were significantly better under W_4: Pre-emergence application of Metribuzin 500g ha^{-1} + hand weeding at 70, 100, 140 DAP.

Intercropping treatment cowpea in between rows of ginger and incorporated at 40 DAS recorded highest ginger yield of 7542 kg ha^{-1} and 8633 kg ha^{-1} in 2013-14 and 2014-15, respectively. Among weed management treatments, a significantly higher giner rhizome yield of kg ha^{-1} and 9340 kg^{-1} and 9340 kg ha^{-1} in 2013-14 and 2014-15, respectively was recorded under pre-emergence application of Metribuzin 500 g ha-1+hand weeding at 70, 100, 140 DAP. Intercropping systems gave better results on the ginger oil yield however

among weed management treatments, it was significantly superior due to pre-emergence application of Metribuzin 500 g ha-1+ hand weeding 70,100, 140 DAP.

Cowpea growth parameters in terms of emergence count (Nos ha-1), plant height (cm), number of branches, leaf area (cm) showed higher results significantly under the treatment I_3:Cowpea in between rows of Ginger and incorporated at 40 DAS. Treatment Metribuzin 500 g ha^{-1}+hand weeding at 70, 100, 140 DAP brought about significantly better results in respect of cowpea growth parameters.

In both the years, cowpea intercropped in between all ginger rows could results in lower weed density and dry weight as compared to res of the treatments at all the stages of record. Pre-emergence application of Metribuzin 500 g ha^{-1}+ hand weeding at 70, 100, 140 DAP resulted significantly lower weed density and weight among all the weed management treatments at the stages.

Higher nutrient uptake by ginger and significantly higher nutrient uptake by cowpea was recorded in cowpea in between all rows of ginger and incorated at 40 DAP. Pre-emergence application of Metribuzin 500 g ha^{-1}+hnad weeding at 70, 100, 140 DAP resulted significant higher nutrient uptake by ginger and cowpea over other treatment. Nutrient uptake by weeds lower under pre-emergence application of Metribuzin 500 g ha-1+hand weeding at 70, 100, 140 DAP than other treatments.

The highest net return (Rs.7,61,426/- in 2013-14 and Rs. 9,94,759/- 2014-15) and benefit : cost ratio (4.5 and 5.9, respectively) were calculated under the treatment combination of cowpea sown in between all ginger rows and Metribuzin 500 g ha-1+hand weeding at 70, 100, 140 DAP.

Response of direct seeded upland rice varieties, rice bean, weeds and soil microflora to weed management practices and their tolerance to herbicides

Bonti Gogoi

A field experiment on "Response of direct seeded upland rice varieties, rice bean, weeds and soil microflora to weed management practices and their tolerance to herbicides"was conducted for two years at the Instructional-Cum-Research (ICR) Farm of Assam Agricultural University in 2014 and 2015 to study the effect of two herbicides Pretilachlor and Oxadiargyl applied at two doses each integrated with manualweeding once on weedsandupland direct seeded rice (*Oryza sativa*), their phytotoxicity on rice and residual toxicity on succeeding ricebean (*Vignaumbellata*), their effect on the soil micro flora and differential expression of resistance of dominant rice weeds to these herbicides.The treatments comprised of 3 rice varieties and 6 different weed management practices including four integrated weed management treatments, one garden hoeing twice and a weedy check laid out in factorial randomized block design with treatments combinations replicated thrice. The study revealed that the percentage of grasses was higherfollowed by broad leaved weeds in variety *Maizubiron* followed by *Guni*during the critical crop growth period. Lowest weed density as well as dry weight at 20, 40 and 60 DAS was recorded in rice variety *Inglongkiri* underIWM of Pretilachlor @ 1.5 kg/ha and Garden Hoeing which resulted higherweed control efficiency (36.29 and 37.62)at 20 DAS. But at 60 DAS, WCE was higher in the combination of*Inglongkiri*andOxadiargyl @ 0.2 kg/ha and Garden Hoeing. The crop parameters like plant height, flag leaf area, no. of leaves, no. of tillers, no. of panicles,no. of grains per panicle and 1000 grain weight were recorded higher in *Inglongkiri*combined with eitherPretilachlor @ 1.5 kg/ha &Garden Hoeing orPretilachlor @ 0.75 kg/ha followed by Garden Hoeing. The leaf angle in *Inglongkiri* was ideal (45.17°±0.30) intercepting more solar radiation and production of photosynthates. The light transmission ratio was lowest in *Inglongkiri* followed by *Guni*.The fungal and bacterial population were reduced at 25 days after herbicide application which gradually increased up to 50 days.The rice bean fodder crop did not show and residual toxicity symptoms of

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either Pretilachlor orOxadiargyl in any of years of study. Higher grain yield and harvest index among rice varieties was recorded in *Inglongkiri* (19.80 q/ha) and application of Pretilachloreither @ 0.75 or1.5 kg/ha combined with Garden Hoeing 30 DAS resulted the higher grain yield (19.49 q/ha) and harvest indexover two years. The pooled interaction effect of variety and weed management caused higher grain yield of 23.63q/ha in*Inglongkiri* combined with Pretilachlor @ 0.75 kg/haand Garden Hoeing 30 DAS and *Maizubiron*in weedy check gave the lower value of 3.91 q/ha. The highest benefit-cost ratio (1.88) was found due to the combination of *Inglongkiri*andPretilachlor @ 0.75 kg/hafollowed by Garden Hoeing at 30 DAS. The available nutrient content varied significantly due to varieties and the higher value was recorded for *Inglongkiri*and the lower for *Maizubiron*. From differential expression analysis, it was found thatin *Panicum repens*, the level of expression for the genes under study at both 30 and 45 DAS has shown decrease in gene expression with the increase of Oxadiargyl dose but it was more significant for the gene, *Arabidopsis thaliana* Glutathione S transferase.

From this study, it wasfound thatthe rice variety *Inglongkiri*had better weed smothering ability over the other two varieties. The treatment combination ofrice variety *Inglongkiri*andPretilachlor @ 0.75 kg/ha followed by Garden Hoeing at 30 DASresultedin better weed control efficiency and better growth, yield attributing characters, grainyield, harvest index and economic returns in upland direct seeded rice without any detrimental effect on soil microflora and persistence in soil.

Effect of intercrop and weed management on productivity and resource use efficiency in turmeric (*Curcuma domestica* Val.)

Dwijendra Mohan Barman

A field experiment was conducted at the Instructional-Cum-Research (ICR) farm of Assam Agricultural University in 2013 and 2014 to study the "Effect of intercrop and weed management on productivity and resource use efficiency in turmeric (*Curcuma domestica* Val.)." The treatments consisted of two planting methods of turmeric *viz*., paired row 80/20 cm and paired row 70/30 cm; two intercropping systems with baby corn and greengram and three weed management practices *viz*., non-chemical i.e. mulching along with four hand weeding at 35, 65, 95 and 140 days after planting (DAP), pre-emergence application of metribuzin @ 500 g ha^{-1} along with five hand weeding at 35, 65, 95, 140 and 185 DAP and pre-emergence application of oxadiargyl @ 90 g ha^{-1} along with five hand weeding at 35, 65, 95, 140 and 185 DAP along with one weedy check (control). Thus, twenty treatment combinations including four controls (sole crops) were laid out in a factorial randomized block design with three replications. The surface soil of the experimental site was acidic in reaction, sandy loam in texture, low in organic carbon, medium in available nitrogen, low in available phosphorus and medium in available potassium.

In the experimental field, *Eleusine indica* (L) Gaertn*., Digitaria setigera* Roth*., Panicum repens* L. among the grasses, *Cyperus iria* L. *and Fimbristylis aestivalis* (Retz.) Vahl. in the sedges and *Ageratum houstonianum* Mill*., Borreria articularis* (L.f.) Will*, Commelina diffusa* Burm.f.*, Mimosa diplotricha* C. Wright *and Mimosa pudica* L. under broad leaved weed were predominant. The grasses and broad leaved weed constituted the major proportion of the weed flora at early stage and later stage, respectively.

Significant difference in total weed density and dry weight was recorded between the method of planting. The planting method 70/30 cm proved to be superior in less weed density, dry weight and higher weed control efficiency in both the years.

In regards to intercropping, significantly higher value of total weed density and dry weight was recorded in turmeric-greengram intercropping system and higher weed control efficiency was found in turmeric-baby corn intercropping system.

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Among the weed management treatments imposed, significantly lower total weed density, dry weight and lower removal of NPK by weeds was observed in the non-chemical weed management practice i.e. mulching along with four hand weeding over other practices during both the years. Weed control efficiency was also higher in the same weed management practice.

The paired row planting at 70/20 cm proved superior in terms of different growth and yield attributes of turmeric crop. Significantly higher fresh rhizome yield of 24.25 and 24.63 t ha^{-1}, higher dry rhizome yield of 5.61 and 5.55 t ha^{-1}, higher uptake of N, P and K were recorded under paired row 70/30 cm as compared to paired row planting of turmeric at spacing of 80/20 cm during both the years.

The corn yield with husk of intercrop baby corn were 6.58 and 6.54 t ha^{-1} under paired row 70/30 cm in both the years which accounted for 57.11 and 56.82 per cent to the sole baby corn yield (11.52 and 11.58 t ha^{-1}) as compared to 57.03 and 56.48 per cent in paired row 80/20 cm during first and second year, respectively.

Intercropping greengram in the intervening space of paired row 70/30 cm produced grain yield of 3.32 and 3.40 q ha^{-1}, which constituted 27.71 and 28.24 per cent of the yield of sole greengram (11.98 and 12.04 q ha^{-1}), as compared to 27.96 and 28.24 per cent under paired row 80/20 cm during both the years. Method of planting of turmeric did not affect significantly in yield of intercrop greengram.

The intercropping greengram had produced significantly higher value of growth and yield attributes and rhizome yield of turmeric as compared to intercropping baby corn.

Different weed management practices had significant effect on the base crop turmeric and intercrops baby corn and greengram. The non-chemical weed management practice by mulching along with four hand weeding at 35, 65, 95 and 140 DAP proved superior in respect of growth and yield attributes. It produced significantly higher fresh yield (32.05 and 32.42 t ha^{-1}), dry rhizome yield (7.14 and 7.66 t ha^{-1}) and nutrient uptake as compared to other treatment of weed management practices. The same weed management practice produced the intercropped baby corn yield of 8.17 t ha^{-1} that accounted for 70.81 and 70.58 per cent to the yield of sole baby corn in both the years. As regard to intercrop greengram, the yields were 4.20 q ha^{-1} and 4.28 q ha^{-1} which accounted for 34.95 and 35.58 per cent to the yield of sole greengram during the two years. Curcumin content did not differ significantly due to different treatment imposed for planting system, intercropping and weed management.

Better resource use efficiency in regard to water, nutrient, light was observed in the 70/30 cm planting method, turmeric-greengram intercropping system and in the non chemical weed management practice.

As regard to cropping system as a whole, planting methods had significant effect on most of the characters studied. Paired row 70/30 cm proved superior in terms of turmeric equivalent yield and land equivalent ratio.

Intercropping baby corn had resulted significantly higher turmeric equivalent yield and greater land equivalent ratio in both the years.

The weed management practice with non-chemical method i.e. mulching along with four hand weeding at 35, 65, 95 and 140 DAP produced significantly higher turmeric equivalent yield of 6.75 t ha^{-1} and 6.78 t ha^{-1} as compared to other management practices in both the years of experimentation.

The sole turmeric (weedfree) was found superior over the sole turmeric (recommended practice) in respect of fresh rhizome and dry rhizome yield in both the years. However, curcumin content did not differ in both the sole crop treatment.

Turmeric planting in paired row 70/30 cm and intercropping greengram in between paired rows with non-chemical weed management practice by mulching along with four hand weeding at 35, 65, 95 and 140 DAP proved superior in most of the attributes studied, followed by paired row 70/30 cm and intercropping baby corn with non-chemical weed management practice by mulching along with four hand weeding at 35, 65, 95 and 140 DAP. The later treatment combination ($M_2I_1W_2$) was found superior in terms of turmeric equivalent yield, land equivalent ratio, net return (R ha^{-1} and (R R^{-1} invested), benefit: cost ratio and bioenergetics.

Productivity and Carbon sequestration potential of food - forage intercropping system as influenced by integrated nutrient management

Khumlo Levish Chongloi

A field experiment was conducted at the Instructional-Cum-Research (ICR) farm of the Assam Agricultural University, Jorhat in 2014-15 and 2015-16 to study the "Productivity and Carbon sequestration potential of food - forage cropping system as influenced by integrated nutrient management". The treatments consist of four intercropping system *viz.*, C_1= sole oats, C_2= sole pea, C_3= 3:2 row proportions of oat+pea and C_4= 3:3 row proportion of oat+pea intercropping and four integrated nutrient management viz., F_1= RDF (inorganics), F_2= 50% N of RDF + 50% N through FYM, F_3= 50 % N of RDF + 50% N through vermicompost and F_4= 50%N through FYM + 50% N through vermicompost. Altogether sixteen treatment combinations were laid out in split plot design with three replications allotting intercropping system in the main plots and INM in the sub-plots. The soils of the experimental sites were acidic in reaction (pH 5.3), sandy loam in texture, medium in OC, low in available N and medium in P_2O_5 and K_2O.

In intercropping system the highest green forage yield (199.38 and 217.98 q/ha) and dry matter yield (43.52 and 49.72 q/ha) of oats was recorded with 3:2 row proportion of oat+pea during 2014-15 and 2015-16, respectively. Higher green pod yield was recorded in sole pea culture showing the value of 44.74 and 47.24 q/ha in 2014-15 and 2015-16, respectively. Among the intercropping systems 3:3 row proportions (oat+pea) recorded the highest green pod yield in both the years. The green forage equivalent yield of the system was observed to be the highest in sole pea but among the intercropping system higher green forage equivalent yield of the system was recorded in 3:3 row proportions over 3:2 row proportions and sole oats in both the years.

The effect of integrated nutrient management on green forage equivalent yield, green pod yield, green forage yield and dry matter yield were significantly higher in 50% N of RDF + 50% N through vermicompost than the other treatment combinations in both the years.

Carbon sequestration potential as influenced by cropping system was recorded to be the highest in sole pea culture in both the years and among the intercropping system the

highest value was observed in 3:3 row proportions being 1.14 and 1.26 Mg/ha in 0-15 cm and 0.90 and 1.08 Mg/ha in 15-30 cm soil depth during 2014-15 and 2015-16, respectively.

Application of integrated nutrient management at 50% N of RDF + 50% N through vermicompost resulted significantly higher carbon sequestration potential of 1.54 and 1.60 Mg/ha in 0-15 cm and 1.29 and 1.55 Mg/ha in 15-30cm soil depth which was followed by 50% N of RDF + 50% N through FYM during 2014-15 and 2015-16, respectively.

Economic efficiency of 1122.84 and 1395.24 R/day/ha was recorded in sole pea during 2014-15 and 2015-16, respectively. Among the intercropping system the highest net return and economic efficiency (568.89 and 707.59 R/day/ha) was observed in 3:3 row proportions in both the years. Effect of INM on net return and economic efficiency were found to be significantly higher with addition of 50% N of RDF + 50% N through vermicompost, but the higher benefit-cost of 3.39 and 4.07 was observed in C_2F_2 followed by C_2F_3 during the two years of experimentation, respectively.

The cultural energy use efficiency was found to be the highest in sole pea cropping with 50% N of RDF + 50% N through vermicompost which positively increased the energy use efficiency over other treatment combinations. Among the intercropping system the highest energy use efficiency was computed from 3:3 row proportions with 50% N of RDF + 50% N through vermicompost in both the years of experimentation. The highest energy productivity ratio (EPR) of 0.80 and 0.88 kg/MJ were computed in the treatment combination of sole oat with 50% N of RDF + 50% N through vermicompost. Among the intercropping system the highest EPR of 0.59 and 0.68 kg/MJ was recorded from 3:2 row proportions of oat+pea with 50% N of RDF + 50% N through vermicompost during 2014-15 and 2015-16, respectively.

In a nut shell it was revealed from the present experiment that 3:3 row proportions of oat + pea intercropping with 50% N of RDF + 50% N through vermicompost was found to be the ideal food-forage intercropping systems. Moreover, this intercropping system has been found to be relatively efficient cropping system in the rice fallows not only for improving and sustaining higher food and forage productivity and profitability, but also for improvement of soil quality, economic use of fertilizers and increased carbon sequestering.

Non-Herbicidal Weed Management in Rainfed Maize (*Zea mays* L.) – Sesamum (*Sesamum indicum* L.) Cropping Sequence under organic Nutrition

Moasunep

An experiment was carried out at the Instructional-Cum-Research farm, Assam Agricultural University, Jorhat during 2013 and 2014 on the topic '**Non-herbicidal weed management in rainfed maize (*Zea mays* L.) - sesamum (*Sesamum indicum* L.) cropping sequence under organic nutrition**' to study the effect of fertility management (F_0 - control, F_1 - 2.5 t/ha enriched compost, F_2 - 5.0 t/ha enriched compost) and weed management (W_0-weedy check, W_1- hand hoeing and earthing up 20 and 50 DAS, W_2-*in situ* cowpea mulching upto 50 DAS, W_3- *in situ* blackgram mulching upto 50 DAS) in maize and also to study the carry-over effects of these treatments on the succeeding crop sesamum in a split-plot design with 3 replications. The fertility management was the main plot and weed management was the sub-plot factor. The soil of the experimental field was sandy loam in texture, acidic in reaction (pH 5.33), medium in soil organic C (0.51%), medium in available N (318.93 kg/ha), P_2O_5 (32.95 kg/ha) and K_2O (167.54 kg/ha). The dominant weeds of maize were *Cynodon dactylon*, *Digitaria setigera*, *Eleusine indica*, *Ageratum houstonianum*, *Borreria articularis*, *Mimosa pudica*, *Cyperus iria* and *Cyperus rotundus* whereas the dominant weeds in sesamum were *Cynodon dactylon*, *Digitaria setigera*, *Ageratum houstonianum*, *Borreria articularis*, *Mimosa pudica*, *Cyperus iria* and *Cyperus rotundus*.

Hand hoeing and earthing up 20 and 50 DAS in maize resulted in significantly lesser density (no./m²) and dry weight (g/m²) at all the stages of observation whereas in case of N, P and K content (%) of weeds, it was observed only at 60 days but in term of uptake (kg/ha) by weeds, it too resulted in significantly the least at 60 days and at harvest compared to other non-herbicidal weed management in maize. Therefore, the growth and yield of maize significantly improved compared to weedy check and *in situ* cowpea or blackgram live mulching upto 50 days. Application of 5.0 t/ha enriched compost also significantly increased the yield of maize (2322.33 kg/ha in 2013 and 2178.29 kg/ha in

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2014). Fertility management interacted with weed management significantly and the best combination was 5.0 t/ha enriched compost in association with hand hoeing and earthing up 20 and 50 DAS (grain yield of 4723.81 kg/ha in 2013 and 4507.24 kg/ha in 2014). The carry over effects of fertility and weed management on density (no./m^2), dry weight (g/m^2), N, P and K content (%) and uptake (kg/ha) of weeds on succeeding sesamum crop were not evident but fertility management during maize seemed to significantly improve the growth and yield of sesamum and the best treatment was application of 5.0 t/ha enriched compost in maize (seed yield of 589.08 kg/ha in 2013 and 402.78 kg/ha in 2014). The interaction effect of fertility and weed management on succeeding sesamum was significant only during 2014 for growth, yield attributing characters, N, P and K content (%) and uptake (kg/ha).

The moisture status was conducive for growth and yield of maize during the period of investigation due to hand hoeing and earthing up 20 and 50 DAS in maize. Application of 5.0 t/ha enriched compost in maize not only significantly increased the growth and yield of maize and sesamum but also proved itself to be significantly better compared to other treatments with respect to maintaining higher organic C, residual soil available N, P_2O_5 and K_2O.

Although application of 5.0 t/ha enriched compost combined with hand hoeing and earthing up 20 and 50 DAS resulted in the best equivalent yield of the sequence (5801.57 kg/ha in 2013 and 4983.84 kg/ha 2014) with higher gross and net return, the comparative economics revealed that application of 2.5 t/ha enriched compost coupled with hand hoeing and earthing up 20 and 50 DAS was better in terms of BC ratio (2.63 in 2013 and 2.22 in 2014 compared with 1.90 in 2013 and 1.54 in 2014 in case of association of 5.0 t/ha enriched compost and hand hoeing and earthing up 20 and 50 DAS).

Assessment of crop condition under abiotic stress using remote sensing technique in upland rice crop

Jonali Goswami

The rise of CO_2 (600 µmol mol^{-1} CO_2 by the middle of 21st century) will effectively influence the productivity of crop plants. Again nitrogen is a limiting nutrient in most of the agricultural soils. In the present investigation, the responses of local genotypes of rice were studied in Carbondioxide Temperature Gradient Tunnel (CTGT) to simulate elevated CO_2 concentration and temperature. Similarly, pot experiment was done at varying levels of nitrogen fertilization. The results revealed that CTGT II had a greater impact on various morpho-physiological parameters and showed a declining trend indicating the deleterious effect of high temperature, at a higher CO_2 and temperature in CTGT III, but, some parameters *viz*. stomatal conductance and transpiration rate were significantly reduced at CTGT II. From the above experiment, it is evident that some degree of tolerance exhibited against high temperature stress which could be attributed to higher accumulation of carbohydrates, proline, adjustment of anatomical features, water status, better defense mechanism particularly in the genotype Inglongkiri followed by Banglami as compared to IET 22238 and Bash under elevated carbondioxide and temperature conditions. Similarly, nitrogenous fertilizer application had a statistically significant effect on yield components of rice genotypes. There was an increase in yield components with increase in each successive level of nitrogen fertilizers. Enhancement of yield components under high nitrogen levels might be attributed to vigorous and healthy growth, higher photosynthetic pigments, improved water relations and the formation of the membrane system of chloroplasts.

Among rice genotypes Inglongkiri recorded significantly higher yield components at low nitrogen levels as compared to the Banglami, IET22238 and Bash. Further, it was revealed that hyperspectral remote sensing could effectively be used for detection of varietal performance, nutrient content and other biochemical parameters of the crop. It was observed that few specific bands were sensitive to chlorophyll (704,803 nm), protein (1514nm), nitrogen (2060, 2300nm), Fluorescence (730nm). Apart from specific bands, indices like NDVI, PSSRa, PSRI, FRI were highly correlated to different parameters of the crop. It is observed

from regression analysis that yield can be estimated as function of different spectral indices with a R square value more the 0.7 under both the conditions at a statistical significance with 95% confidence level. A GUI has been developed for display and retrieval of information for the target plants which aided in generation of spectral data base to discriminate spectral behavior of commonly grown genotypes of rice in this region.

Tapping of carbon dioxide in rice ecosystem through *Azolla* cultivation

Rowndel Khwairakpam

The present investigation was carried out in the stress physiology laboratory under fully automated bioreactor where tapping of CO_2 and external injection regulation CO_2 facility were available. To understand the assimilation and N accumulation in *Azolla-Rice ecosystem* in response elevated CO_2 possible interactions of CO_2 and *Azolla* on the growth and yield of rice investigation was conducted during the *kharif* season of 2014 and 2015.The studies revealed that there was variable response of photosynthetic parameters which lead to impact on carbon sequestration potential as well as change in O_2 evolution under varying levels of CO_2 environment under rice-*Azolla* ecosystem. In case of fluorescence and related parameters, there was deviation from the normal range as the CO_2 concentration increased, however these deviations were minimized in presence of *Azolla*. These were also same in case of ETR, NPQ, PQ, δ PSII etc. Photosynthetic and its related parameters viz. g_s, Ci, T, etc. were found to be related to stomatal density and size. These factors ultimately affected plant growth which was translated as yield. Elevated (500 ppm) CO_2 with *Azolla* has a greater potential for C sequestration, while soil organic carbon enhancement helped increase crop productivity and sustainability which was evident from higher yield and yield attributing parameters. Soil microbial population with higher C:N ratio was recorded under elevated CO_2 with rice-*Azolla* ecosystem.

There have been increasing concerns regarding the role of soil microbial population in biological stabilization of SOC in agricultural soils because change in the soil microbial population within rhizo-spheres with changes in organic matter input. Significant reduction of NPK was recorded due to elevated CO_2, however; reduction rate was variable with *Azolla* when compared with without *Azolla* and ambient. Conversion of inorganic nitrogen was significantly reduced in elevated CO_2 however there was amelioration affect under 500 ppm CO_2 with *Azolla* due to significant increase in key enzymes such NR, NiR and GS syntheses activity. CO_2 enrichment decreased the N concentration in rice without any

change in the C content, leading to an increase in C:N ratio However variability among systems also recorded. This study: (1) depicts the changes in microbial population and fungal predominance; (2) infers a biological stabilizing mechanism behind the C sequestration which includes physical-chemical stabilization as the major controlling processes leading to variation of yield. *Azolla* has enormous potential to sequester of atmospheric CO_2 due to its rapid growth in freshwater without the need for a soil-based nitrogen source. *Azolla* is a novel opportunity to expand and diversify the supply of fertilizers and production of rice fields *vis a vis* tapping the CO_2 and enhancing the O_2 evolution system under changed environmental conditions.

Physiological characterization of some wheat genotypes for higher nitrogen use efficiency and yield potential in Assam

Sonbeer Chack

Wheat is one of the most important cereal crops globally, and is a staple food for about one-third of the world's population (Hussain *et al.*, 2002). Nitrogen is the most important yield-limiting nutrient for crop production in the world (Huber and Thompson, 2007). Two field experiments were conducted for two consecutive years near Stress Physiology Laboratory, Department of Crop Physiology, Assam Agricultural University. The main objective of the study was to characterise some wheat genotypes (collected from East Zone of India) physiologically for higher nitrogen use efficiency (NUE) and yield potential in Assam. In the first year experiment (November, 2014-April, 2015): Nitrogen @ 0, 50, 100, 150 kg ha^{-1} (as Urea) in the form of granules @ 50% of N as basal with the whole recommended doses of P (as Single super phosphate) and K (as Muriate of potash), and the rest 50% Urea were applied at maximum tillering stage. In the second year experiment (November, 2015-April, 2016), Nitrogen @ 0, 500, 1000, 1500 ppm (equivalent to granules in kg ha^{-1}) were applied as foliar spray at the maximum tillering stage (once in a week for two weeks) of the crop.

In the first year experiment, the varieties having the higher NUE in leaves were Wheat 231 (11.36%)> HP 1744 (8.58%)> Pusa Gold (8.42%), and higher NUE in seed were Wheat 231 (19.41%)> HP 1744 (10.01%)> Pusa Gold (9.29%)> PBW 343 (8.27%)> HD 2967 (6.08%). The physiological parameters contributing to the higher NUE in the varieties were maximum Leaf area in Wheat 231(16.81, 17.55 cm^2 plant^{-1})> HD 2967 (15.11, 16.98 cm^2 plant^{-1}) at maximum tillering and PI stages respectively. The maximum leaf number was observed in wheat 231 (23.27)> HP 1744 (21.53)> PBW 343 (19.43) under the highest dose of N i.e. 150 kg ha^{-1} at panicle initiation stage. The other physiological parameters viz. root length of Wheat 231 (12.77 cm)>Pusa Gold (12.57 cm), root volume of Wheat 231 (10.31 cc)> PBW 343 (8.43 cc), and shoot dry weight of Wheat 231 (1.66 g)> HP 1744 (1.55 g) were responsive to augment NUE in the wheat varieties. The variety Wheat 231 (36.18, 34.26)> HP 1744 (33.19, 33.60) showed the highest NR activity (nmol

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NO_2^- g^{-1} fw of leaf) at both Maximum tillering and PI stages. Wheat 231 also exhibited higher N contents in leaf (0.41%) at PI stage, in grain (0.61%), and in leaf (0.37%) at harvest. The yield and yield attributes for higher NUE in the variety Wheat 231 were number of seed spike^{-1} (48.73), spike length (12.72 cm), spike weight (4.01 g), test weight (45.67), economical yield (3.02 t ha^{-1}) and harvest index (47.32%).

Nitrogen @ 150 kg ha^{-1} imparted higher NUE in leaves (12.48%) and grain (15.79%). In this contest, the physiological & biochemical parameters were leaf number (22.45), leaf area (18.30 cm^2), root volume (8.41cc), NR activity (34.08 nmol NO_2^- g^{-1} fw of leaf) at PI stage, and starch content in leaf (271.05 mg g^{-1} d.w.) at maximum tillering stage, total N uptake (37.50%) and N content in seed & leaf (0.46%, 0.38%) at harvest as compared to values in controlled one.

In the second year experiment, the varieties having the higher NUE in leaves were of Wheat 231 (10.90%)> HP 1744 (8.15%); and in case of seed, it was in Wheat 231 (18.74%) only. The physiological parameters contributing to the higher NUE in the variety Wheat 231 were: maximum leaf area (15.29 cm^2 plant^{-1}) at PI stage; root length (14.66 cm) at PI stage, NR activity (37.40 nmol NO_2^- g^{-1} fw hr^{-1}) at maximum tillering stage, nitrogen content in leaf (0.456%) at PI stage and starch content in leaf (221.20, 241.22 mg g^{-1} d.w) at both maximum tillering and PI stages. The yield and yield attributes for higher NUE in the variety Wheat 231 were number of seed spike^{-1} (46.39), spike length (12.03 cm), test weight (44.00 g), economical yield (2.76 t ha^{-1}) and harvest index (47.07%).

The N dose @ 1500 ppm triggered higher NUE in leaves (12.07%) and grains (15.61%) at harvest. In this case, the other physiological & biochemical parameters contributing the higher NUE were leaf area (16.05 cm^2), root length (14.39 cm), NR activity (19.08-37.69 nmol NO_2^- g^{-1} fw hr^{-1}), N content in seed & leaf (0.493% & 0.394%) at harvest and nitrogen harvest index (0.56%) as compared to values in the controlled one.

Overall, in the experiment 1, the variety Wheat 231 possessed the highest score (12) followed by PBW 343 (3)> Pusa Gold (1), and the variety HP 1744 & HD 2967 obtained zero score at harvest. In the second year, too, Wheat 231 (11) scored the highest followed by PBW 343 (3)> Pusa Gold (2)> HP 1744 (1), and the variety HD 2967 obtained zero score at harvest. Thus, it could be concluded that Wheat 231 emerged as the most physiologically efficient variety in the experiments. This variety possesses the adaptive traits, especially the higher NUE, yield and its attributes. Further, N-dose response studies revealed that N @ 150 kg ha^{-1} (as granule) or N @ 1500 ppm (as foliar spray) in the form of Urea was the most effective in augmenting the NUE and its related physiological indices including economic yield in wheat crop in Assam.

Species characterization and behavioural study of bee predatory wasps in Assam

Denisha Rajkhowa

Investigations were carried out for four consecutive years i.e., from 2012 to 2016 in the Department of Entomology, Agricultural Biotechnology, Agricultural Meteorology, Instructional-cum-Research Farm, Experimental Farm, Department of Horticulture, Assam Agricultural University, to ascertain the morphometric and molecular variations as well as the behavioural aspects of three bee predatory wasp species *viz*., *Vespa cincta*, *V. affinis* and *V. magnifica* collected from four agro-climatic zones of Assam *viz.* Upper Brahmaputra Valley zone, Lower Brahmaputra Valley zone, North Bank Plain zone and Barak Valley and Hill zone.

A total of 3099 specimens of bee predatory wasps *viz*., *V. cincta*, *V. affinis* and *V. magnifica* were collected from various locations of four agro-climatic zones of Assam. The morphometric study of *V. cincta* revealed that, specimen from Barak and Hill zone were larger in size (41.68±0.06 mm), followed by North Bank Plain zone (41.34±0.04 mm), Upper Brahmaputra Valley zone (41.30±0.04 mm) and Lower Brahmaputra Valley zone (41.29±0.03 mm). In case of *V. affinis* it was found that specimen from Barak and Hill zone (26.09±0.05 mm) was also found to be biggest in size whereas the specimens from Upper Brahmaputra valley zone (25.64±0.03 mm) were the smallest. The morphometric characters of *V. magnifica* collected from Barak and Hill zone showed the body length 47.37±0.07 mm; head length 9.71±0.04 mm; thorax length 12.15±0.01 mm and abdomen length 25.51±0.03 mm which conforms distinction from other zones.

By using 10 SSR markers, it was found that the marker UN373 showed the highest polymorphic information content (PIC) while marker UN112 showed the lowest PIC value for *V. cincta*. The highest PIC value was found for marker KO908 (0.824) and the lowest was found for marker UN063, among specimens of *V. affinis*. In case of *V. magnifica*, the highest PIC value was recorded for marker KO908 with marker BI3555 showing the lowest PIC value.

The morphometric analysis of *V. cincta, V. affinis* and *V. magnifica* revealed that there were two distinct morphoclusters *viz.,* hill and plain morphoclusters. The variation in morphoclusters was based on elevation or altitude. The molecular analysis of samples gave an indication in genetic variation of different morphoclusters. Based on this morphometric

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and molecular characterization, we may term as two distinct races i.e., hill races and plain races.

The behavioural study of *Vespa* species indicated the behavioural variation among these three species during predation, feeding, nest construction and breeding. Predatory behaviour of *V. cincta*, *V. affinis* and *V. magnifica* revealed that they grabbed and took the bees during foraging time and mostly waited for capturing the bees at small openings and crevices in the hives and the activity was found to be highest in July/August. These species dissected the head of prey with the help of mandibles then chewed the thorax but left the abdomen, legs and wings. In total, for both seasons 2013-2014, it was noticed that *V. affinis* and *V. cincta* constructed aerial nest and *V. magnifica* typically lived in underground nest. It was found that *V. cincta* and *V. affinis* laid eggs in the last part of February and continued up to September. While breeding season of *V. magnifica* was started from last part of March.

Bioecology on Lepidiota sp. Indet. (Coleoptera: Scarabaeidae)

Dhanalakhi Gogoi

Field and laboratory experiments were carried out at Ramie Research Station, Sorbhog and nearby areas and at Soil Arthropod Laboratory of the Department of Entomology, Assam Agricultural University, Jorhat during 2013 - 2017 to engender comprehensive information on the bioecology of *Lepidiota albistigma* Burmeister, (Coleoptera: Scarabaeidae), a major white grub species endemic to Lower Brahmaputra Valley of Assam. Experimental results confirmed the annual life cycle of *L. albistigma* with a mean duration of 336.30 ± 14.25 days. The pre-ovippositional, ovipositional and post-ovipositional period were 8.83 ± 0.75, 3.03 ± 0.76 and 9.13 ± 0.73 days, respectively. The mean fecundity was 22.20 ± 1.1 numbers. Eggs were creamywhite, opaque and elongated in shape with mean length and breadth of 5.61 ± 0.40 mm and 4.32 ± 0.36 mm, respectively. Mean incubation period was found to be 10.73 ± 2.02 days. There were three larval instars with the duration of third instar (237.11 ± 4.86 days) being significantly longer than the first (22.29 ± 1.10 days) and second (39.65 ± 2.90 days) instar. Mean pupal duration was recorded to be 23.36 ± 1.18 days. The mean length and width of first (16.12 ± 0.77 and 4.37 ± 0.54 mm), second (37.60 ± 1.30 and 9.16 ± 0.46) and third (80.28 ± 2.61 and 13.68 ± 0.63 mm) instar grubs were significantly different from each other. The mean length and width of pupae were recorded to be 43.76 ± 1.32 and 16.53 ± 0.60 mm, respectively. Sexual dimorphism based on adult morphometrics revealed that females (61.58 ± 1.64 mm) were significantly longer than males (57.34 ± 0.85 mm). The length of head plus thorax and abdomen were significantly longer in females (27.23 ± 0.55 mm and 24.36 ± 1.30 mm) than in males (23.88 ± 0.41 mm and 23.80 ± 1.30 mm). The mean length of forelegs (31.20 ± 0.79 mm), mid legs (32.77 ± 0.30 mm) and hind legs (42.42 ± 0.97 mm) were significantly longer in females than the males (Foreleg: 28.244 ± 0.61, Mid legs: 30.42 ± 0.18 mm; Hind leg: 41.32 ± 1.41 mm) but the claws in males were strongly bifid. The female alimentary canal (324.94 ± 7.05 mm) was significantly longer than males (315.80 ± 8.74 mm). Both male and female reproductive system exhibited synchronous attainment of sexual maturity. Distinct sexual dimorphism was also observed in the antennal segments and in antenna

sensilla types. Scanning electron microscopic studies revealed 14 different types of sensilla in male and 9 types in female. Lamellae were significantly longer in males.

Field surveys revealed that mango, guava, mussaenda, *ixora*, Assam lemon, arecanut, periwinkle, pomelo, betelvine, *thuja*, croton and black pepper were the primary hosts for adults. Feeding status of adults was further confirmed by presence of food materials in their dissected alimentary canals. Further, sterozoom microscopic images of mandibles and maxillae of both sexes exhibit dentations which indicated that mandibles and maxillae were fitted for phytophagy with probable application in digging of soil for burrowing. Host specificity test revealed that potato, colocassia, green gram and sugarcane to be the most preferred hosts of grubs.

Studies on habitat selection by grubs of *L. albistigma* at five different ecosystems revealed thatgrubs were significantly more abundantat grasslands which were located near water sources. Grubs of *L. albistigma* were more abundant at soil depths of 0 - 10 cm and 11 - 20 cm in grassland and cultivated lands. In grasslands, grubs showed significant preference for soil depths of 0 - 10 cm (3.79 ± 3.34) and 11 -20 cm (2.31 ± 2.09). In cultivated fields, the highest population was recorded at the depth of 11 - 20 cm (2.78 ± 1.54) which significantly differed with other depths. There is no significant difference in abundance of grubs at 0 - 10 cm (1.40 ± 1.22), 21- 30 cm (1.40 ± 1.22) and 31- 40 cm (0.57 ± 1.22). The mechanism of survival of grubs were examined by means of a simulation model which displayed that the grubs were atleast able to survive upto 3 days under water whereas, under simulated conditions they survived upto 15 days. SEM results indicated presence of one pair of thoracic and eight pair of abdominal fictional spiracles which denoted that the respiratory system of the grub is peripneustic. The spiracles are characterized by external structures consisting of a central bulla which is surrounded by a smooth cresent shaped sieve/spiracular plate with numerous aeropyles. Absence of a conventional spiraclular opening, presence of a convex projecting central bulla in place of the opening, sclerotized and smooth sieve plate with ultramicroscopic (< 3 micron wide) aeropyles might have provided protection against entry of water into the tracheoles, allowing only gaseous exchange

Observations on relative abundance of *L. albistigma* indicated that the highest population of grubs were recorded during the month of August whereas lowest was recorded during December, 2014 - 15. Correlation studies between *L. albistigma* grubs and soil physico-chemical parameters revealed that among all physical parameters, sand ($r = -0.693$) and silt content ($r = -0.845$) had significant negative correlations whereas, clay ($r = 0.839$) recorded a significant positive correlation. Among the chemical parameters, soil organic matter content ($r = 0.901$) and available nitrogen ($r = 0.963$) had significant positive correlation with grub population.

Microbial investigation on the gut content of third instar grubs of *L. albistigma* revealed 20 different bacterial cultures of which 5 bacterial cultures designated as B_2, B_5, B_{11}, B_{14} and B_{17} had the highest colony forming unit/ml. Bacterial flora considerably varied in size, colour, pigmentation, margins and elevation and as well as in utilization of carbohydrates and their response to various enzymes.

Reaction of some aromatic rice varieties against major insect pests and their management

Hemam Ramananda Singh

Investigation on reaction of some aromatic rice varieties against major insect pests and relationship between morphological and biochemical properties of the rice varieties with insect pest incidence and evaluation of some promising insecticides and neem based insecticides to major insect pests and their natural enemies were carried out at the Assam Agricultural University, Jorhat, during *Kharif,* 2013 and 2014.

From the present investigation, it was found that among the 13 aromatic rice varieties screened during *Kharif* 2013 and 2014, none of the varieties showed resistance to stemborer. However three varieties *viz*. Boga Maniki Joha, Koli Joha and Ronga Joha showed Moderately Resistance during vegetative stage and Moderately Susceptible during reproductive stage. In case of case worm and leaf folder, none of the varieties were found to be resistant during the investigation.

The morphological characters of the aromatic rice varieties showed non-significant correlation with the incidence of insect pests studied. In case of biochemical properties, carbohydrate showed significant positive correlation with case worm and leaf folder infestation, while non-significant positive correlation with stem borer. Nitrogen showed significant positive correlation with stem borer infestation but non-significant positive correlation to case worm and leaf folder infestation. Chlorophyll, fat and protein showed non-significant positive correlation with the entire insect pest studied. However, phenol showed significant negative correlation with stem borer and leaf folder and non-significant negative correlation with case worm.

Investigation on efficacy of some insecticides revealed that Fipronil 80 WG @ 40 g *a.i.*/ha was superior in reducing the infestation by stemborer in terms of both DH and WEH followed by Flubendiamide @ 24g *a.i.*/ha, Lambda-Cyhalothrin @ 25g *a.i.*/ha and Thiamethoxam @ 25g *a.i.*/ha. In case of case worm, the percent reduction over control was highest in Flubendiamide @ 24g *a.i.*/ha (78.31) followed by Fipronil 80WG @40g *a.i.*/ha (75.00), Thiamethoxam @ 25g *a.i.*/ha (69.01) and Lambda-Cyhalothrin @ 25g *a.i.*/ha (66.12) respectively. Similarly in case of leaf folder, the present finding showed that Flubendiamide @ 24g *a.i.*/ha was most effective and it was equally effective statistically

with Thiamethoxam @ 25g *a.i.*/ha and Fipronil 80WG @ 40g *a.i.*/ha followed by Lamda-Cyhalothrin @ 25g *a.i.*/ha. The highest yield was recorded in Fipronil 80WG @ 40g *a.i./*ha followed by Flubendiamide 39.35 SC @ 24g *a.i./*ha and Thiamethoxam @ 25g *a.i.*/ha however the highest benefit-cost ratio was observed in Thiamethoxam @ 25g *a.i.*/ha.

Data on the effect of treatments on natural enemies revealed that Chlorpyriphos @ 500g *a.i.*/ha recorded the least population of odonates and coccinellids followed by Lambda-Cyhalothrin @ 25g *a.i.*/ha and Thiamethoxam @ 25 g *a.i.*/ha respectively while Lambda-Cyhalothrin @ 25g *a.i.*/ha recorded the least population in case of spider followed by Chlorpyriphos @ 500g *a.i.*/ha and Thiamethoxam @ 25g *a.i.*/ha respectively. Neem insecticide @ 3ml/L showed least effect on spider and coccinellids followed by Flubendiamide @ 24g *a.i.*/ha and Spinosad @ 50g *a.i.*/ha respectively. However Flubendiamide 24g *a.i./*ha showed the least effect on odonates followed by neem insecticide @ 3ml/L and Spinosad @ 50g *a.i.*/ha respectively.

Ecology and management of mound building termites

Himangshu Mishra

Study on ecology and management of mound building termites were carried out in Jorhat and Golaghat district of Assam. Ecological studies were conducted at four different habitats *viz.,* forest, agriculture, rural and urban habitat of both the districts during 2015 and 2016 while management of termites in tea ecosystem was conducted in experimental plot under department of tea husbandry and technology, AAU. Sampling in different habitats revealed 8 species of termites from both the districts. Among the 8 different species, 5 species were belonged to Macrotermitinae subfamily, whereas other 3 species belonged to Nasutitermitinae, Kalotermitinae and Amitermitinae subfamily. The genus *Odontotermes* were found dominant and consisted of four species *viz., Odontotermes obesus* (Rambur)*, O. feae* (Wasmann)*, O. parvidens* (Holmg. and Holmg.) and *O. kapuri* (Roonwal and Chhotani) while the remaining 4 species were belonged to different genera and these were *Microtermes mycophagous* (Desneux)*, Trinervitermes biformis* (Wasmann)*, Neotermes buxensis* (Roonwal and Sen-sarma) *and Speculitermes chadaensis* (Chatterjee and Thapa). Four different feeding groups of termites were recorded among which soil, litter and fungus feeder were dominantly found. Moreover, out all eight species two termites (*O. obesus* and *O. feae*) were dominantly distributed in different habitats of both the district. Morphometric studies of some termite species under Macrotermitinae subfamily revealed that *O. feae* were comparatively bigger than *O. parvidens*, *M. mycophagous,*

O. obesus and *O. kapuri*. Collection of termites from different habitats revealed that higher population of the termite species were recorded from forest habitats than rural, agriculture and urban habitats of both the district. In addition it was also observed that forest habitats had highest mound density per ha (4.42 & 4.35 and 4.50 & 4.40) than rural (3.85 & 3.55 and 3.40 & 3.20), agricultural (3.25 & 3.05 and 3.30 & 3.15) and urban (3.15 & 3.00 and 3.25 & 3.10) sites of Jorhat and Golaghat district respectively. Ecology of mounds were studied through proper observation on nesting patterns of *O. obesus* and *O. feae* mounds in different habitats of both the district. Nesting pattern observed in mounds of forest habitats recorded comparatively higher sizes of basal diameter, height, incubation cavities, nursey

cell, diameter and depth of the royal chamber from the ground level, moreover the mounds noticed in forest habitats also had higher sizes of length and width of the fungal comb than rural, agriculture and urban habitat of Jorhat and Golaghat. Caste composition recorded in the mounds of different habitats confirmed that higher numbers of worker, soldiers were collected from the mounds of forest habitats. Termite population of *O. obesus* and *O. feae* also recorded in the Assam Agricultural University, Campus and the study found fluctuating trend of termite castes in different months during March, 2015 to February, 2016. Correlation of population with mound dimension and weight of the fungal comb revealed that both *O. obesus* and *O. feae* showed positively significant correlation with basal diameter [0.982*(0.001) & 0.956*(0.001)], height [0.975*(0.001) & 0.925*(0.001)] and weight of the fungal comb [0.921*(0.002) & 0.925*(0.001)] respectively. Observation on termitophiles and inquilines associated with the mounds of *O. obesus and O. feae*, stated that scarabaeids and carabids were highly dominant where as staphylids, elaterids, formicids, arachnids and diplopods were moderately dominant termitophiles. Out of different types of inquilines recorded, annelids were highly dominant whereas molluscs and squamets were found moderately and less dominant inquilines. Study on fungal and bacterial colony in the mounds soils of different habitats revealed that, mound soils of forest habitat exhibited higher numbers of bacterial and fungal population than rural, agricultural and urban habitats of both the district. Physicochemical properties of mound soils of different habitat exhibited higher amount of silt (%), clay (%), soil moisture (%), organic carbon (%), available nitrogen (g/kg) and soil microbial biomass (g/kg) than the surrounding mound soil collected from different habitats of both the district.

Management of the termites in tea ecosystem revealed that *Metarhizium anisopliae* registered least number and portion of infestation (13.86 & 12.04% and 14.11 & 12.04%) and showed statistical parity with *Heterorhabditis indica* treated plant (14.49 & 13.73 and 15.60 & 14.26%) after 30 and 60 days of treatment. The tea plants treated with Jatropha oil 50 EC and Neem oil 30 EC exhibited number of infestation (15.52 & 16.56%) and portion of infestation of (14.60 and 15.36%) while the untreated control plants recorded 38.44 & 37.35 and 40.32 & 39.48 per cent of infestation after 30 and 60 days of treatment respectively.

Molecular basis of varietal resistance of brinjal against *Leucinodes orbonalis* Gunee (Lepidoptera: Pyralidae) and its eco-friendly management

Kasturi Choudhury

The investigations on **"Molecular basis of varietal resistance of brinjal against *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) and its eco-friendly management"** were carried out at College of Agriculture, Assam Agricultural University, Jorhat during 2013-14 and 2014-15.

Studies on the varietal screening of brinjal varieties revealed that the minimum shoot as well as fruit infestation on number basis recorded on variety Khorua-1 with 2.96 and 9.31 per cent, respectively. The minimum fruit infestation on weight basis was recorded on variety Brinjal long green (5.54 %). The highest infestation of shoot (17.85 %) and fruit infestation on number basis (36.52 %) and weight basis (36.08 %) noted on variety JC- 1.

The remaining varieties *viz.,* Brinjal long green , Khorua-2, White brinjal, Borbengena, Sagalihingia, Tita bengena, Pusa purple cluster and Pusa purple long registered shoot infestation ranged from 3.05 to 13.69 per cent, 9.70 to 21.81 per cent fruit infestation on number basis and 5.54 to 21.84 per cent on weight basis. The highest brinjal fruit yield was recorded on JC-1 (238.69 q/ha) followed by Pusa purple long (177.83 q/ha). The minimum fruit yield was recorded on Khorua-2 (30.69 q/ha).

Varieties Brinjal long green, Khorua-1, White brinjal and Khorua-2 were designated as resistant to *L. orbonalis* as fruit damage recorded between 1.0 to 10.00 per cent. The fairly resistant varieties to *L. orbonalis* comprised of Pusa purple cluster, Borbengena and Sagalihingia which registered fruit infestation ranged from 11.0 to 20.0 per cent. Two varieties *viz.,* Khorua-3 and Pusa purple long were categorized as tolerant (21.0 to 30.0%) fruit infestation. The varieties *viz.,* Tita bengena and JC-1 were found susceptible to shoot and fruit borer with fruit infestation between 31.0 to 40.0 per cent.

The influence of morphological and biochemical factors on the infestation by *L.orbonalis* revealed that the correlations of shoot diameter (r= 0.646), plant height (r=0.291), leaf thickness (r=0.314), and leaf area (r=0.137) with shoot infestation by *L. orbonalis* were positive but did not show any significant correlation , however the effect of trichome

density (r = -0.140) exhibited negative association with shoot infestation , while length of pedicel (r=0.388), length of calyx (r =0.473) and fruit length (r =0.234) were statistically significant but did not show any significant correlation with fruit infestation. Among biochemical contents in shoots, the total phenol (r= -0.584), peroxidase (r= - 0.796) and polyphenol oxidase (r = -0.734) showed significantly negative correlation with per cent shoot infestation caused by *L. orbonalis*.

In regards to the studies of defense response gene, the relative expression level of *Ascorbate Peroxidase*1 (*AP*1) and *PR3* gene were significantly higher in resistant Khorua variety than in the susceptible JC-1 variety in response to *L. orbonalis* regurgitant. The relative expression of *AP1* and *PR-3* gene in Khorua brinjal were greater than 45 and 40 fold higher than untreated control, respectively. However, the expression of this gene was significantly lower in susceptible brinjal, JC1.

Six different modules were tested against *L.orbonalis* in order to develop an ecofriendly management tactics against this pest. Among the different treatment modules, Module III that includes seedling root dip treatment by Imidacloprid 17.8 SL @ 0.5 ml/lit for 3 hrs + Clean cultivation at 15 days interval +Clipping of infested shoots and destruction of infested fruits +Intercrop with Coriander +Spraying with Spinosad 45 SC @ 0.1ml/lit were found to the best performer in suppressing of shoot infestation (6.04% and 6.95%) in 2013-14 and 2014-15, respectively as well as fruit infestation on number basis (15.71%) and weight basis (17.16%) by *L. orbonalis*. All the treatment modules had also significantly reduced the shoot and fruit infestation as compared to untreated control. The maximum total increased in yield over untreated control was recorded in Module III (162.17 q/ha) followed by Module IV (133.91 q/ha), and Module V (95.47 q/ ha) while, minimum total increase in yield (88.18 q/ ha) over untreated control was recorded in ModuleI followed by Module II (92.92 q/ ha).

The maximum net profit of Rs. 322790.00/ ha was obtained in Module III followed by Module IV (Rs. 279910.00/ ha), Module II (Rs. 218065.00/ ha) and Module I (Rs. 205465.00 /ha) and Module V (Rs. 195125.00/ha) while, the minimum net profit of Rs. 97920.00 was obtained in control plot (Module VI).

The maximum B:C ratio of 4.06 was obtained in Module III followed by Module IV (3.50), Module II (2.72) and Module I (2.40), Module V (1.82) and Module VI (1.60).

Neuroendocrine regulation of lipid metabolism in *Periplaneta americana*

Nirmali Borah

The present investigation on Neuroendocrine regulation of lipid metabolism in *Periplaneta americana* was conducted during 2013-2017 in the Physiology laboratory of Department of Entomology, Assam Agricultural University, Jorhat.

A total of six instars were recorded during the biology study of *P. americana*. The pre oviposition period, incubation period, nymphal period, adult longevity and total life cycle period of *P. americana* during the present investigation were 8.4 ± 1.40, 40.66 ± 4.43, 326.83 ± 76.30, 272.76 ± 57.40 and 367.50 ± 74.95 days, respectively. The duration of each nymphal instar from first to last were 40.70 ± 4.41, 44.96 ± 2.66, 56.20 ± 1.16, 58.60 ± 1.28, 61.11 ± 3.44 and 65.26 ± 1.47 days, respectively. The mean ootheca length, width and weight recorded were 10.53 ± 1.48 mm, 5.23 ± 0.45 mm and 125.73 ± 16.35 mg, respectively. The mean number of oothecae produced by a female were 13.86 ± 1.56 with 14.93 ± 1.89 eggs per ootheca. The number of eggs hatched per ootheca was 12.76 ± 2.20 with a hatching percentage of 90.63 ± 5.57 per cent. The body length of each instar increased significantly from the first (3.26 ± 0.60 mm) to the sixth (39.33 ± 2.04) and attained its peak in adult stage, exhibiting sexual dimorphism, the male was comparatively longer (43.30 ± 6.38 mm) than the female (39.43 ± 2.03 mm). The antennae length recorded from first instar to sixth instar were 5.01 ± 0.13, 14.41 ± 0.61, 15.17 ± 0.30, 23.62 ± 0.98, 25.01 ± 0.13 and 45.02 ± 0.25 mm, respectively. The adult male and female antennae length recorded were 50.08 ± 1.61 and 43.03 ± 3.85 mm. The head width from first instar to sixth instar were 1.04 ± 0.04, 1.51 ± 0.08, 2.59 ± 0.32, 3.00 ± 0.28, 4.00 ± 0.09 and 4.02 ± 0.08 mm, respectively. The head width of adult male and female were 5.00 ± 0.10 and 4.11 ± 0.18 mm. The pronotum size (length ´ width) recorded from first instar to sixth instar were (1.06 ± 0.06) ´ (1.07 ± 0.70) mm, (1.15 ± 0.08) ´ (1.17 ± 0.09) mm, (3.05 ± 0.22) ´ (3.71 ± 0.37) mm, (4.86 ± 0.16) ´ (6.94 ± 0.19) mm, (6.92 ± 0.11) ´ (8.87 ± 0.15) mm, (7.96 ± 0.06) ´ (9.03 ± 0.10) mm respectively. The pronotum size (length ´ width) of adult male and female were (9.45 ± 0.57) ´ (10.96 ± 0.71) and (9.14 ± 0.46) ´ (10.80 ± 0.71) mm, respectively.

A positive and significant correlation was observed between female weight and ootheca number ($r = 0.743$) and weight ($r = 0.747$). The weight of males increased after

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adult ecdysis till first mating on day 5 (1.11±0.03 g), and then decreased to day 30 (0.87±0.03 g) after emergence, then again increased from day 40 onwards, however, subsequently it maintained fairly a constant weight (1.22±0.11 g). The weight of females began to increase steadily during its adulthood (1.27±0.04 g) and peaked (1.40±0.08 g) on day 30. The highest weight was recorded on day 75 (1.43±0.07 g). A decrease in body weight was observed on day 80 (1.32±0.15 g) and day 85 (1.31±0.06 g), which were coincide with ootheca deposition. The lipid content of the adult male *P. americana* increased from day 1 (103.70±0.67 mg) to day 50 (281.93±1.94 mg) and reached its peak on day 65 (283.40±2.72 mg) after which it starts declining. The lipid content of the older males stayed fairly constant. The lipid content of adult female increased significantly in a similar trend with that of male and reached peak from day 60 (326.66±1.25 mg) to day 70 (326.23±1.11 mg) after that it remained fairly constant. A significant drop in the lipid content was observed on day 80 (217.16±2.98 mg). The correlation study revealed that the body weight was positively correlated with lipid content (mg) of both male and female *P. americana*. The exposure of adults to growth hormones suppressed adult emergence and caused morphological abnormalities producing either nymphoids or giant nymphs and adultoids. Among the different concentration of growth hormones tested 5 ppm methoprene and 5 ppm JH III were found to be effective in lowering the body weight and lipid content of *P. americana* when applied either topically or by injection.

An adult male and female *P. americana* imbibed 62.66±7.18 ml and 66.33±8.32 ml of water per day when they were deprived of water for 24 hours, but after 48 hours of starvation water consumption was 70.63±9.44 and 80.07±9.51 ml per day for adult male and female, the latter were significantly higher than the former. Very low impact was observed at short deprivation periods and it was observed that all the females died before the longest deprivation period ended. The hatching percentage was found to be less in case of the ootheca produced by the deprived female than that produced by a normal female *P. americana*.

Morphometrics and molecular characterization   of honey bees and stingless bees

Prarthna Rajkumari

The present investigations have been carried out in the Department of Entomology, Biochemistry and Agricultural Chemistry and Agricultural Biotechnology, Assam Agricultural University during the period 2011-2015 to study the morphometric and molecular characterization of honey bees of north east India and stingless bees of India. The different physiographic zones of North east India *viz*. Arunachal Himalaya, Brahmaputra valley, Barak valley, Meghalaya plateau and South-eastern hill tract and for stingless bees from seven different states have been taken *viz*. Karnataka, Maharashtra, Kerala, Tamil Nadu, Andhra Pradesh, Assam and Jammu & Kashmir.

The morphometric study of honey bees, *Apis cerana* revealed that, *bees* from Arunachal Himalaya has the largest body length (9.58±0.03 mm), and smallest was found in Barak valley (8.23±0.01 mm), followed by South-eastern hill tract (9.18±0.01 mm) and Meghalaya plateau (9.04±0.01 mm) and Brahmaputra valley (8.62±0.02 mm). Cluster analysis of *Apis cerana* reveals that maximum euclidean distance is in between Rangia and Hailakandi (11.73) and minimum distance has been observed between Nongpoh and Umiam (1.55). The genetic similarity between Basar and Itanagar of *Apis cerana* has been recorded to be maximum 81.8 per cent while minimum 14.7 per cent was recorded between Katlicherra and Roing. Based on morphometric and molecular study, two distinct races of *Apis cerana* have been identified i.e. Plains and Hill races.

The specimens collected from different states were identified on the basis of taxonomic characters and six species *viz. Tetragonula iridipennis, T. praeterita, T. bengalensis, T. laeviceps, T. ruficornis* and *Lepidotrigona arcifera* have been included from seven states of India. State wise each species has been studied and comparative variations was recorded in body length of *Tetragonula iridipennis* (3.56±0.04 mm) from Jammu & Kashmir and minimum (3.21±0.05 mm) from Kerala. In case of *Tetragonula praeterita* Assam has the maximum body length (3.86±0.05 mm) and minimum (2.79±0.01 mm) from Andhra Pradesh. The body length *Tetragonula bengalensis* was maximum (3.70±0.12 mm) from Assam and minimum (3.24±0.13 mm) from Kerala. Maximum body

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length of *Tetragonula laeviceps* (3.59±0.04 mm) was found in Assam. Similarly for stingless bees, maximum euclidean distance has been 14.15 between *Tetragonula bengalensis* and *Lepidotrigona arcifera* from Assam and minimum distance is 0.437 was observed between *Tetragonula iridipennis* Maharashtra and Tamil Nadu. And genetic similarity of stingless bees, between *Tetragonula iridipennis* from Karnataka and Andhra Pradesh and Kerala and Tamil Nadu with 100 per cent similarity whiles the minimum 26.7 per cent was found between *Tetragonula iridipennis* of Kerala and *Tetragonula praeterita* of Andhra Pradesh.

Biochemical analysis of four floral honeys was analysed and highest moisture content was found in poly floral honey 27.57±0.49 per cent and lowest moisture content was found in litchi honey 16.96±0.40 per cent. The reducing sugar in per cent was highest for the mustard honey i.e., 82.35±0.54 and lowest was found in leucas honey i.e., 57.10±0.68. The percentage DPPH scavenging activity 43.48±0.02 was found in mustard honey and lowest was found in leucas honey 25.52±0.01. All the sample shows below 50 per cent scavenging activity. Highest proline content was found in leucas honey 8.328, followed by mustard honey 7.22, poly floral honey 4.89 and lowest was found in litchi honey 2.411 mg/g.

Major arthropods diversity of rice ecosystem and evaluation of rice varieties of Assam against yellow stem borer (*Scirpophaga incertulas*) and leaf folder (*Cnaphalocrocis medinalis*)

Rituraj Saikia

The present investigation was conducted at ICR farm, Assam Agricultural University, Jorhat and farmers field near Regional Agricultural Research Station, Titabor during the period 2013 to 2015 to generate comprehensive information about diversity of major arthropods communities, varietal reaction against yellow stem borer and leaf folder and distribution pattern of major insect pests and their natural enemies in rice ecosystem.

A total of 14 species of odonates, 7 species of spider and 6 species of lepidopteran pests were recorded during the investigation period. Among odonates, damselfly diversity was more in vegetative stage (1.717), but in reproductive stage of the crop, the highest diversity index of 1.675 was observed in case of dragonfly. Spider also showed highest diversity index (1.665) during reproductive stage, whereas, lepidopteran pests recorded highest diversity of 1.499 during vegetative stage of the crop. Infestation of case worm as well as leaf folder was recorded more in disturbed field condition compared to normal rice field. In varietal reaction experiment the variety Ranga Bas and Bor Aijung showed comparatively more resistant against leaf folder and yellow stem borer, respectively. Among the different morphological characters tested, leaf folder recorded significant positive correlation with stem diameter (r = 0.285), width of leaf blade (r = 0.378), thousand grain weight (r = 0.402), whereas significant negative impact was observed with leaf length: width ratio (r = -0.302) and number of leaves (r = -0.584). In case of stem borer, dead heart exhibited significant positive correlation with stem diameter (r = 0.390), width of leaf blade (r = 0.469) and thousand grain weight (r = 0.402) as against negative correlation with length of leaf blade (r = -0.304), leaf length: width ratio (r = -0.506) and yield (r = -0.292). Similarly, white ear head showed significant positive correlation with stem diameter (r = 0.628), thousand grain weight (r = 0.402) and dead heart (r = 0.545), but it showed significant negative correlation with leaf length: width ratio (r = -0.291), number of leaves (r = -0.311) and yield (r = -0.291). Distribution pattern of leaf folder, stem borer and case worm were mostly contagious, whereas green leaf hopper and gundhi bug showed uniform distribution in rice ecosystem. The dominant natural enemy's complex, *viz*., odonate and spider showed uniform and contagious distribution pattern, respectively.

Pest complex of Bhut Jolokia and their management

Dr. Rojeet Thangjam

Field and laboratory experiment on pest complex and their natural enemies, identification and detection of insect vectors, integrated management of important pest of *Bhut Jolokia* and cost benefit ratio of different treatment modules were carried out during *rabi* (2014-15 and 2015-16) at Horticultural Orchard, Department of Entomology and Department of Plant Pathology, Assam Agricultural University, Jorhat (Assam).

Altogether 110 species of arthropods were found to be associated with *Bhut Jolokia* at Jorhat, out of which 19 species were identified as pest, 64 as natural enemies and 27 species as casual visitors. Among the different insect pests recorded, 6 species were identified as "major" and they were *Aphis gossypii* (Glover), *Myzus persicae* (Sulzer), *Bemisia tabaci* (Gennadius), *Bactrocera latifrons* (Hendel), *Scirtothrips dorsalis* (Hood) and *Polyphagotarsonemus latus* (Banks). Among the natural enemies recorded, 44 species of predators, 13 species of parasitoids and one species of entomopathogenic fungus belongings to different orders have been reporting for the first time adding the number of natural enemies in *Bhut Jolokia* ecosystem. Moreover, among the dipteran predators, Syrphid fly (*Lathyrophthalmus arvorum*) has been reporting for the first time from Assam. All the genotypes of *Bhut Jolokia* collected from Assam, Manipur and Nagaland showed susceptible to viral diseases. However, the lowest incidence was observed in KCM2 (33.33%) and KCN1 (33.33%). Among the insect pests, 3 species *viz., B. tabaci, A. gossypii* and *M. persicae* have also been identified as a vector of Chilli Leaf Curl Virus (ChLCV), Cucumber Mosaic Virus (CMV) and Potato Virus Y (PVY), respectively during the investigation and they were confirmed through DAS-ELISA and PCR technique.

Among the different treatment modules, module M_2 that includes seedling root dip treatment with imidacloprid 17.8 SL @ 40g *a.i.*/ha for 30 minute just before transplanting + growing of border crop (okra) + spraying of imidacloprid 17.8 SL @ 40g *a.i.*/ha at 20 days after transplanting at 15 days interval (4 sprays) was found to the best performer in

suppressing the population of aphid and whitefly followed by module M_4 that includes seedling root dip treatment with imidacloprid 17.8 SL @ 40g *a.i.*/ha for 30 minute just before transplanting + growing of border crop (maize) + spraying of lambda cyhalothrin 5 EC @ 25g *a.i.*/ha starting from 20 days after transplanting (4 sprays) which were significantly superior over untreated control module M_6. All the treatment modules had also significantly reduced the viral disease incidence as compared to untreated control. But the module M_2 was the most effective in reducing the viral disease incidence followed by module M_4 in both the seasons. However, these two modules greatly affect the population of coccinellids and spiders. The insecticidal treatment modules had significant effect in reducing the insect pest population and also the incidence of viral diseases thereby increasing the yield of *Bhut Jolokia* during the investigation. The highest yield was obtained in module M_2 (3564.44kg/ha) followed by M_4, M_1, M_3 and M_5 (2687.94, 2303.98, 2100.15 and 1511.41kg/ha, respectively). The results on cost benefit ratio revealed that the highest was recorded in module M_2 (1: 4.85) followed by M_4 (1: 3.37) and M_1 (1: 2.13).

Population dynamics and economic injury level estimation of sugarcane plassey borer *Chilo tumidicostalis* Hampson (Lepidoptera: Pyralidae)

Rupak Kumar Nath

Laboratory and field studies on population dynamics and economic injury level estimation of sugarcane plassey borer *Chilo tumidicostalis* Hampson (Lepidoptera: Pyralidae) were conducted in Krishi Vigyan Kendra, AAU, Tinsukia and in three farmer's field at Margherita, Kakapather and Gellapukhuri area of Tinsukia district during 2014-16.

The cane damaged by the insect started in case of primary infestation from first fortnight of April 2014 with a peak (10.36%) in the first fortnight of July. In the subsequent months, *i.e.* from second fortnight of July 2014 to March, 2015, there was a decreasing trend in the percentage of primary damaged cane by the insect with a lowest in the first fortnight of October.

In the case of secondary infestation, per cent incidence of the cane was observed lately in the second fortnight of June 2014 with a highest peak (19.53%) in the first half of November 2014. After that, there was a steady decrease in the secondary infestation from second fortnight of November, 2014 to March, 2015.

The similar trend was observed for the year 2015-16 also, showing cane damaged by the insect from first fortnight of April 2015 with a peak (11.55%) in the second fortnight of June 2015 in case of primary infestation. The per cent incidence of secondary infestation of the cane started lately in the first fortnight of June with a highest peak (21.78%) during first fortnight of November, 2015. But, a decreasing trend of secondary infestation was observed from second fortnight of November, 2015 till harvest of the crop.

The larval population of insect in case of primary and secondary infestation was observed in second fortnight of April and August for both the year, 2014-15 and 2015-16 respectively. Similarly, during both the years, the peak larval population in primary and secondary infestation was recorded in the month of August (17.37 & 15.20 larvae/m^2) and November (5.73 and 5.83/m^2). The population of larvae showed a gradual decline from November to March.

Cotesia flavipes was an important potential parasitoid parasitizing 40.07 per cent larvae in second fortnight of September and 39.04 per cent in second fortnight of September for the year 2014-15 and 2015-16, respectively. In the field maximum and minimum temperature, morning and evening relative humidity, total rainfall had positive correlation with the pest population while number of rainy days showed negative influence on the population build up of the insect. Migration of the larvae and field studies on the measurement of length of damaged canes caused by plassey borer in the field along with peak period of moth emergence in different generations and factors influencing carryover of pest from one season to another were studied detail.

The absolute population of *C. tumidicostalis* and its natural enemies have been used to prepare age specific life tables to determine the role of various mortality factors acting during different generations. Maximum contribution towards mortality during different generations was of the early (expected) as well as the late instar larvae owing to dispersal, parasitoids and various unknown factors. Generation survival, trend indices, 'k' values and other factors influencing the build up and the decline of the pest population during the crop seasons have been studied. Positive value of trend indices in the second (1.1), third (1.39) and fourth generation (1.02) during different seasons indicated an increase in the borer population during subsequent generations. Negative value of trend indices during the first (0.85) and fifth generation (0.74) implied a decline in the pest population in the next generation.

The per cent loss in yield of sugarcane due to secondary infestation by the plassey borer varied from 2.84 to 11.15 per cent. The intensity of borer attack in terms of number of internodes damaged due to secondary infestation varied from 15.38 to 58.33 per cent. The economic injury level of plassey borer was estimated as 17.6 per cent infestation.

Aquatic insect fauna of Majuli river island of Assam

Shimantini Borkataki

Studies on composition of aquatic insect fauna and their diversity were carried out at Majuli river island, Soil Arthropod Pests Laboratory, Department of Entomology and All India Coordinated Research Project on Water Management Laboratory, Department of Soil Science, Assam Agricultural University, Jorhat during 2016-17. Seasonal surveys conducted during pre monsoon, monsoon, post monsoon and winter covering 3 locations, 15 villages and 60 sampling sites revealed the occurrence of a wide array of aquatic insects. Altogether 48 aquatic insect species belonging to 6 orders and 20 families were recorded. At order level, Odonata (47.92%) was the most dominant with the highest numbers of species (23) followed by Coleoptera and Hemiptera (9 species with 18.75% abundance each) and Ephemeroptera (3 species, 6.25% abundance). Comparatively fewer species were found in Ephemeroptera (3), Tricoptera (2) and Diptera (2). Out of 23 Odonates recorded, 16 and 7 species were belonged to the sub-orders Anisoptera and Zygoptera respectively. While studying the diversity indices, the highest aquatic insect species were registered in Lower Majuli (29 species) followed by Upper Majuli (24 species) and Central Majuli (17 species). Highest Shannon-Weiner Index (H'=3.156), Simpson Index of Diversity (1-D=0.983) and Evenness (E_H=0.983) were recorded during monsoon season in Upper Majuli, whereas the lowest Shannon-Weiner Index (H'=2.341), Simpson Index of Diversity (1-D=0.913) and Evenness (E_H=0.860) were registered during winter in Central Majuli.

The effects of different water parameters *viz*., pH, total alkalinity, electrical conductivity, bicarbonate, carbonate, nitrate, dissolved oxygen, ammonium content, fluoride, arsenic on the aquatic insect population from five selected aquatic systems were also analyzed during 2016-17. Experimental results showed that the assemblage of aquatic insects were found maximum in water bodies with dense, floating and submerged vegetation during monsoon (67.75±3.26) followed by post monsoon (42.50±3.04) and pre monsoon (40.58±2.40). Comparatively, highest population of aquatic insects was recorded during winter in periodically managed streams (16.92±3.96). Correlation and regression analyses revealed that arsenic (µg/L) and fluoride (mg/L) contents of water samples were negatively correlated with the population of aquatic insects in all the five studied aquatic systems during monsoon season. However, dissolved oxygen, nitrate, carbonate, bicarbonate (mg/L) and pH were positively correlated with the aquatic insect population. Similar trend of results were also observed in case of the remaining seasons.

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Green synthesis and characterization of silver nanoparticles and their efficacy against certain lepidopteran pests

Supriya Sadanand Gogate

An investigation was carried out in the Department of Entomology and Plant pathology, Assam Agriculture University, Jorhat during 2015-16 and 2016-17 to study the efficacy of green synthesized silver nanoparticles against certain lepidopteran pests. Silver nanoparticles (AgNPs) were synthesized from plants like *Nerium oleander, Ocimum sanctum, Datura metel* and *Mimusops elengi.* Synthesis was confirmed through UV-Vis spectrophotometer in wavelength range of 200-700 nm. The peak was recorded at 410nm, 420nm, 422nm and 420 nm for *N. oleander, M. elengi, O. sanctum* and *D. metel* respectively which confirmed the formation of silver nanoparticles. Zeta potential values were found to be -13.7mV, - 16.4mV, -12.6mV and -7.03mV for *N. oleander, O. sanctum, D. metel, M. elengi* respectively. FT-IR analysis for *N. oleander, M. elengi, O. sanctum* and *D. metel* showed strong peaks at ranges of 800-4000cm^{-1} which exhibited presence of different types of functional groups *viz.,* O-H, H-H, C-H, C-C and N-H). TEM analysis determined the size and shape of *O. sanctum* AgNPs with average size of 64.04nm which is roughly circular or spherical in shape.

Efficacy of green synthesized AgNPs against *Corcyra cephalonica, Leucinodes orbonalis, Helicoverpa armigera* and *Pieris rapae* was evaluated in dilutions of 200,300,400 and 500 ppm. Nanoparticles extracted from *O. sanctum* were found to be effective against *C. cephalonica, L. orbonalis and H. armigera* for both years 2015-16 and 2016-17, with larval mortality of *C. cephalonica* (80% and 83.33), *L. orbonalis* (80 % and 83.33%) and *H. armigera* (83.33% and 83.33%). Nanoparticles extracted from *D. metel* were found to be effective against *P. rapae* with 80 % and 83.33% larval mortality for year 2015-16 and 2016-17, respectively.

The LC$_{50}$ was calculated for all the tested insects' larvae against all the synthesized plant AgNPs both in 2015-16 and 2016-17. For *C. cephalonica* the lowest LC$_{50}$ value was recorded to be 244.04 ppm from *O. sanctum* AgNPs after fifth day of the treatment and

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highest LC_{50} was 378.12 ppm recorded from *M. elengi* AgNPs for year 2015-16. In the year 2016-17, highest LC_{50} recorded to be 369.69 ppm from *M. elengi* AgNPs after first day of the treatment while the lowest LC_{50} was recorded to be 247.84 ppm from *O. sanctum* AgNPs after fifth day of the treatment. For *L. orbonalis*, the highest LC_{50} recorded 362.37 ppm from *M. elengi* AgNPs after fifth day of the after and lowest LC_{50} of 273.48 ppm was recorded from *O. sanctum* AgNPs after fifth day of the treatment during 2015-16. In 2016-17 also the lowest LC_{50} value 252.43 ppm was obtained from *O. sanctum* and highest LC_{50} of 335.00 ppm was obtained from *M. elengi* after fifth day of the treatment. For *H. armigera,* the lowest LC_{50} from *O. sanctum* AgNPs was found to be 279.93ppm whilst highest LC_{50} from *M. elengi* AgNPs of 365.97 ppm was recorded after fifth day of the treatment in 2015-16. In 2016-17 also *O. sanctum* showed lowest LC_{50} value of 278.48 ppm and highest of 362.37 ppm from *M. elengi* was recorded after fifth day of treatment. In 2015-16 for *P. rapae* lowest LC_{50} was found to be 312.59 ppm from *D. metel* AgNPs followed by *O. sanctum* with 316.14 ppm after fifth day of the treatment and highest LC_{50} obtained from *M. elengi* AgNPs 374.91pppm after fifth day treatment. In 2016-17, *D. metel* AgNPs was found to be potent with LC_{50} value of 311.79 ppm and lowest was recorded to be 381.52 ppm from *M. elengi* on fifth day after treatment.

The results suggested that the use of selected plants for synthesis of silver nanoparticles may be considered as environmentally safer and greener approach for pest control. Green synthesis of silver nanoparticles can be used as a valuable tool in pest management strategies against lepidopteran pests.

Pest complex analysis in rice-rice cropping sequence and impact of Indigenous Technical Knowledge (ITK) in their management

Surajit Kalita

Field experiments were conducted both at Instruction cum Research (ICR) Farm, Assam Agricultural University (AAU) of Jorhat district during 2016 and 2017 and farmers' storage godowns of Chirang district of Assam during 2014 and 2015. Species composition and abundance of insect pests during 2016-17 revealed that white stem borer (WSB), *Scirpophaga innotata* Walker (Pyralidae : Lepidoptera) and yellow stem borer (YSB), *Scirpophaga incertulas* Walker (Pyralidae : Lepidoptera) were the most dominant in both rice growing seasons along with minor occurrence of green leaf hopper (GLH), *Nephotettix nigropictus* Stal. and *N. virescens* Stal. (Cicadellidae : (Hemiptera); white backed plant hopper (WBPH), *Sogatella furcifera* Stal. (Delphacidae : Hemiptera), rice hispa (RH), *Dicladispa armigera* (Olivier) (Chrysomelidae : Coleoptera) and grass hopper (GH), *Hieroglyphus banian* (Acridiidae : Orthoptera) throughout the crop growth stages. Leaf folder (LF), *Cnaphalocrocis medinalis* Guenee (Pyralidae : Lepidoptera) and gandhi bug (GB), *Leptocorisa acuta* (Thunberg) (Alydidae : Hemiptera) were also found to occur at mid and late crop growth stages. Rice case worm (CW), *Nymphula depunctalis* (Lepidoptera) was a major pest of *kharif* rice. However, between all the pests, whorl maggot (WM), *Hydrellia philippina* Ferino (Ephydridae : Diptera) was most prominent recording 23.12 - 38.34% damaged leaves/hill during the *rabi* season. Moreover, six species of spiders (SP), eight species of dragon and damsel flies (DDF), four species of coccinellid beetles (CB), one species of hymenopteran parasitoid and one species of carabid predator were the natural enemies recorded in rice-rice cropping sequence during 2016-17. Twelve and nine species of weeds were recorded as the alternate hosts for insect pests, but served as a refuge for natural enemies during the study period.

Amongst the *kharif* rice varieties, *Black rice* was the least preferred by the insect pests, on the other hand, *Kola Joha* suffered highest infestation; while, during *rabi*, tested varieties reacted differently showing no tolerance or preference. In a rice-rice cropping sequence, when *Mahsuri* was followed by *Mahsuri*, the crop suffered 7.69% and 23.08%

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increase in infestation of SB and WBPH, respectively; while it was not so when *Ranjit* was followed by Luit. The peak appearance of CW and WM was found to be restricted to 33rd-34th Standard Meteorological Week (SMW), while LF in 37th-38th SMW, GB in 43rd-45th SMW and GLH in 38th-39th SMW during *kharif* season of rice. While CW and WM population peaks were recorded on 13th-15th SMW, GLH in 17th-19th SMW, GB in 20-22nd SMW and SP in 20-21st SMW during *rabi* season of rice cultivation.

During *kharif,* 2016, appearance of CW, WM and LF were positively correlated with max. temperature (Tmax), min. temperature (Tmin) and rainfall (RF); while RH and SB were positively correlated to Tmax and Tmin but negatively correlated with morning relative humidity (RHm), and GB was found negatively correlated with Tmax and Tmin and positively correlated with RHm.

Covering 585 farmers across 17 districts of Assam; altogether 142, 64, 26, 17, 38, 18, 20, 9, 30, 64 and 44 numbers of ITKs pertaining to cereal crops, vegetables, plantation crop, cash crop, storage, fruit crop, plant disease, fishery, animal husbandry, miscellaneous aspects and ITKs of ritual believes, respectively were collected from primary and secondary sources. Information on entomophagy with respect to preparation procedure of eri silk worm pupa (*Samia ricini*), giant water bug (*Lethocerus indica*), burrowing crickets (*Brachytrupes portentosus*), social wasp (*Vespa magnifica*) and fresh water snails (*Brotia costula* and *Pila globosa*) as food were also documented.

While, validation of selected ITKs related to rice cultivation during 2016-17 revealed that erection of *Vitex negundo* branches in management of CW (49.90% reduction over PrTC) and WM (32.75% reduction over Pre-treatment Count, PrTC) at 21 DAT, but erection of *Alpinia galangal* pseudostem was not effective in limiting major insect pests that only provide site for bird perching. Application of *Colocasia esculenta* cut pieces was found effective in reducing the case worm population to as high as (23.97% reduction over PrTC) at 30 DAT and dusting of wood ash and soil mixture at higher doses reduced the population of GLH to an extent of 15.87% and 12.70% over PrTC at 7DAT and 21 DAT, respectively. All the ITKs were found to be safer to natural enemy complex in rice ecosystem as compared to chlorpyriphos, which recorded 8.27 – 71.43% reduction of damage or population of CW, WM, LF, GLH and GH over control at 21 DAT.

The experiment on validation of ITKs against storage pests during 2014-15 in farmers godown at Chirang district of Assam revealed mixing of *Polygonum hydropiper* dry leaf powder @ 10 gm/kg resulted the lowest of 55.36%, 44.57% and 44.80% increase in seed damage over PrTC on top (0-15 cm), middle (15-30 cm) and lower (> 30 cm) layer, respectively at 90 DAT as against 221.60%, 204.35% and 201.615% increase over PrTC in the control, respectively. While mixing of *Ocimum sanctum* leaf powder @ 4 gm/kg resulted the lowest of 83.68% and 80.365% increase in seed damage over PrTC on upper (0-15 cm) and lower (> 15 cm) seed layer stored in bamboo storage structures against 152.36% and 142.075% increase over PrTC, respectively at 60 DAT. Both the treatment showed significantly highest reduction in seed damage up to 30 DAT, which their bioefficacy afterwards with time.

The laboratory experiment on effect of both *O. sanctum* and *P. hydropiper* leaf powders against *Sitophilus oryzae* and *Callosobruchus chinensis* revealed that treatment with 5 gm/kg recorded 70.00% and 96.67% adult mortality of *S. oryzae,* while 66.67% and 93.33% adult mortality of *C. chinensis* at 10 DAT, respectively. The LC_{50} values of *O. sanctum* was found to be 0.86 gm/kg and 1.69 gm/kg against *S. oryzae* and *C. chinensis* at 10 DAT, while *P. hydropiper* recorded a LC_{50} value of 1.01 gm/kg and 1.32 gm/kg against *S. oryzae* and *C. chinensis*, respectively at 10 DAT.

Individual and System level Performance analysis of Agricultural Technology Management Agency in Assam

Chittaranjan Deka

The Agricultural Technology Management Agency (ATMA), defined as a semi-autonomous decentralized participatory and market-driven extension model (Swanson *et al.,* 2008), represents a shift away from transferring technologies for major crops to diversifying output. As the ATMA programme is under operation in Assam for the last ten years, the researchable questions may arise about to what extent the functions of ATMA through cafeteria of activities at district level are achieved such as farmer oriented activities, farm information dissemination, agricultural technology refinement, validation and adoption (R-E-F-Linkage), administrative and capital expenses, innovative activities and other innovative activities etc.

Moreover to perform the above mentioned functions/activities, numbers of functioning committee/body has been made such as ATMA Governing Body (GB), ATMA Management Committee (AMC), Block Technology Team (BTT) and Farmers Advisory Committee (FAC) at District and Block level. In these area the researchable questions may also arise that to how and what extent the members (Extension personnel from line department, Scientists from KVKs and Farmers from respective district and Block) of the respective committee/body performed their role to accomplish the functions/activities of ATMA.

Keeping in view the broad aims and objectives of ATMA and to find out relevant answers on the above stated questions, a study entitled **"Individual and System level Performance analysis of Agricultural Technology Management Agency in Assam"** was planned with the following objectives:

1. To study organizational level performance of ATMA under new extension reforms
2. To assess role performance of extension personnel and FAC members of ATMA at District and Block level
3. To find out direct and indirect effects of a set of selected predictor variables on role performance of extension personnel

4.   To study problems in planning and executing the programmes of ATMA

5.   To suggest measures for improvement of Bottom-up planning in ATMA based on analysis of its organizational level performance and opinions of respondents

The present study was conducted in Assam, one of the states of North-Eastern region of India. A multistage purposive cum random sampling method was followed to select the respondents for the study. For study the organizational level performance of ATMA, three districts namely, Kokrajhar, Bongaigaon and Goalpara were selected purposively due to limitation of time and resources. Again to carry out study on the level of role performance of extension personnel and FAC members, two CSS-ATMA districts namely Kokrajhar and Bongaigon were selected purposively.

The secondary data in the present study were collected from the respective district office. The same secondary data also collected from the Director Office, SAMETI for comparison. On the other hand the primary data in the present study were collected directly from the respondents with the help of the structured schedule through personal interview method. Various descriptive and inferential statistical measures were employed to analyze the data. In the context of the statistical analysis, a set of explicit hypotheses were formulated in the present study. In general, testing of hypotheses was done on the basis of null hypotheses under consideration.

The result of the findings highlighted that the trend of achievement of cafeteria of activities as per ATMA guideline were below 50.00 per cent in the three consecutive years *viz.*, 2013-14, 2014-15 and 2015-16 except in few activities where the achievement of activities under the heads "Agril. Technology Refinement, Validation and Adoption (R-E-F-Linkage)", "Administrative/Capital Expenses" and "Innovative Activities", were 62.50 per cent, 59.39 per cent and 50.03 per cent respectively in the year 2013-14. On the other hand, in the year 2014-15, the achievement of activities under the head "Other Innovative Activities" were 100.00 per cent.

The findings of this study revealed that majority of the GB (76.67%), AMC (73.08%) and BTT (64.29%) members belonged to the age group of 42-55, 40-55 and 37-51 years respectively. The findings also highlighted that majority of the DLFAC (54.17%) and BFAC (61.67%) members belonged to the age group of 35-50 and 31-47 years respectively.

Majority of GB (60.00%) and AMC (57.69%) members were graduates. On the other hand, majority of BTT (54.77%) were post-graduates. As regards to DLFAC and BFAC, majority of DLFAC (75.00%) and 48.33 per cent of BFAC members possessed high school education. Majority of GB (66.67%), AMC (76.92%) and BTT (50.00%) members had 13 to 27 years, 14 to 28 years and 6 to 23 years of job experience respectively. Majority of DLFAC (70.83%) and BFAC (65.00%) members had 9-25 and 11-23 years of farming experience. Majority of GB (70.00%), AMC (69.24%) and BTT (66.67%) members had received to 6-19 nos., 5-24 nos., and 5-16 nos. of training respectively. On the other hand, majority of DLFAC (70.83%) and BFAC (80.84%) members had received 5-17 nos. and 5-14 nos. of training respectively. Cent per cent of GB and AMC members and more than 80.00 per cent of BTT members were regularly reading the newspapers and viewing

television. Further, the study highlighted that majority DLFAC (54.17%) and 14.17 per cent of BFAC members were viewing television regularly. The findings revealed that more than 40.00 per cent of the DLFAC and BFAC members, the source of motivation for joining FAC were ADOs and VLEWs respectively. Majority of GB (70.00%), AMC (65.39%) and BTT (61.90%) members expressed their satisfaction about facilities and resources at their work.

The findings of the study revealed that majority of GB (53.33%), AMC (57.69%) and BTT (54.77%) members had moderate level of job satisfaction respectively. Majority of GB (63.34%), AMC (65.38%) and BTT (66.67%) members had medium level of achievement motivation respectively. Majority of GB (53.33%), AMC (65.38%) and 45.23 per cent of the BTT members had medium level of role conflict. The findings highlighted that highest rank was occupied by the motivational factor 'Job-security', 'Recognition' and 'Gain in pay and perequisitives' in case of GB, AMC and BTT members respectively. The highest rank was occupied by the work value 'Service to rural people' in case of GB, AMC and BTT members. Majority (65.39%) of the AMC, 46.67 per cent of the GB and 42.86 per cent of the BTT members had medium level of job involvement respectively. Majority of GB (63.33%), AMC (73.08%) and BTT (76.20%) members had favourable attitude towards extension work respectively. Majority of GB (66.66%), AMC (76.92%) and BTT (78.58%) members perceived organizational climate as facilitating respectively. Majority of GB (70.00%), AMC (65.39%) and 42.85 per cent of the BTT members perceived medium level of job stress respectively. Majority of GB (56.66%), AMC (61.54%) and 45.23 per cent of the BTT members had medium level of leadership ability respectively.

The findings revealed that majority of extension personnel (62.24%) and FAC (68.75%) members had medium level of role performance.

The coefficients of correlation were worked out to examine the relationship of 12 independent variables with the level of role performance of the extension personnel. The findings showed that the overall level of role performance of extension personnel had positive and significant correlation with job satisfaction (r=0.453**), achievement motivation (r=0.478**), motivational profile (r=0.453**), job values cherished (r=0.469**), attitude towards extension work (r=0.567**), organizational climate (r=0.487**) and leadership ability (r=0.621**) at 0.01 level of probability. Further, it was found that the variables *viz.,* role conflict (r= -0.508**) and job stress (r= -0.580**) were negatively and significantly correlated with the level of role performance at 0.01 level. While the variable job experience (r= -0.223*) had negative and significant correlation with level of role performance at 0.05 level.

Multiple regression analysis was used to determine the contributory effects of selected independent variables in explaining the variation in the level of role performance of the extension personnel. Results of the regression analysis revealed that variables *viz.,* organizational climate (b= 0.154**) had positive and significant contribution towards the overall role performance of the extension personnel at 0.01 level of probability while job satisfaction (b=0.124*), achievement motivation (b=0.152*), motivational profile (b=0.158*), attitude towards extension work (b=0.080*) and leadership ability (b=0.030*) were found to have positive and significant contribution towards the overall role performance of the

extension personnel at 0.05 level of probability. The variables *viz.,* role conflict (b= -0.019**) and job stress (b= -0.125**) had negative contribution towards the overall role performance. The value of coefficient of multiple determination (R^2) being 0.597 indicated that the twelve independent variables jointly could predict 59.70 per cent of the variation in level of overall role performance of the extension personnel. The remaining variation was, thus due to the other unidentified factors not considered in the study.

The results of path analyses revealed that the variables *viz.,* organizational climate, achievement motivation, leadership ability, job satisfaction and role conflict emerged to be five most important variables which exhibited substantial direct effects on the overall level of role performance of extension personnel. The Path diagram also clearly shows how the variables are linked with one another and their direct and indirect effect on the level of role performance of extension personnel.

The findings highlighted that in case of GB and AMC members, four problems were really serious as more than 70.00 per cent of the respondents faced them. The problems were "Excessive work load besides the normal work of the Dept. like election, NRC and relief duty", "Lack of mechanism to discuss policies, plans and actions of ATMA at district level", "Overlapping of ATMA programmes with other programmes of the department" and "Inadequate fund for implementation of the programme". Further, the findings revealed that in case of BTT members, five problems were really serious as more than 80.00 per cent of the respondents faced them. The problems were "Irregularity in release of funds for implementation of different development programmes", "Constraints of fund to meet the expectation of farmers", "Excessive work load besides the normal work of the Dept. like election, NRC and relief duty", "Supply of insufficient technology materials to BTT members" and "In sufficiency and untimely arrival of necessary inputs which are needed to provide for Common Service Centers and Kissan Call Centers". Further, the results showed that in case of FAC members, three problems were really serious as more than 80.00 per cent of the respondents faced them. The problems were "Delay in fund transferred against purchase of seeds/input by farmers", "Insufficient training and exposure for up gradation of their knowledge in agriculture and allied fields" and "Area of scheme in village level is very small, which create difficulties during selection of farmers for conducting the demonstration".

The findings of the organizational level performance highlighted that activities under farm information dissemination were very negligible except in the year 2013-14 where only 40.16 per cent achieved. So, emphasis should be given on these activities in near future for improvement of Bottom-up planning. However, provisioning of adequate nos. of farmers' friend would definitely help in improvement of Bottom-up planning in ATMA through effective information dissemination system.

The majority of the respondents (Extension personnel and FAC members) suggested that conducting PRA in each revenue villages, elimination of political interference during selection of FAC members and farmers' friends, strengthening the FIAC, launching a wide publicity, provision for adequate communication facilities, proper government instruction regarding flow of fund and provision of incentives/pension for the real farmers by the Government would help in improving Bottom-up planning in ATMA.

A study on learning style of the under-graduate students of Assam Agricultural University, Jorhat

Gitauditya Laishram

The study was conducted at the College of Agriculture (Jorhat) and the College of Home-science (Jorhat) under Assam Agricultural University, Jorhat with a view to study the 'learning style' of the under-graduate students of Assam Agricultural University. Additional studies have also been conducted to know the 'learning skill' and 'critical thinking ability' of the students. Problems faced by the students during the learning process have also been covered. Students of both the colleges were taken as respondents and selected by using a proportionate random sampling design. A total of 226 students were selected for the study. The data were collected by administering structured questionnaires. Relevant statistical tools were employed for analyzing the data collected.

The study revealed that majority (74.34%) of the students was female and 25.66 per cent were male. In academic achievement, 69.91 per cent of the students belonged to the category having CGPA between 7.5 - 8.5. Majority (63.72 %) of the students came from an urban background and 94.69 per cent of the students went to English medium school during their 10+2 level. The study also revealed the proficiency of the students in the medium of instruction where 42.48 per cent were termed as good and 6.19 per cent as poor in it. 37.17 per cent of the students had a second preference for Agriculture as a study area at their higher secondary level with 15.04 per cent having first preference for Agriculture.

The study revealed that the students of Agriculture and Home-science possessed almost the same learning skill. The students of both the colleges 'always' possessed the skill of 'co-operating with others' and 'class-participation', while they 'often' possessed the skill of 'independent work', 'initiative', 'home-work completion in time and effectively', 'problem solving' and 'goal setting to improve work'. The learning style was also found to be similar in both the colleges where 34.07 per cent of the students belonged to 'Reflector' category and 'Activist' (10.19 %) the least. In College of Agriculture, 33.33 per cent of the students belonged to 'Reflector' category, while in case of College of Home-science, 37.50 per cent of the students belonged to 'Reflector' category. In case of critical thinking ability of the total respondent, more than 2/5th of the students (44.25%) belonged to the phase of being

'competent' in 'analyzing' the information and data. Similarly in 'employing' the formulas and procedure, more than 2/5th of the students (42.04%) belonged to the competent phase. However, in 'integrating' the information from different point of view, 39.82 per cent of the students belonged to 'developing' phase. In 'drawing a conclusion', 33.19 per cent of the students belonged to the 'accomplished' phase. On the other hand, in 'revising the conclusion', 40.71 per cent of the students belonged to the 'developing' phase.

Large syllabus, irregular power supply, more of theoretical oriented curriculum, difficulty in simultaneous use of LCD and blackboard, limited teacher- student interaction, less attention span and least interest of students in study, non audible of some teachers' voice till last bench, lack of frequent field demonstration, less applicability of subject matter to real life were found to be the major problems as perceived by the students.

Assessment of training needs of Agriculture Extension Assistants in Recent Advances of Extension Education : A study in Dibrugarh and Tinsukia Districts of Assam

Jahnabi Senchowa

The economy of the state of Assam is basically based on Agriculture as the dependence of rural labour on Agriculture and allied activities was nearly 53 percent. Majority of the Assamese community survives on Agriculture and its allied aspects as their livelihood. Improvements in the field of Agriculture is solely dependent upon the improvement of the personnel of the State Departments associated with this discipline.

The Agriculture Extension Assistants has to play a vital role in effective transfer of agricultural technology. The Agriculture Extension Assistants has to motivate, educate and guide farmers to adopt new ideas and practices. Keeping this in view, the present study entitled , "Assessment of training needs of Agriculture Extension Assistants in recent advances of Extension Education – a study in Dibrugarh and Tinsukia districts of Assam" was undertaken with the major objective of Assessing training needs of Agriculture Extension Assistants in recent advances of Extension Education.

The Findings of this study revealed that majority (65.00 %) of the Agriculture Extension Assistants were middle aged .Majority (47.50 %) of the respondents had educational qualification up to HSLC. Majority (62.50 %) of the respondents had Total Service Experience of 13-24 years. Majority (65.00 %) of the respondents had Training Exposure between 3- 14 in their service tenure.

It is evident from the study that 100 per cent of the respondents had attended training on Subject Matter, 93.33 percent of them had attended training on Extension Methodology and 61.66 percent on other categories apart from Subject Matter and Extension Methodology. A very high majority (71.67 %) of the Respondents had moderately favourable Attitude towards Extension work. Maximum (74.16 %) Respondents are Moderately

Satisfied in their Job. The study revealed that most important Sources of Information of the respondents is the "Progressive farmer", and the Least Important Source is "Agents of Input Organizations". The Motivational Profile of the study reveals that "Better Relationship with Superiors of the Department" is the most important Motivational Factor and "Better Relation with Co-Workers" is the least important motivational factor for the Respondents. Majority (67.50 %) of the Respondents had shown medium Role Conflict. Majority (70.83 %) of the Agriculture Extension Assistants had shown medium level of Role Awareness in their Designation.

The Training need areas for AEAs were categorized into ten aspects- Application of ICT Based Extension, Prospects of Market led Extension, Prospects of Group led Extension, Approach to Participatory planning, Perspectives of Human Resource Management, Approach to Liberalization of Economy, Preparation of module for skill development of farmers, Knowledge on Private Extension and Privatization, Perspectives of Farm Journalism and Agri-preneurship Development.

The most needed training need areas of Agricultural Extension Assistants identified were – "Fundamentals of Internet Browsing" (WMS= 2.94), "Concept of Market led Extension" (WMS= 2.95), "Promotion and practices of Group farming" (WMS=2.99), "Knowledge on PRA tools" (WMS=2.95), "Mainstreaming gender in Agriculture" (WMS=2.94), "Knowledge on Globalization of Economy" (WMS=2.91), "Formulation of Training design" (WMS=2.95), "Public Private Partnership in Agriculture" (WMS=2.96), "Knowledge and role of Mass Communication" (WMS=2.90), and "Concept of Agripreneurship" (WMS=2.96).

The Study revealed that majority (69.16%) of Agriculture Extension Assistants have Medium level of training needs , followed by high level of training needs (20.00%), and low level (10.84%) of Training needs.

The findings of Co-relation analysis of the various selected Socio-personal characteristics of Agriculture Extension Assistants and their training needs revealed that Age (r=0.04); Service Experience (r=0.02), Attitude towards Extension Work (r=0.02), Job Satisfaction (r=0.01), Motivational profile (r=0.12), Role Conflict (r=-0.04) was found to be Non significant with Training needs, whereas Role Awareness (r=-0.15) was found to be negatively significant with Training needs.

An Evaluative Study of Training Programmes on Panchayati Raj Institute conducted by Extension Training Centre, Jorhat

Mridupaban Mudoi

India is a vast country with many states that have a population of more than 1.3 billion. Democratically governing a country of this size necessitates several tiers of government. Keeping this in view Panchayati Raj Institutions have been introduced under the 73rd Amendment Act of the Constitution of India. Accordingly in view of the historic Constitution (73rd Amendment) Act, 1992, the Assam Panchayati Raj Act, 1994 was enacted and came to effect from 5th May, 1994. Preparing the Panchayat members for their new roles as local decision-makers, calls for education and training on a massive scale, for which appropriate tailor made training content, methods and tools are needed.

The study was conducted with a view to measure the effectiveness of training programmes conducted by Extension Training Centre, Jorhat and to delineate the factors affecting training transfer by PRI members and the resultant transfer outcome. A purposive cum random sampling technique was followed for selection of total 120 nos. of respondents. Only 2 districts namely Jorhat and Golaghat were selected for the present study.

In this study, first a database of the training programmes conducted by ETC, Jorhat for 3 years (2013-14 to 2015-16) was developed. The database of the training programme revealed that maximum numbers of training programmes were conducted during the period 2013-14 (140 nos.), followed by 2015-16 (77 nos.) of which majority (51.77%) of the trainees were female and belonged to OBC category (44.26%). Maximum (72.22%) numbers of training programmes were conducted for the trainees of Jorhat district and also majority (51.04%) of the training programmes were conducted on campus.

The findings of this study revealed that majority (72.50%) of PRI members were in between 31 to 50 years and 11.67 per cent of PRI members were graduate followed by 40.83 per cent of PRI members belonged to OBC caste. Majority (56.67%) of the trainees were female with the experience of working in PRI ranging from 4 to 8 years (73.33%). Majority (84.17%) of the trainees were belonged to nuclear family. A healthy percentage

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(74.17%) of the PRI members possessed moderate level leadership behaviour. The study also showed that majority (78.33%) of the respondents possessed moderate level cosmopoliteness and have moderate level decision making ability.

Regarding the effectiveness of training programmes in terms of perceived usefulness, knowledge gained and skill developed as a result of training programme, majority (75.83%) of the trainees opined that the training was moderately useful. On the other hand, 75.00 per cent trainees perceived that there was moderate gain in knowledge as result of the training programme and there were 77.50 per cent of the trainees perceived that the skill was moderately developed. Moreover, in terms of its perceived usefulness, the topic on "Community participation in Swachh Bharat Mission" (WMS= 2.79) was ranked "first".In terms of perceived knowledge gained, the topic on "Pradhan Mantri Gram SadakYojana" (WMS= 2.71) was ranked "first". Besides, effectiveness of training programme regarding its perceived skill developed, the topic, "Panchayati raj institution accountant software" (WMS= 2.90) was given "first" rank by the respondents.

Moreover, "peer support" (WMS= 4.67) and "Strategic link" (WMS= 4.67), followed by "Supervisor support" (WMS= 4.64) and "General work environment" (WMS= 4.64) were considered to be major factors of training transfer and "Community participation under Swachh Bharat Mission reduces open defecation" (WMS= 4.68) followed by "MIS under MGNREGS improves decision making ability and communication" (WMS=4.68), "RKVY increases total production and reduces yield gap of important crops" (WMS= 4.68), "role played by GP in increasing livestock production and management increases nutritional status of the villagers" (WMS= 4.63), were considered to be the major training outcome of the training programmes.

Findings of correlation analysis showed that age (r = 0.15*), work experience (r = 0.21**) and decision making ability (r = 0.19**) had positive and significant relationship with effectiveness of training programmes. However, It can be further seen from the analysis that the relationship between leadership behaviour (r= -0.15*) and effectiveness of the training programme were negatively significant.

A study on motivation of Agri-preneurs towards Agro-based enterprise in Upper Brahmaputra Valley Zone of Assam

Pareenita Baruati

The study was conducted in three districts of Assam namely Jorhat, Golaghat and Dibrugarh with a view to find out the entrepreneurial motivation of Agri-preneurs. Purposive and random sampling techniques were used for the selection of respondents. Total 186 respondents were selected for the study. Data was collected by administering a structured schedule. Statistical tools employed to analyze the data included frequency distribution, percentage, mean, standard deviation (wherever applicable) and weighted mean score.

The study revealed that 46.78 per cent of the agri-preneurs belong to age group between 36-50 years; majority (77.97%) of the respondents belong to the general caste; had Hindu as their religious preference (94.08%). It was observed that majority of the respondents (87.63%) were male and majority (93.02%) were married. It was seen that 40.32 per cent respondents were class IX passed; majority (57.53%) had nuclear family and majority (80.64%) of the respondents were first generation entrepreneurs. In terms of experience of the respondents in the enterprise (in years) majority (54.83%) had an experience in the enterprise of 7-20 years. The study also revealed that majority (90.86%) of the respondents received support from their respective families; 48.40 per cent respondents received advice as form of help and majority (60.22%) of the respondents had 51-75 per cent contribution of the family in their enterprise. Majority (55.92%) of the respondents spent up to 5-8 hours of time in their enterprise, majority (86.03%) of the respondents had their enterprise located rurally and majority (76.88%) had their enterprise as part of their house. 69.36 per cent respondents utilized "cash" as the mode of sales. It was seen that majority (80.64%) respondents had both own and burrowed funds as their sources of finance; majority (65.34%) had their sources of borrowings as co-operative banks. The study further revealed that majority (78.49%) of the respondents had annual income ranging between ` 166882 to ` 329665. In terms of type of agri-business undertaken by the respondents 38.17 per cent had opted for food processing. Majority (64.52 %) had individual ownership of

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agri-business. Majority (89.78%) did not participate in any entrepreneurship development programme. Majority (63.97%) had medium level of marketing orientation and majority (83.87%) of the respondents had low level of management orientation and majority (94.08%) had medium level of entrepreneurial motivation.

In terms of entrepreneurial motivation, 26 factors of motivation were selected by going through various research papers and judges rating. It was measured on the basis of weighted mean score; the study revealed that out of all the 26 factors, "a sense of determination and hard work" (3.82) ranked first. Two factors *viz.,* "urge to earn extra income" and "become self sufficient" (3.81) ranked second. "Regard or fondness towards business" (3.41) was ranked third. "Responsibility towards family" (3.24) ranked fourth and the factor "attain a certain status in the society" (3.07) ranked fifth.

The advantages received from government and other institutions by entrepreneurs were analyzed by using cumulative frequency and percentage. It was seen that "attending training under various institutions"; "credit facilities provided by cooperatives", "Public Private Partnership", "supply of animal feed at subsidized rate", "exposure visits", "awareness campaign", "provision of farm machineries at subsidized rate" and "market assurance to entrepreneurs through regulated markets" were some of the advantages received as outlined by the respondents.

As shown by the rank found through frequency and percentage; constraints reported by the respondents included, "lack of capital", "lack of marketing facilities", "lack of government government assistance in terms of need based trainings", "lack of knowledge about proper techniques of marketing", "lack of adequate knowledge on use of inputs such as seed material, fertilizer doses, etc.", "non availability of water filtration", "lack of equipments such as pumps sets and other equipments required for irrigation", "lack of access to raw materials and labour at proper time", "interruption of power supply" and "lack of awareness of different schemes availed for entrepreneurs".

Assessing Impact of National Food Security Mission (NFSM) – Rice in Assam

Debajit Borah

At present, rice occupies about two-third of the total cropped area (25 lakh ha) in Assam. Being the single major source of agricultural GDP, rice plays a significant role in the state economy. However, the productivity of rice in Assam is much lower than the national average. There is a gap of around 600kg/ha between the state and national average of rice productivity. Therefore, NFSM-rice programme is being implemented through Agricultural Technology Management Agency (ATMA) in 13 districts of Assam since 2007-08 comprising five agro-climatic zones of the state under central sector scheme. The main theme of NFSM-rice has been the promotion of proven agricultural technologies to the farmers in relatively less productive districts of the country. This is possible when the technology is most appropriate to the farmers' situation and needs, and technology dissemination processes are quicker and more efficient. In order to make these things possible it is essential to know the impact of the rice production technologies recommended by NFSM-rice in Assam. Keeping these facts in view, the proposed study entitled **"Assessing impact of National Food Security Mission (NFSM)-rice in Assam"** was undertaken with the following objectives.

1. To assess the effectiveness of NFSM-rice in Assam in terms of mission objectives.
2. To determine the appropriateness of recommended technologies of NFSM-rice.
3. To investigate the factors that influences the likelihood of adoption of recommended technologies of NFSM-rice.
4. To identify the problems faced by farmers to adopt technologies of rice recommended by NFSM-rice and pool suggestions there off.

The study examined the determinants of adoption of recommended technologies under NFSM-rice among beneficiary and non-beneficiary respondents of the State. Data for the study were obtained from 150 beneficiary respondents and 300 non-beneficiary respondents selected through multi-stage sampling procedure. Inferential statistical techniques namely the Logit model and the Tobit model were used to estimate the likelihood of technology

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adoption and the extent of adoption of recommended technologies by the respondents, respectively. Data pertaining to the study were collected through personal interview method during the period of October, 2015 to January, 2016. The study included two dependent variables, 15 independent variables and three descriptive variables. After analysis of the obtained data, it was found that there is no significant difference between the mean score of age, educational level, family size, primary source of income, size of operational land holding and land situation of the beneficiary and non-beneficiary respondents. Hence, the beneficiary and non-beneficiary respondents were having similar background. Regarding the overall extent of adoption of different recommended production technologies (i.e. HYB, IPP and SRI) it was seen that majority of the sampled respondents were partial adopters. The Tobit analysis indicates that educational level, size of operational land holding, land situation, extension contact and training exposure were positively and significantly related to the extent of adoption of hybrid rice technologies. Family size had a negative and significant influence on it. In case of the extent of adoption of IPP; educational level, family size, average annual family income, size of operational land holding and sources of credit had a positive and significant relation. Family size, size of operational land holding, labour availability within household, land situation and training exposure of the respondents had a positive and significant relationship with the extent of adoption of SRI. In light of the effectiveness of NFSM rice, it was seen that there is a remarkable increase in the rice area, productivity, soil fertility status and farm profit at individual farm unit of beneficiary respondents. However, in case of non beneficiary respondents no significant change occurred. The recommended technology of NFSM rice was found as appropriate by majority of the respondents regarding acceptability, affordability, accessibility & attractiveness. Multiple regressions with dummy variables indicates that higher secondary and above level of education big family, average annual family income are positive and significant predictors for the likelihood of adoption of hybrid rice whereas the size of operational land holding is a negative predictor. Average annual family income, primary source of income and land situation is positive and significant predictors for the likelihood of adoption of IPP and size of operational land holding is a negative predictor. The higher secondary and above level of education, average annual family income, primary source of income, labour availability within house hold and extension contact are positive and significant predictors for the likelihood of adoption of SRI. Logit estimation shows that age, educational level, average annual family income, extension contact, training exposure and sources of credit are positive and significant predictors for the likelihood of adoption f hybrid rice varieties while family size is a negative predictor. In case of IPP demonstration, age, educational level, labour availability within household, land situation and training exposure are positive and significant predictors for the likelihood of adoption of HYV of rice while extension contact and sources of credit are negative predictors. Family size, average annual family income and training exposure are positive and significant predictors for the likelihood of adoption of transplantation practice under SRI technology and educational level size of operational land holding, labour availability within household and land situation are negative predictors. For three types of practices, farmers had various kinds of problems.

The major problem faced by most of the hybrid rice growers was high cost of input such as seed, fertilizer, labour, micronutrients etc. Lack of clarity about new technology was the major problem faced by most of the respondents under IPP demonstration. In case of SRI, problem of water management was reported by most of the farmers.

The study reveals that, spreading affect of recommended technologies under NFSM-rice among the non-beneficiary respondents is slow. To speed up the adoption process, it is suggested to make appropriate interventions like campaign, exposure visit of farmers, training etc. among the non-beneficiary farmers. Based on the findings of the study, it is recommended that improved technologies in the form of high yielding varieties should be made available to farmers. SRI may be recommended for irrigated *Boro* rice instead of practicing in kharif season. Farm service centre should be establish within reasonable distance from farming communities which will bring technologies closer to farmers, thereby reducing the risk that farmers have to encounter to get farm inputs. It is imperative to call for attention from government, policy makers, and planners to design effective rice production policy/strategy that would ensure to overcome the constraints faced by the farmers for promoting rice production and to sustain food security.

A study on performance of women entrepreneurs in agricultural enterprises in Assam

Shamima Yasmin Ali

Women constitute one half of the country's human resources so they are regarded as the "better half of the society". Our late Prime Minister Mrs. Indira Gandhi once observed that "Humanity is deprived of half of its energy and creativity if the women are neglected". In India, though women have played a key role in the society, their entrepreneurial ability has not been properly tapped due to lower status of women in the society. But the scenario is gradually changing and now almost all the fields are women inclusive. Women constitute about 48.46 per cent of the total population of the country. Women constitute nearly one half of the world's population having enormous potential. Assam accounts for 18 per cent women entrepreneurs as against 7.70 per cent in the country.

The present study entitled "A study on performance of women entrepreneurs in agricultural enterprises in Assam" was undertaken with the following objectives i) To study the socio-personal and entrepreneurial characteristics of women agri-entrepreneurs, ii) To study the entrepreneurial performance of women agri- entrepreneurs, iii) To study the relationship and association between some of the selected socio-personal and entrepreneurial characteristics with entrepreneurial performance of women agri-entrepreneurs, iv) To determine the direct and indirect effects of selected variables with the performance of women agri – entrepreneurs, v) To enlist the constraints faced by women agri-entrepreneurs in managing their enterprises, vi) To document case studies of some of the selected women agri-entrepreneurs. Data for the study were obtained from 120 respondents from 6 districts namely, Kamrup, Jorhat, Dibrugarh, Tinsukia, Sonitpur and Dhemaji with stratified random sampling. Data pertaining to the study were collected through personal interview method during the period of October, 2015 to January, 2016. The study included one dependent variables, 20 independent variables and two descriptive variables.

A large majority (65.70%) of the respondents engaged in entrepreneurial activity were from lower middle age group (31 – 50 years), followed by old age group with 20.70 per cent. A sizeable percentage of the respondents (39.20%) were higher secondary passed

followed by high school level passed (34.20%), (61.60%) were from general caste, (89.20%) were married, more than half of the respondents were from nuclear family (72.50%), (83.30%) belonged to small land holding, majority of the respondent were general member or office bearer with 41.7 per cent, cent per cent of the respondents had micro enterprises and (65.10%) of the respondents had high level of training exposure. Majority of women entrepreneurs (64.20%) had medium level of innovative proneness, (66.70%) had medium economic motivation, (68.30%) belonged to medium level of scientific orientation, 72.50 per cent had medium level of participation in decision making ability, 65.80 per cent had medium level of risk bearing ability, (66.70%) had medium level of coordinating ability, (78.30%) had medium level of planning ability, (24.17%) regularly read news paper, (53.30%) had medium level of cosmopoliteness and(66.70%) had medium level of management orientation. A large majority of respondents (100.00%) of the respondents started their business by own proprietorship in the area of weaving followed by 86.25 per cent under weaving were from rural background, 85.50 per cent and 85.00 per cent engaged in food processing and preservation and weaving respectively started their business by own capital, 57.50 per cent of the respondents invested less than Rs. 50,000/- in machineries, 60.00 per cent of respondents spent 4-6 hours in their work, (81.25%) used to sale their products by themselves, (57.50%) selected expo/ trade fair to sale their products, 86.25 per cent used public transport for their marketing. A large majority (95.83%) had low annual sales/ turnover, (99.20 per cent) had low manpower strength, (49.17 per cent) of the women entrepreneurs had low profit making and (91.67%) of the women entrepreneurs falls into the low net value of the assets category. Increase in productivity, manpower strength, profitability and net value of the assets in the year 2014-15 over 2010-11 were observed with an increase in 33.33, 12.50, 21.21 and 44.45 per cent respectively in percentage change annually.

Entrepreneurial performance under the productivity (annual sales / turnover dimension) had positive and significant correlation with age ($r = 0.198^*$), educational qualification ($r = 0.309^{**}$), marital status ($r = 0.231^*$), size of the operational land holding ($r = 0.240^{**}$), social participation ($r = 0.181^*$), extent of entrepreneurial experience ($r = 0.201^*$), magnitude of business ($r = 0.242^{**}$), training exposure ($r = 0.229^*$), innovative proneness ($r = 0.557^{**}$), economic motivation ($r = 305^{**}$), decision making ability ($r = 0.230^{**}$), risk bearing ability ($r = 0.267^{**}$), mass media exposure ($r = 0.460^{**}$), cosmopoliteness ($r = 0.297^{**}$), planning orientation ($r = 0.402^{**}$), production orientation ($r = 0.381^{**}$) and marketing orientation ($r = 0.406^{**}$) at 0.01 level of probability and 0.05 level of probability. Entrepreneurial performance of women entrepreneurs under the manpower strength dimension had positive and significant correlation with age ($r = 0.238^{**}$), size of the operational land holding ($r = 224^{**}$), social participation ($r = 0.276^{**}$), extent of entrepreneurial experience ($r = 0.297^{**}$), magnitude of business ($r = 0.234^{**}$), innovative proneness ($r = 0.290^{**}$), economic motivation ($r = 0.204^{**}$), risk bearing ability ($r = 0.215^{**}$), planning orientation (0.254^{**}), production orientation (0.281^{**}) and marketing orientation (0.186^*) at 0.01 level of probability and 0.05 level of probability. Entrepreneurial performance of women entrepreneurs under the dimension profit had positive and significant relationship with age ($r = 0.197^*$), social participation ($r = 0.196^*$),

entrepreneurial experience (r = 0.296**), magnitude of business (r = 0.189**), training exposure (r = 0.184*), innovative proneness (r = 0.290**), economic motivation (r = 0.268**), co-ordinating ability (r = 0.179*), planning ability (r = 0.181*), production orientation (r = 0.241**) and marketing orientation (r = 0.306**) at 0.01 level of probability and 0.05 level of probability. entrepreneurial performance of women entrepreneurs under the dimension net value of the assets had positive and significant relationship with age (r = 0.205**), size of the operational land holding (r = 0.204*), social participation (r = 0.331*), magnitude of business (r = 0.271**), training exposure (r = 0.179*), innovative proneness (r = 0.181*), economic motivation (r = 0.267**), risk bearing ability (r = 0.204*), co-ordinating ability (r = 0.180*), mass media exposure (r = 0.282**), planning orientation (r = 0.261**), production orientation (r = 0.245**) and marketing orientation (r = 0.197*) at 0.01 level of probability and 0.05 level of probability.

The value of co-efficient of multiple regression (R^2) jointly contributed 66.10, 69.20, 59.60 and 52.30 per cent towards the entrepreneurial performance of women entrepreneurs under annual sales, manpower strength, profit and net value of the assets dimension. The highest total effect on the entrepreneurial performance of women entrepreneurs under annual sales / turnover dimension was exhibited by family type (8.9486) followed by entrepreneurial experience (7.7387), magnitude of business (7.2969), education (3.7414) and age (2.0667).

Difficulty in finding subject – matter specialist to consult and lack of scope for skill upgradation ranked as I and II respectively followed by difficulties faced by respondents was undue interference from local / social / political organizations with rank I in social constraints, lack of coordination and team work among the staff members, lack of support from Govt./NGOs in getting financial assistance, lack of availability of good quality raw materials locally, rely on assured local market to market their products and that non-availability of own vehicle in staff management constraints, financial constraints, constraints related to resources, marketing constraints and transportation constraints were ranked I respectively. Government of India has launched different schemes like Entrepreneurship Development Programme, Trade Related Entrepreneurship Assistance and Development Programme, Micro Credit Scheme, Prime Minister Employment Generation Programme, Micro and Small Enterprise, Cluster Development Programme for over all development of women entrepreneurs in different aspects. It is imperative to call for attention from government, policy makers, and planners to design policy/strategy that would ensure to overcome the constraints faced by the women entrepreneurs for successfully managing their enterprise.

Hydroponic systems for growth, development and quality flower production

Ruby Sarma

An investigation was carried out at Department of Horticulture, Assam Agricultural University, Jorhat during the year 2016 to 2017 to find out the best hydroponic system, EC of hydroponic nutrient solution and growing media for quality flower production in Tuberose, Gladiolus and Marigold. The experiment was laid out in two factor completely randomized design with 15 treatment combinations and with three replications comprising of five different levels of hydroponic systems *viz*. S1 (NFT or Nutrient Film technique), S2 (Water culture system) , S3 (Aggregate or drip systemwith coco peat), S4 (Aggregate or drip system with sand), S5 (Aggregate or drip system with sawdust) and three different levels of hydroponic nutrient solution concentration *viz*. N1 (EC 1.0 dS/m), N2 (EC 1.5 dS/m), N3 (EC 2.0 dS/m) and one control (soil and water). Statistical analysis of the data revealed that most of the growth, flowering, root, bulb characters and physiological parameters were significantly influenced due to differences in systems of cultivation, media and nutrient concentrations (EC). Among the various levels of hydroponic systems, S2 (water culture) has shown the best results for most of the growth characters including root, bulb characters and physiological parameters in Tuberose. While, S1 (NFT) was significantly superior in most of the flower characters. The nutrient treatment N3 (EC 2.0 dS/m) has significantly improved all growth parameters except leaf length and plant height which were best in N1 (EC 1.0 dS/m). N3 treatment (EC 2.0 dS/m) was found to be the best in terms of flower and bulb characters including physiological parameters under study. However, the results of root characters were significantly superior in N1 (EC 1.0 dS/m). Hence, S1N3 (NFT + EC 2.0 dS/m) was found to be the best for Tuberose in terms of growth and flowering.

In case of Gladiolus, most of the growth characters were found to be significantly superior in S2 (water culture). This treatment was also found to be effective in terms of root, corm and physiological parameters under study. In Gladiolus, a remarkable growth, flowering and corm production was observed in the nutrient treatment N2 (EC 1.5 dS/m). It can be concluded that, the treatment combination S2N3 (water culture + EC 2.0 dS/m) was

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the most suitable treatment for Gladiolus. In case of marigold, experimental data revealed that the growth and flower characters have shown significant superiority in S1 (NFT). Whereas, S2 (water culture) has shown the best results in root and physiological characters. Among the nutrien treatments, N2 (EC 1.5 dS/m) has shown the best response in marigold in most of thegrowth characters. Early emergence of bud and flower was noticed in N3 (EC 2.0 dS/m), whereas other flower characters were found to be significantly better in N2 (EC 1.5 dS/m). The root characters of marigold were expressed at its best in N1 (EC 1.0 dS/m) whereas, the physiological characters were found to be significantly improved in N3 (EC 2.0 dS/m). Thus, from the floriculture perspective conclusion can be drawn that treatment combination of S2N2 (NFT + EC 1.5 dS/m) is optimum for quality flower production of marigold.

The experimental findings also deduced that for all crops under experiment, S3 (coco-peat) and S4 (sand) are the best media. However, S5 (sawdust) has shown the inferior result among media under study and it was at par with control in most of the observations. The statistical analysis of control *vs.* rest was shown to be highly significant in most of the observations under study. Thus, it can be concluded that different hydroponic systems, potting media along with their combinations among them exert effect on overall growth, flowering, root, bulb & other physiological
parameters in different flowering crops.

Morphological characterization, phenotypic stability analysis and value addition in marigold

Sangita Mahanta

The experiments were conducted during 2015-17 in six environments created by planting at different dates and spacings and involving 12 varieties to assess morphological characters, genetic variation, genetic diversity, genotype-environment interaction, phenotypic stability of marigold flowers and their value addition. The morphological traits contributed largely to variability in leaf colour, leaflet margin, stem colour, visibility of disc floret, flower colour, flower shape and petal edge. Significant differences were observed among the varieties for quantitative characters. The performance of the variety Seracole exhibited maximum for quantitative traits, *viz*., branches/plant (79.80), leaves/plant (256.13), flowers/plant (111.47), self life (17.66 days), loose flower life (4.93 days) and, yield (574.20g/plant, 2.41 kg/ m2 and 199.52 q/ha).The variety Seracole exhibited highest carotenoid content (290.50 ìg/g). The estimates of genotypic and phenotypic coefficients of variation and heritability revealed high genetic variation for most of the characters. High heritability with moderategenetic advance exhibited by leaves/plant, branches/plant, leaf length, fresh weight of flower, flowers/plant and yield/plant indicated that along with additive gene effect non additive effects like dominance and epistasis might have played a role in the expression of these characters.Based on D2 values, all the 12 marigold varieties were grouped into two clusters. Cluster I consisted of 11 varieties, *viz*. Pusa Narangi Gainda, Pusa Basanti Gainda, Pusa Arpita, Hajo Orange, Mumbai Orange, Hajo Yellow, Sunrise Orange, Hawaii Orange, Calcutta Orange, Calcutta Yellow, Yellow Babuda; while cluster II consisted of only Seracole. Inter-cluster distance was greater than intra-cluster distance which indicated wider genetic diversity among the varieties of the two clusters. There was significant genotype-environment (GE) interaction for all the growth and flower characters, except plant height and number of ray florets. Both linear and non-linear components contributed towards GE interaction except disc floret, for which only linear component contributed. The varieties, *viz*. Seracole, Pusa Narangi Gainda, Pusa Basanti Gainda exhibited average stability for flower yield/ha. Pusa

Narangi Gainda and Pusa Basanti Gainda showed average stability for plant height and earliness to days to bud visibility.

Among the various drying methods tested, cabinet drying gave the highest carotenoid content (337.64ìg/g) compared to the other methods. The basal diet, supplemented with fresh and dried marigold petals @12 mg carotenoid/kg diet recorded highest carotenoid content 38.82 ìg/g and 39.86 ìg/g respectively, and respective colour score 10.73 and 10.8 of egg yolk. The carotenoid content was highest in the first month with LDPE packaging materials of 400 gauge (270.47 ìg/g), 300 gauge (269.64 ìg/g) and 200 gauge (266.94 ìg/g) which decreased with advancement of storage period. The outcome of the present investigation could be considered as a basic work for this region which could provide guidance and basic information to the researchers for further value addition to marigold flowers, particularly for incorporationin poultry diet.

Efficacy of biologically and chemically synthesized silver nanoparticles for enhancing the vase life of cut flowers

Shisarenla Aier

The efficacy of biologically and chemically synthesized silver nanoparticles (AgNPs) was evaluated for their potential to increase the postharvest vase life of three cut flowers *viz*., Anthurium cv. 'Fire', Rose cv. 'First Red' and Gerbera cv. 'Antibes'. Extracts of five different medicinal plants, namely *Zanthoxylum oxyphyllum* Edgew, *Curculigo capitulata* (Lour.) Kuntze, *Chloranthus glaber*, *Perilla ocymoides* and *Lasia spinosa* (L.) Thwaites were used as reducing as well as capping agent and were compared with chemical reducing agents Sodium borohydrate and Tri-Sodium citrate along with control. 1mM AgNO3 solution was used as a source for the reducing agents to reduce silver nitrate into nanoparticles. Nanoparticles were characterized by using UV-Vis absorption spectroscopy, FTIR, XRD, DLS & TEM. TEM analysis showed the average particle size range from 10 to 50 nm. Bacteria and fungi were isolated from cut flowers and characterization of the bacterial and fungal isolates was carried out using 16S rRNA and ITS primers. BLAST results displayed homology of sequences in the range of 97-99%. The six bacterial isolates were identified as *Serratia marcescens* subsp. Sakuensis (AR1), *Alcaligenes faecalis* subsp. Faecalis (AR2), *Alcaligenes faecalis* (AR3), *Pseudomonas putida* (AR4), *Pseudomonas putida* (AR5) and *Bacillus* sp. (AR6) and the six fungal isolates were identified as *Aspergillus flavus* (SAPB1), *Rhizomucor variabilis* (SAPB3), *Fusarium proliferatum* (SAPB4), *Fusarium equiseti* (SAPB5), *Fusarium fujikuroi* (SAPB6) and *Nigrospora oryzae* (SAPB7). Inhibition assay was performed for both bacterial and fungal isolates and treatment T2 (50 ppm AgNP2) was found to be the best compared to other treatments against the isolates. Thereafter, the seven best concentrations of synthesized AgNPs along with 20 ppm AgN03 + 4% sucrose and control flowers were placed as vase treatments. All levels of AgNPs significantly prolonged the vase life compared to control. The microbial growth was suppressed which resulted in increase in the vase life of the flowers treated with AgNPs.

Abstract of Ph.D. Thesis

Department : Horticulture

Major Advisor : : Dr. P. K. Borthakur

Postharvest parameters *viz.,* relative fresh weight, vase solution uptake, days taken for bud opening, open flower diameter, days taken for drooping of flower head, days taken for discolouration of flower heads, days taken for first fall of petals and determination of vase life of florets were taken into consideration while evaluating the vase life of the flowers. Total soluble solids (TSS) and membrane stability index (MSI) showed an increasing trend from 3rddday to 5th day but a sharp decline from 10th day onwards. Among AgNPs treatment the most effective treatment was T3 (50 ppm biological AgNP2+ 4% sucrose) compared to all other treatments and control.

Characterization and evaluation of some turmeric (*Curcuma longa* L.) genotypes of north eastern region of India

Solei Luiram

A field experiment was conducted at Horticulture Experimental Farm, AAU, Jorhat, Assam for two consecutive years (2015 & 2016) to characterize and evaluate the performance of thirty one (31) turmeric (*Curcuma longa* L.) genotypes of north eastern region of India along with two check varieties. The experimental materials were collected from farmer's field of all the eight north eastern states of India. The experiment was laid out in Randomized Block Design with 3 replications. The individual plot size was 1.5m x 1.5 m with plant to plant spacing of 30 cm x 30 cm accommodating 25 plants per plot.

In the present study, all the growth parameters at different growth stages showed significant variations due to genotypes. The effect of year was found significant for leaf length at 105 DAP, leaf width at 75, 105 and 135 DAP, number of leaves per hill and number of leaves per main shoot at 75 DAP, number of leaves per tiller at 75, 105 and 135 DAP, number of tillers per hill and plant height at all the growth stages. However, the effects of interaction between the genotypes and year were significant for number of leaves per tiller at 75 DAP, number of tillers per hill in all the growth stages and plant height at 165 DAP.

Significant variations in both the fresh and dry rhizome yield per hectare were observed among the different genotypes evaluated. The maximum fresh rhizome yield was recorded in the genotype TMN-2. While the minimum was recorded in the genotype TAS-14. However, the dry rhizome yield was found highest in the genotypes TPR-2 while the lowest dry rhizome yield was recorded in TNL-1. Significantly high variation was noticed for dry recovery and harvest index showing the highest in the genotype TPR-2 and Check-2 variety respectively and the lowest was recorded both in the genotypes TAS-6.

The high significant variations in the curcumin and oleoresin content among the different genotypes studied were observed due to genotypes. The highest curcumin content was

recorded in the check-2 variety and the lowest curcumin content was observed in the genotype TAS-3 (1.72 %). The oleoresin content in the present study ranges from 7.63 % to 17.52 %.

The correlation study showed that the plant height, leaf length and leaf width at 105, 135 and 165 DAP, length of mother and primary rhizome, finger rhizome per plant, weight of mother, primary and secondary rhizome, LAI at 135 DAP and LAD were found significant and positively correlated with rhizome yield of turmeric. Thus, these characters maybe considered very important factors in selecting the genotypes for increasing the yield of turmeric in any improvement programmes.

Summarizing the PCV, GCV, heritability and genetic advance characters, it could be concluded that the genotypes giving higher values of these characters might be given more emphasis and hence better selection process for further crop improvement programme. Thus, the result of the present study demonstrates that there existed wide variability among different turmeric genotypes of north eastern region of India indicating high potential for effective crop improvement through breeding as the genotypes in this region are good sources of genes for many desirable traits.

The promising genotypes, viz. TMN-1, TMN-2, TNL-2, TNL-4, TML-1, TPR-1, TPR-2, TAP-2, TSK-1, TAS-4, check-2 variety and TAS-10 gave high fresh rhizome TML-3, TPR-2, TAP-2, TAS-5, TAS-6, TAS-7, TAS-8, check-2 variety and TAS-14 variety gave appreciable yield per hectare in the range from 306.11q/ha to 413.89 q/ha whereas, the genotypes TML-1, TML-2, amount of curcumin contents in the range between 5.11 % to 6.51 % which were encouraging and thus suitable for commercial production of turmeric in the north eastern region of India.

Effect of biotic and abiotic factors on morphology and morphometry of *Meloidogyne incognita*

Rimi Deuri

Studies were conducted to observe the effect of biotic and abiotic factors on morphology and morphometry of *Meloidogyne incognita*. Five crops *viz.*, tobacco, castor, tea, citrus and neem were inoculated with *M. incognita*. In neem plants, no infestation was found, while in citrus plants, development of female was inhibited. Second stage juveniles (J_2) in castor population showed small and short hyaline tail terminus than original population (tomato). Smaller females were observed in castor and tea populations as compared to the original population. In case of perineal patterns of different host plants, variation was observed in tobacco population with faint broken lateral line. On the basis of C.V. value of J_2 (1.78-23.40%), the lip width, 'a', 'b¹' and 'c' ratios from the different plants were found as variable characters, while the body length, stylet length, 'b' ratio and MB were stable characters (C.V. 2.27-10.54%). The body length, stylet length, LMB and WMB of mature female were observed as stable characters (C.V. 3.08-11.09%), while body width and neck length were variable characters (C.V. 10.13-34.03%). The morphometric characters of perineal pattern from the different hosts were found as stable with C.V. 2.83-10.8 per cent.

The morphology and morphometric variations of root knot nematode *Meloidogyne incognita* were studied at three different soil pH levels *viz.,* pH 4.2 (acidic), 7.0 (neutral) and 8.1 (alkaline). The effect of pH levels on morphology of *M. incognita* second stage juvenile showed variation in tail shape and size, while other morphological characters showed no variation. Acidic population of J_2 showed comparatively short hyaline tail terminus than other populations. The acidic and alkaline populations were observed to be smaller than original population in relation to body length and body width. The body length, stylet length, lip width and 'b' ratio were observed as stable characters (C.V. 2.29-11.54%). The MB of J_2 in neutral population (mean 55.3 µm) was higher than original population (mean 49.7 µm). Smaller body size of mature female was observed at acidic and alkaline pH levels. The neck length of mature female was found as moderately variable character (C.V.7.07-17.55%). The morphometric characters of perineal pattern at different pH were stable (C.V. 3.84-9.14%).

Abstract of Ph.D. Thesis
Department : Nematology
Major Advisor : : Dr. P. Das

Geographical variations of *M. incognita* were studied from fifteen district of Assam. The morphological variations of *M. incognita* among the populations exhibited only in tail shape. The tail shape of *M incognita* second stage juveniles in Kamrup and Dibrugarh were observed having larger tail with short hyaline region. The lip height of J_2 was recorded with 3 µm in most of the population *viz.,* Sonitpur, Kokrajhar, Karbi Anlong, Marigaon, Borpeta and Goalpara. The major morphometric characters of second stage juveniles were moderate to highly variable except the stylet length and lip height (C.V. 2.74-20.21%). The perineal pattern of Dhemaji population showed high squarish dorsal arch while, weakly formed lateral line was observed in Karbi Anglong. On the basis of C.V. value (3.51-11.42%), the AVS and LVS of perineal pattern were found as stable characters, while the length and width of perineal pattern were moderately variable (C.V. 1.0-15.49%). Male population were found in five district of Assam. The body length (C.V. 5.06-26.68%) and 'a' ratio (C.V. 4.44-28.79%) of male were found as highly variable characters, while the stylet length and MB were stable characters (C.V. 4.16-9.52%).

North Carolina host test for race identification of *M. incognita* were done from six population *viz.,* Jorhat, Lakhimpur, Nagaon, Sonitpur, Karbi Anlong and Kokrajhar districts of Assam. Based on the reaction of differential host to *M. incognita* the population of Jorhat, Lakhimpur, Sonitpur and Kokrajhar were identified as race 2.

Development of an organic module for the management of root-knot nematode, (*Meloidogyne incognita*) in cucumber

Th. Sunita Devi

Study on the efficacy of commercially available bio-agents against root-knot nematode (*Meloidogyne incognita*) on cucumber, under field condition exhibited significant difference over the control in respect of plant growth parameters and yield of cucumber. All the treatments significantly increased the plant growth characters of cucumber and reduced the multiplication of *M. incognita.* However, application of *Trichoderma harzianum* @ 30kg talc formulation/ha was found to be the best in suppressing the nematode population (20.62%) in soil and increased the yield of cucumber (26.02%), with a C:B of 1:2.41.

Study on the potentiality of organic amendments against root-knot nematode (*Meloidogyne incognita*) on cucumber, under field condition showed that all the organic amendment at different doses were effective in increasing plant growth parameters and yield of cucumber and reducing number of galls, eggmasses and egg per eggmasses and nematode population in soil. Application of neem cake @ 1000kg/ha was found to be the best in increasing plant growth parameters and yield of cucumber. Application of FYM @ 1.5t/ha was highly economically beneficial with a C:B ratio of 1:2.8 as compared to neem cake @ 1000kg/ha (1:1.30). However, application of poultry manure @ 2.5t/ha added high amount of organic carbon, nitrogen, phosphorus, potassium and increased pH content in soil. In case of ashes, application of rice husk ash @ 30g/plant was found to be the best in increasing plant growth parameters and increased the yield (21.64%) and reducing final nematode population (64.30%) in soil. This treatment was found to add high amount of organic carbon, nitrogen, phosphorus and potassium. Application of rice husk ash @ 20g/ plant was found to increase the pH content.

Study on development of organic module for the management of root-knot nematode (*Meloidogyne incognita*) on cucumber, under field condition showed that all the treatments differed significantly over the control in respect of increasing plant growth parameters and

yield of cucumber and reducing nematode population. Combined application of *T. harzianum* @ 30kg talc formulation/ha + neem cake @ 1000kg/ha + rice husk ash @ 30g/plant was found to be the best in suppressing the nematode population in soil. The treatment with *T. harzianum* @ 30kg talc formulation/ha+ neem cake @ 1000kg/ha + rice husk ash @ 30g/plant was found to add high amount of organic carbon, nitrogen, phosphorus and potassium, while the treatment rice husk ash @ 30g/plant was found to increase pH content.

Genome analysis of root traits in indica rice in relation to drought tolerance

Harendra Verma

The present investigation was conducted to study genetic variation & diversity for root traits associated to drought tolerance, allelic variation and the expression analysis of major aquaporin genes and identification of markers for root traits linked to drought tolerance in 160 genotypes of rice. One way ANOVA of herbicide score using buried herbicide technique (BHT) of 160 genotypes for different dates exhibited that F value and heritability both increased from 41DAS and after that it slowly decreased. A significant positive rank correlation (0.173) between drought tolerance and mean herbicide phytotoxicity at 55 DAS was observed. BHT is important technique for rapid screening of genotypes for root vigour and root depth. Drought sensitivity leaf scoring revealed that Banglami, ARC10372, Inglongkiri, Bizor, Bizor-2, As 38/2 and Horin kajuli are the drought tolerant genotypes. The 114 genotypes taken for genetic divergence analysis differed significantly with regards to the 15 characters studied using PVC pipes. The genotypes differed significantly for root traits, drought tolerance and recovery. In the present study Inglongkiri, ARC 10372, Horin Kajuli, Bizor and Banglami (local drought tolerance check) genotypes exhibiting drought tolerance bearing long roots, high root volume system. Path analysis revealed that selection for root volume, fresh root weight, dry shoot weight and root:shoot ratio traits will be effective for improvement of drought tolerance. D^2, Path analysis and PCA have identified five important characters *viz.,* root volume, dry shoot weight, fresh root weight, drought tolerance and recovery. A set 114 diverse rice germplasm lines using diversity and genetic relatedness. AMOVA revealed that population is divergent. The value of PIC ranged from 0.18 (RM480) to 0.75 (RM474) with an average of 0.507 for all the genotypes under study. Populations were diverse and markers mediated diversity is better than D^2 diversity analysis in depicting the diversity in the present genotypes. Selection of parents based on their performance and diversity need to be consider for heterosis. Primers form *OsSIP1;1* genes has amplified two allele and allelic variation difference is correlated with drought tolerance. Primer from *OsSIP1;1* can be used in selection for root traits associated with drought tolerance. Aquaporin gene might play important role in root development under water stress situation to overcome stress situation. Gene expression and drought tolerance showed a close correspondence based on qPCR analysis of few major aquaporin genes. Marker trait association analysis identified several QTLs for root, shoot parameters and drought tolerance.

Genetics of adaptive traits in rice (*Oryza sativa* L.) under aerobic condition

Hrishikesh Ojah

An investigation on genetic improvement of rice had been taken up to study the performance of few genotypes, their heterosis and combining ability, character association and nature of gene action under aerobic condition. The experiment was carried out at the experimental field of Sarat Chandra Sinha College of Agriculture, Assam Agricultural University, Dhubri during 2015 and 2016 spanning over four seasons. Evaluation of fifteen rice genotypes comprising ten traditional cultivars and five high yielding varieties both in aerobic and irrigated lowland situations revealed sufficient variability and interaction of the genotypes with the environment.

Combining ability analysis in Line x Tester design involving 10 lines of traditional upland genotypes and 5 testers of HYV, revealed importance of both additive and dominance effects. Three lines (Banglami, Nagina 22 and Tamdao) and three testers (Luit, IR 36 and Gopinath) were identified as good general combiner, while six crosses were identified with specific combining ability (SCA) effect for higher number of characters. Days to anthesis, days to maturity, plant height and height growth rate were found to have significant SCA and heterobeltiosis in favourable direction in higher number of crosses. Four crosses *viz*. Aus Jaria/ IR 36, Kasalath/IR 36, Dimrow/KMJ-13A-6-1-2 and Tamdao/IR36 recorded heterobeltiosis for maximum number of characters (4 each). Significant correlation was observed among mean, heterobeltiosis and SCA for most of the characters. Genetic parameters estimated in Line x Tester experiment revealed that number of productive tillers, plant height and proline content were highly amenable for improvement, whereas, high genetic variability existed for proline content, root shoot ratio, number of productive tillers and grain yield. Significant correlation with grain yield existed for 3 characters (number of productive tillers, spikelet fertility and chlorophyll content) apart from sufficient inter correlation among various adaptive characters. Path coefficient analysis revealed the highest positive direct effect of root weight (1.65) on grain yield, followed by spikelet fertility (1.43) and plant height (0.92). Harvest index (1.25) through spikelet fertility exerted the highest indirect effect, followed by panicle harvest index (1.07) through spikelet fertility.

Generation mean analysis was carried out in three selected crosses *viz.* Banglami/ Luit, Koimurali/Luit and Guni/Gopinath, involving six generations (P-$_1$, P$_2$, F$_1$, F$_2$, BC$_1$ and BC$_2$). The individual scaling tests were used to test the adequacy of additive dominance model. The gene effects were estimated using three parameter model (joint scaling test) suggested by Cavalli (1952) and six parameter model suggested by Haymen (1958). The analysis of variance among different generations of different crosses revealed significant variation for most of the characters indicating considerable variability in the material studied. All the characters except height growth rate in cross II, recorded significance for at least one of the four individual scaling tests in all the 3 crosses. Estimation of different gene effects and their interactions revealed significant positive additive effect for plant height and height growth rate in all the three crosses. Preponderance of dominance effect in the expression of height growth rate, spikelet fertility, grain yield, harvest index, root weight and root shoot ratio was evident from the significant positive dominance (h) effect in all the three crosses. With respect to interaction effects, all the characters except height growth rate in cross II, exhibited significant interaction effect for one or more epistatic interactions i.e.[i], [j] or [l] in all the three crosses studied. It is evident that for all the yield and other adaptive traits, additive, dominance and interaction effects were present indicating the complex inheritance of the traits under aerobic condition. On the basis of estimation of various parameters under 3 different sets of experiment over 4 seasons, plant height, shoot weight, number of productive tillers, spikelet fertility, proline content, days to antheis and days to maturity were identified as important adaptive traits to be considered for further improvement of aerobic rice.

Characterization of selected *winter* rice (*oryza sativa* l.) genotypes for nitrogen use efficiency

Shantanu Das

In the present investigation, a panel of 26 winter rice genotypes including land races and improved varieties were evaluated under various N levels during Kharif 2014 and 2015 with the objective of identifying high yielding N use efficient genotypes for N limiting and/or non-limiting environments. Pooled analysis of variance revealed significant genotypic differences for all the characters. Among the genotypes, Lothabor, Kolabor, Luhasali, Aki Bora, Betguti Sali and Gitesh were found to be promising for grain yield and NUE. High estimates of GCV were recorded for root volume, root dry weight, nitrate reductase activity and flag leaf area. High heritability coupled with high GA were recorded for root volume, stem starch content, flag leaf length, flag leaf area, plant height, culm length and 1000-grain weight indicating the importance of additive gene action for these traits. The D^2 statistics grouped all the genotypes into 4 clusters, and the highest inter-cluster distance was found between cluster III and IV followed by cluster I and III. Hybridization involving the genotypes of clusters I and IV showing the highest mean values for most of the important characters are expected to produce desirable recombinants for N use efficiency and related traits. The principal component analysis generated 4 PCs explaining 83.273% of the total variability, whereas PC 1 is the largest contributor to the total variation followed by subsequent components. Correlation and path analysis revealed the importance of biological yield, N utilization efficiency, harvest index, grain N and panicle length as selection criteria for genetic improvement of yield in rice. Regression analysis revealed that the environments created by graded N levels were effective in inducing environmental variations for screening NUE in rice. The stability analysis identified 4 genotypes namely Kolabor, Aki Bora, Ronga Bora and Luhasali as suitable to grow under both N limiting and N non-limiting environments, whereas Betguti Sali was suitable for N non-limiting environments. Correlation analysis based on stability parameters revealed that yield stability is contributed by the plasticity of some other component traits. Characterization of N environments for NUE screening revealed that N60 would be the suitable dose to evaluate the genotypes for grain N content. A low N level was the best to screen the genotypes for PNUE. The genotypes for NUtE and NHI

could be evaluated at both N limiting and N non-limiting environments. Phylogenetic analysis involving the NUE related traits and grain yield suggested that the clustering pattern for Mohmda Nneng, Khauji, Betguti Sali, Myochang, Lothabor, Bhog Prasad and Manohar Sali was independent of the N levels. Hybridization programme could be undertaken among the diverse genotypes to achieved high yielding N use efficient genotypes. Kolabor, Aki Bora, Ronga Bora and Luhasali having high yield and stability for yield and NUE related traits could be used in breeding stable genotypes for both N limiting and non-limiting environments, whereas, Betguti Sali may be utilized in the breeding programme for developing N responsive high yielding varieties.

Development of IPDM module for cultivation of brinjal

Gunadhya Kumar Upamanya

Brinjal growers of Assam completely depend on the chemocentric cultivation practices to combat harmful pests and diseases, which not only increase the cost of cultivation but also affect consumers with pesticide residues. Moreover, the indiscriminate use of chemical pesticides, fertilizer etc. also causes harm to the environmental matrix. Development of an alternative eco-friendly IPDM module for sustainable production of the crop is the need of the hour. The present study was done on development of a consortia of phytopathogenic biocontrol agent, entomopathogens together with application of the consortial formulation biofertilizers with an aim to get a combine effect against diseases, pests and simultaneously supply of major nutrients for organic cultivation of brinjal. *In vitro* dual culture study showed that out of six (6) biocontrol agents *T. harzianum* showed marked inhibition against *Rhizoctonia solani* (74.44%), *Fusarium solani* (70.68%)*, Alternaria melongenae* (72.48%), *Sclerotinia sclerotiorum* (69.15%) and *Phomopsis vexans* (77.82). In another *in vitro* study done in pot condition, *M. anisopliae* (@1X10^8 spores/ml of water) was found better in reduction of population of sucking pests like aphid (64.87%), jassid (57.74%), and white fly (63.80%). On the other hand, *B. bassiana* was found better for *hadda* beetle with 67.16% reduction in population. *B. bassiana* was also found to be the superior in reduction of brinjal shoot and fruit borer (per cent shoot infestation=9.34, Percent fruit infestation by number=11.73 and by weight=14.32). Compatibility study done by coculture method showed that amongst the tested biocontrol agents, T. *harzianum* and two entomopathogens viz., *B. bassiana* and *M. anisopliae* were found to be compatible. Based on the *in vitro* study a liquid consortial formulation with three best biocontrol agents viz., *T. harzianum, B. bassiana* and *M. anisopliae* was prepared with already standardized additives (Department of Plant Pathology, AAU, Jorhat). Shelf life study showed that the consortia can retain 45% viability up to 6 months at room temperature and up to 54% at 4^{0}C and 64% viability at -20^{0}C for a year. Pot and field experiment conducted at Mycology Research Section and organic block of Experimental Farm, Department of Horticulture, AAU during 2014-15 to test the efficacy

of six different IPDM modules showed that module-6 (seed treatment + seed bed treatment in nursery + soil application in main field + seedling dip treatment with consortia of biofertilizer, *Rhizobium* sp, *Azotobacter* sp strain 52, *Azospirillum* sp strain 71 and *Bacillus* sp strain 5 W + spraying of BCA) was the best in the management of pests (aphid, jassid, *hadda* beetle and brinjal shoot and fruit borer) and diseases (*Phomopsis* leaf blight and fruit rot, *Alternaria* leaf spot, *Fusarium* wilt) of brinjal. Field experiment was conducted at KVK, Barpeta during 2015-16 to study the efficacy of the six modules against pest and disease management and growth parameters of brinjal and module 6 was found best for controlling pest and disease incidence with increased growth parameters and yield of the crop. Result of pooled analysis of field experiment showed an yield of 570.97 q/ha with B:C ratio 3.99. The module was also found effective in improving the nutrient status with significant increase of P and K status of soil and with microbial biomass carbon in both the years of experiment (2014-15 and 2015-16). Further, the module was tested in farmer's field as OFT and comparison was made with farmer's practice i.e, use of cypermethrin 10% EC and carbendazin 50% WP and chemical fertilizer @ NPK 50:50:50 kg/ha. Result showed that the developed IPDM module can curb the pests and disease complex of brinjal with farmer's practice (application of chemical pesticides). An yield of 442.10 q/ha with B:C ratio of 3.48 was obtained in the best module which was at par with the farmer's practice (yield= 449.56 q/ha and B:C ratio= 3.12). Post treatment nutrient status and physical properties of soil was found statistically non significant except the status of P which was significantly higher in farmer's practice. However, the soil microbial biomass carbon was found statistically superior in the tested module (834.10 ìg/g of soil) over farmer's practice (351.74 ìg/g of soil) and control (362.56 ìg/g of soil).The module can be used by farmers for organic cultivation of brinjal after multilocational field trial in different agroecological condition of Assam.

Bioremediation and management of bacterial blight of rice with compatible   consortia of arsenic degrading bacteria and plant growth promoting microbes

Kuldeep Talukdar

Microorganisms influence the fate of heavy metals in the environment. Increasing anthropogenic and irrigation activities had escalated the risk of arsenic pollution in crop fields and this has added new thoughts for research workers to explore microbial transformation as a tactic to achieve arsenic bioremediation. Present study was made to exploit the potential of arsenic absorbing bacteria (AAB) and develop consortial formulation with plant growth promoting *Pseudomonas fluorescens Pf-1* for bioremediation of arsenic and management of bacterial blight (BB) of rice in Assam. Out of six *Bacilli* bacteria isolated from arsenic contaminated soils of Assam, two *Bacilli* showing phylogenetic similarity with *Paenibacillus* sp. and *Bacillus cereus* had potential for arsenic bioremediation. The two *Bacilli* strains could tolerate 1000ppm of arsenic with 98.30 and 97.68 per cent absorption ability, respectively. Talc based consortial bioformulations were prepared using these arsenic absorbing microbes along with *P. fluorescens Pf-1* and field evaluated for management of bacterial blight of rice along with arsenic bioremediation. Significantly highest reduction of bacterial blight severity (41.11%) and highest reduction of arsenic (17.56ppm) was recorded with the treatment comprising consortial formulation of *Paenibacillus* sp. and *Pseudomonas fluorescens Pf-1*. Population dynamics of the bioagents in different bioformulations were assayed upto 90 days for their compatibility assessment in sterilized and unsterilized soil conditions. Significantly higher population count of *Paenibacillus* sp., *Bacillus cereus* and *P. fluorescens Pf-1* was recorded upto 90 days of soil inoculation in both sterilized and unsterilized soil depicting positive compatibility of the microbes in varied soil micro-environmental conditions. The consortial formulation of *Paenibacillus* sp. and *Pseudomonas fluorescens Pf-1* also significantly enhanced yield of rice (24.67g/plant) as well as other yield attributing characters of rice plant. Enzymatic assay experiment tested the activity of glutaredoxin-dependent arsenate reductase (glutaredoxin 2 from *E. coli*), with NADPH/arsenate being the electron donor/acceptor. Compared to the control without protein extracts or glutaredoxin, arsenate reduction by *E. coli* glutaredoxin 2 was observed, with absorption decreasing at a rate of 0.0012 ABS/min.

Reaction of aromatic and glutinous rice genotypes against Sheath rot (*Sarocladium oryzae*) disease and its management with IDM Module

Manjay Singh

Sheath rot of rice caused by *Sarocladium oryzae* (Sawada) Gams and Hawksworth, has gained the status of major disease of rice, and yield losses varies from 9.6 to 85%. The present investigation was under taken to identify the resistant genotypes/cultivars as a donor gene for the development of HYV and to evaluate the efficacy of different IDM Modules for management of sheath rot of rice. The sheath rot disease sample was collected from the rice field of Regional Agriculture Research Station, Titabar. The isolates were cultured, purified and mass culture was prepared in half boiled rice grain, and single grain insertion method was followed for inoculation in aromatic and glutinous rice genotypes/ cultivars. Among the genotypes/ cultivars that were screened, eight entries showed resistant reaction from aromatic rice and five entries showed resistant reaction from glutinous rice genotypes/ cultivars. The physiological parameters were evaluated in both resistant and susceptible genotypes/ cultivars of both aromatic and glutinous rice. The resistant entries possess a higher concentration of phenol, protein and lower concentration of starch and sugar as compared to the susceptible one. The total phenol concentration was increased in, Resistant (R), Moderately resistant (MR), Moderately susceptible (MS) and decreased in susceptible genotypes/ cultivars after infection. Similarly, protein, starch, and TSS were found to be decreased in all the categories of genotypes/ cultivars (R, MR, MS, S). However, maximum reduction was observed in susceptible genotypes/ cultivars after infection. The interaction among the stem attacking fungal pathogens showed that *Sarocladium oryzae* suppresses the growth of *Rhizoctonia solani* and *Sclerotium oryzae*. in both *in vitro* and *in vivo*, while *Sclerotium oryzae* was more sensitive against *Sarocladium oryzae* as compared to *Rhizoctonia solani*. Among the modules that were evaluated for management of sheath rot disease of aromatic and glutinous rice. PDI and PDS were significantly reduced and increase of growth parameters and yield, in the entire module as compared to the inoculated control. However, the maximum reduction of PDI, PDS and increase of growth parameters

and yield were recorded in Module- 2, where seeds were treated with carbendazim @ 2g/ kg of seed, soil application of *Pseudomonas fluorescence* @ 2.5kg/ha (2.5kg +50kg FYM) and 50% of potash of recommended dose at tillering stage along with Foliar spray with Carbendazim @ 0.2% after 30 days of transplanting and Foliar spray with Bioveer @ 2% at booting stage.

Molecular characterization of *Fusarium oxysporum* f.sp. *cubense* causing Panama wilt of Banana and its management through consortia approach

Neethi Baruah

Considering the importance of Panama wilt of Banana caused by *Fusarium oxysporum* f.sp. *cubense* in Assam, a research programme was undertaken to study the diversity of the pathogen, if any and exploring beneficial microorganisms against the disease. The study revealed that *F. oxysporum* f.sp. *cubens*e (Foc) varied in terms of morphology, cultural characteristics, Vegetative Compatibility Grouping (VCG) and also at molecular level. VCG analysis has proved that the Foc cultures belonged to VCG 0124 and 0125, indicating the presence of Race 1 of Foc in Assam. Under molecular analysis, the ISSR primers 890, 842, $(GAC)_5$ and CCA $(TG)_5$ T showed good polymorphism and the diversity analysis indicated presence of two major clusters (A and B) of Foc. The phylogenetic tree clearly showed that all the Foc isolates were originated from major cluster 'A' – signaling a strong ancestral relationship among the Foc isolates to Race 1. Of the collected rhizospheric and endophytic microbes, 10 rhizospheric isolates were found to be effective at different levels and out of the 10 isolates, three *Trichoderma harzianum* isolates from different locations with compatible interactions *inter se* were found more effective against Foc *in vitro*. In another study to record the efficacy of the three *T. harzianum* isolates against Foc individually and in combinations, it was observed that the efficacy of the *T. harzianum* isolate from Bartari area under Kamrup Rural district was found to be the best with significant difference with other treatments. The effect of that isolate of *T. harzianum* was further studied against Panama wilt disease in a hot spot and significant difference was observed under the treatment in controlling the disease.

Genetic diversity of *Banana Bunchy Top Virus* (BBTV) prevalent in Assam and its sustainable management strategy

Nilakshi Kakati

Banana bunchy top disease (BBTD) is the most serious and devastating viral disease of banana (*Musa* spp.) caused by a multi component ssDNA virus *Banana Bunchy Top Virus* (BBTV) which is persistently transmitted by banana aphid *Pentalonia nigrnervosa* from plant to plant and by man from place to place through infected vegetative planting material. Field surveys were carried out in 8 banana growing districts *viz.,* Jorhat, Sonitpur, Golaghat, Morigaon, Nagaon, Kamrup Metro, Kamrup Rural and Goalpara comprising four agroclimatic zones of Assam to determine the incidence of BBTD. Altogether 512 samples were collected from six different banana cultivars *viz.,* Jahaji (*Musa acuminata* Colla.), Malbhog (*Musa paradisiaca* Colla.), Chenichampa (*Musa acuminata* Colla.), Grand Naine (*Musa acuminata* Colla.), Kachkol (*Musa sapiantum* L.) and Bhimkol (*Musa bulbisiana* Colla.). Banana plants exhibiting the characteristic symptoms, such as bunched appearance at the top of the plant with narrow, upright and erect leaves, which were yellowed at the margins, stunting of plant, presence of small dark green streaks on the petioles, leaf lamina, midrib and pseudostem were observed on BBTV infected plants. Survey results indicated prevalence of the vector *Pentalonia nigrnervosa* in the region.

Molecular detection of BBTV was carried out using nucleic acid based polymerase chain reaction (PCR) method with six different primer pairs for the six components of BBTV (DNA1 to DNA6) genome. All the six primer pairs detected the BBTV positive samples giving a band size of 1111 bp for DNA 1, 1058 bp for DNA 2, 1075 bp for DNA 3, 1046 bp for DNA 4, 1018 bp for DNA 5 and 1089 bp for DNA 6 .The results showed 224 banana leaf samples infected with BBTV indicating 43.75 per cent diseases incidence in Assam. Results revealed presence of BBTV in all the surveyed districts of Assam showing a high incidence of 50.00 per cent BBTV infection in Kamrup Metro district followed by 47.13 per cent in Morigaon district and the percentage of positivity was more in higher age groups *viz.,* 5-11 months and > 11 months of plants followed by lower age group (<5 months old plants). This indicated prevalence of BBTV was more in matured and older plants.

Among the different banana cultivars, Jahaji showed a significantly high BBTV infection of 70.83 per cent followed by Chenichampa (56.82%), Malbhog (49.07%), Grand Naine (37.84%), Kachkol (27.50%) and Bhimkol (0.00%). The results of PCR revealed that in all the eight districts Bhimkol is free from BBTD incidence**.** Partial sequencing of twelve PCR products were done and sequence similarity of these BBTV isolates were compared with different known BBTV isolates of India and abroad using nucleotide BLAST programme at National Centre for Bioinformatics. The sequence similarity and phylogenetic analysis showed 86.00 to 99.00 per cent similarity with known isolates of Pacific Indian Ocean (PIO) group members of BBTV. However, two BBTV Assam isolates (BBTV2CcDNA2 and BBTV2MbDNA2) showed 94 to 95 per cent similarity with members of South-East Asian (SEA) group of BBTV**.** This give an indication of prevalence of genetic distinctiveness of BBTV Assam isolates with known Indian (under PIO group) isolates.

Study was made for *in vitro* evaluation of compatibility of three entomopathogenic fungi *viz., Beauveria bassiana* (Bals.) Vuill., *Metarhizium anisopliae* (Metchnikoff) Sorokin and *Verticillium lecanii* with three pesticides used in banana production system to develop a suitable management strategy against banana aphid in field. The pesticides were used in three different concentrations *i.e.,* recommended dose (RD), half of the recommended dose (½ RD) and one fourth of the recommended dose (¼ RD). *V. lecanii* was found highly compatible with all the pesticides followed by *B. bassiana*. The concentration ¼ RD of all the insecticides were found safe showing higher mycelial growth of the biocontrol agents. Imidacloprid (17.8% SL) at 0.025 % showed no inhibition (0.00 %) of the fungus *V. lecanii* followed by 9.81 per cent to the fungus *B. bassiana* . Dimethoate (30 EC) at 0.05% showed maximum inhibition of 21.25 per cent of the fungus *V. lecanii* followed by 27.81 per cent to the fungus *B. bassiana*. The botanical insecticide Azadirachtin at 0.075% showed maximum inhibition of 22.94 per cent of the fungus *V. lecanii* followed by 35.19 per cent to the fungus *B. bassiana.* In the field, banana plants treated with foliar spraying of Imidachloprid @ 0.1% at 60, 90, 120 and 150 days after planting (DAP) showed no BBTD incidence (0.00 %), zero insect vector population count (0.00 no.) and highest yield of banana (42.67 kg/plant in 2013-14, 44.42 kg/plant in 2014-15 and 43.55 kg/plant in pooled data, 2013-15) in all the cropping seasons followed by banana plants treated with foliar spraying of Azadirachtin @ 0.3% at 60, 90, 120, 150 DAP showed low BBTD incidence of 16.67 per cent in 2013-14, 8.33per cent in 2014-15 and 12.50 per cent in pooled data, 2013-15 and produced yield of 34.13 kg/plant in 2013-14, 38.00 kg/plant in 2014-15 and 36.07 kg/plant in pooled data, 2013-15. Insect vector banana aphid population was recorded in the range of 0.00 to 10.67, average 3.28 (2013-14), 0.00 to 9.33, average 2.67(2014-15) and 0.00 to 10.75, average 3.39(pooled data,2013-15).Whereas in untreated control (banana plants without any spraying of pesticides) recorded the highest BBTD incidence 100 per cent (2013-14), 91.67 per cent (2014-15)and 95.84 per cent (pooled data, 2013-15) with a corresponding lowest yield of banana (0.83 kg/plant in 2013-14, 0.92 kg/plant in 2014-15 and 0.88 kg/plant in pooled data, 2013-15). Highest insect vector banana aphid population was recorded in the range of 0.00 to 121.67, average 25.83 (2013-14), 0.00 to 99.42, average 23.89 (2014-15) and 0.00 to 110.55, average 24.86 (pooled data, 2013-15) in untreated control plots.

Biochemical and molecular assessment of micronutrient enhanced efficacy of *Pseudomonas fluorescens* in suppression of bacterial blight of rice (*Xanthomonas oryzae* pv. *oryzae*)

Pranamika Sharma

The present study was made to isolate and screen native *Pseudomonas fluorescens* having plant growth promoting and antagonistic properties against plant pathogenic bactera. A total of 10 *P. fluorescens* isolates were collected from 54 soil samples on the basis of pigment production in Kings B media. The *P. fluorescens* cultures were also characterized on the basis of cell morphology, biochemical tests and molecular characterization to assess variation among the isolates. All the isolates were screened for their plant growth promoting (PGP) activities also. The antagonistic potential of these isolates were tested *in vitro* against *Xanthomonas oryzae* pv. *oryzae* (Xoo) the rice BB pathogen. The highest inhibition (38.05%) against Xoo was recorded against *P. fluorescens* As1 (*Pf*As1).

The isolate *Pf*As1 was selected and tested in combination with four different concentrations of four selected micronutrients (Zn, Mo, B, Fe) for their combined suppressive effect against Xoo using SPA as basal media. The highest inhibition (45.92%) was recorded in *Pf*As1 with Zn @ 50 µg/ml followed by *Pf*As1 with Fe @ 50 µg/ml (37.84%). The efficacy of different micronutrients *viz*., zinc, iron, boron and molybdenum was also tested in SPA broth at 4 different incubation periods (7, 30, 60 and 90 days) for enhanced aggressiveness of *Pf*As1. Population of *Pf*As1 treated with Zn @ 5µg, 10µg and 50µg and 100µg/ml increased when it was assayed after four different incubation periods. Highest population of *Pf*As1 (75.50 x 10^9 cfu/g) was recorded @ 50 µg/ml after 60 DOI.

Host defense responses of pot grown rice (variety-Mahsuri) was evaluated upon treatment with *Pf*As1 along with micronutrients. Disease intensity (DI) was significantly lowest (17.01%) in the treatment comprising of *Pf*As1 + Zn (50 µg/ml) in Xoo inoculated rice plant, applied as root dip and spray drenching methods, respectively. This was followed by the treatment comprising *Pf*As1with DI of 37.42 per cent. The yield attributing parameters

'shoot weight, root weight, shoot length, root length, root -shoot ratio, number of panicles, weight of panicles and 1000 grain weight' were significantly superior in the treatment with *Pf*As1 + Zn (50 µg/ml).

A defense related gene expression was studied after Xoo application in the *Pf*As1 + Zn (50 µg/ml) treated plants with inoculated control and uninoculated control to find out the host interaction at the molecular level. The qRT- PCR analyses confirmed that application of *Pf*As1 + Zn (50 µg/ml) upregulated rice defense genes *PR1a*, *PR1b*, *PR10a* and R genes *Xa1* and *Xa 26,* over uninoculated control after treating the plants with *Pf*As1 + Zn (50 µg/ml).

Development of next-gen nano-bio formulation of *Trichoderma* for seed treatment of vegetable crops

Sarodi Boruah

Trichoderma is a potential antagonistic biological control agent for the management of soil borne and aerial plant pathogens. *Trichoderma* based bioformulations has been developed by different scientists throughout the world with effective field results. Chitosan nanoparticles have various applications due to its biodegradable and non- toxic properties. It can elicit natural innate defense responses within the plant system to resist plant diseases. *Trichoderma* spp. can be stimulated for production of chitinase by addition of nano chitosan in its bioformulation. In the present study, chitosan nanoparticles were synthesized from four different fungus *viz., Fusarium oxysporum, Metarhizium anisopliae, Beauveria bassiana* and *Trichoderma viride* and one commercial product of chitosan (Sigma Aldrich) was taken for comparison. Synthesized nanoparticles were characterized by using UV-VIS Spectroscopy, Fourier transform infrared spectrometer (FTIR), Zetasizer, Dynamic Light Scattering (DLS) and Transmission Electron Microscopy (TEM). Formation of chitosan nanoparticles (NPs) were confirmed by UV-VIS spectroscopy study with absorption peaks at the range of 310.02 to 342.00 nm. FTIR study showed that synthesized chitosan NP has all the required functional groups like OH, N-H, C-H, C=O, C-O, C-N and P=O. Study on surface properties of NPs by using zetasizer resulted that chitosan NPs synthesized from *F. oxysporum, M. anisopliae, B. bassiana, T. viride* and commercial product were found to be positively charged and were stable in nature with zeta potential of 3.24, 18.6, 5.4, 9.78 and 17.6 mV respectively. Electron microscopy study showed that the shape of NP as nearly spherical. DLS analysis showed the average size of the chitosan NPs synthesized from *F. oxysporum, M. anisopliae, B. bassiana, T. viride* and commercial products as 273.20, 172.50, 78.36, 89.03 and 300.10 nm respectively. Compatibility with *T. asperellum* study showed that nano chitosan at all the tested concentrations (@ 0.01, 0.02 and 0.03 per cent) were compatible. Study on *in vitro* efficacy against three soil borne plant pathogens *viz., Fusarium oxysporum, Sclerotium rolfsii* and *Rhizoctonia solani* showed that the

combination of *T. asperellum* and chitosan NP was superior in inhibiting the mycelial growth of the tested pathogens as compared to the recommended chemical @0.1 per cent. Nanochitosan based liquid formulation of *T. asperellum* was prepared and energy dispersive X- ray spectroscopy (EDX) study showed the presence of the required elements with per cent atomic weights. Further, study on *in vitro* bioefficacy of the nanobioformulation showed highly effective result with highest radial growth inhibition percentage of 62.07, 47.85 and 63.25 per cent against *F. oxysporum*, *S. rolfsii* and *R. solani* respectively. Seeds treated with nanobioformulation @ 0.3 per cent could protect the crops upto 47.02, 50.00 and 60.00 per cent at 50 days after sowing in pea, tomato and cabbage respectively over control with significant increase in growth as well as physiological parameters.

Genomic characterization of fluorescent Pseudomonads, their biocontrol ability against bacterial wilt pathogen Ralstonia solanacearum'

Thalhun Lhingkhanthem Kipgen

Fluorescent Pseudomonads are often predominant among plant rhizosphere associated bacteria. In the present study, 290 rhizosphere soil samples were collected from six North Eastern states of India *viz.*, Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram and Nagaland with different agro-climatic conditions, assayed for the presence of fluorescent Pseudomonads using King's B medium under UV light (366 nm). Forty two bacterial isolates showed typical blue green characteristic pigmentation under UV light. On the basis of phenotypic analysis, 29 fluorescent Pseudomonad isolates were tentatively identified as *Pseudomonas fluorescens* and designated as biovar I, II, III and V having 21, 4, 3 and 1 number of isolates under these biovars, respectively. Hierarchical cluster analysis using Ward Linkage Cluster Method on the basis of phenotypic tests of 29 *Pseudomonas* isolates generated 3 distinct clusters ranging from 75 to 98 per cent similarity level. Genotypic analysis based on BOX-PCR fingerprinting revealed high degree of genetic diversity by showing 17 genotypic patterns with band size ranging from 2 to 7 between 500-4000 bp. Among these, 2 main genotypes containing 3 to 4 isolates, while 15 other genotypes showed unique patterns having 1 isolate each. Phylogenetic analysis based on 16S rDNA sequences of representative eight isolates from five states revealed high homology (94% to 99%) with different *Pseudomonas* species. Under dual culture assay *in vitro*, the isolate *Pf* 8 showed highest antagonistic potential showing 7.7 cm dia (85.6% growth suppression) on tomato *R. solanacearum*, *Pf* 4 with 6 cm dia in brinjal (67.7% growth suppression) and in case of chilli, isolate *Pf* 33 showed highest inhibition (6.5 cm dia) with suppression of 72.2 per cent growth, respectively. *In Planta* studies showed that, *Pf* 33 based bioformulation as seed, root and soil application exhibited lowest wilt incidence (2.0%) in tomato plants, 8.0 per cent in brinjal plants and 4.0 per cent in chilli plants, respectively. A negative correlation between population densities of *R. solanacearum* and *Pseudomonas* spp. as well as between *Pseudomonas* and PWI was observed. Application of *Pf 33* based bioformulation also significantly increased the yield and other plant growth characteristics of tomato (3.2 kg/plant), brinjal (5.2 kg/plant), chilli (160 g/plant) plants respectively, serving as most effective biocontrol and PGP activity against *R. solanacearum* under *in vitro* as well as *in vivo* conditions.

Screening and Evaluation of Methanotrophic bacteria from rice ecosystem

Amrita Phukan

Methane (CH_4) is an important greenhouse gas with 25 times more global warming potential than carbon dioxide (CO_2). Rainfed/wetland rice fields are one of the major anthropogenic sources of CH_4 release to the atmosphere. Therefore, there is utmost need to mitigate the methane menace. Microorganisms especially Methanotrophs play vital role for biological sink of methame through oxidation to CO_2. Considering the fact, the present study was undertaken to isolate and screen novel organisms with methane oxidising properties. A total of 28 Methanotrophic bacterial cultures were isolated from 20 different rice rhizosphere samples of Jorhat district. Altogether 11 out of 28 isolates were selected as methanotrophs on the basis of their growth in Nitrate Mineral Salt (NMS) with CH_4 as their sole carbon source. The 11 Methanotrophic bacterial cultures were characterized on the basis of cell morphology, carbohydrate utilization and the degree of susceptibility towards the antibiotics to assess variation within the cultures. All the isolates were screened for their methane oxidizing property and other enzyme activities *viz*., soluble methane monooxygenase (sMMO), particulate methane monooxygenase (pMMO) and nitrate reductase. The results showed the variation among the cultures in enzyme activities, however all the selected cultures showed methane oxidizing property to the tune of 16053.153 ± 1.333 ppm CO_2 to 1787.574 ± 0.938 ppm CO_2. Nitrate reductase and sMMO activity was also determined quantitatively for all the isolates to screen the efficient cultures. Specific activity of sMMO by different cultures ranged from 685.489 ± 0.494 nmol h^{-1} mg of protein^{-1} to 55.712 ± 0.659 nmol h^{-1} mg of protein^{-1}. The nitrogenase enzyme activity was determined to check the biofertilizer potential of the test cultures by acetylene reduction assay. The amount of acetylene reduced to ethylene by the test isolates ranged from 8.282 ± 0.240 µmole C_2H_4/ml/hr to 0.015 ± 0.003 µmole C_2H_4/ml/hr. The bacterial strains recorded varying soil enzyme activities under soil incubation study of 30 days indicating its role in maintaining soil health. Some of the enzyme activities studied were: MBC, Dehydrogenase, Phosphomonoesterase, FDA hydrolysis, arylsulfatase and urease. The test cultures showed

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variation in these properties. It was observed that methane oxidation and emission highly correlated with some of the enzyme activities. For instance, Dehydrogenase was found to be the most influencing parameter for methane oxidation ($r = 0.887, P = 0.001$) and emission ($r = -0.611, P = 0.001$). Similarly, there was a significant positive correlation between sMMO activity and methane oxidation ($r = 0.536, P = 0.001$) but a negative correlation with methane emission ($r = -0.539, P = 0.001$). Based on qualitative and quantitative evaluation, the Methanotrophic bacterial cultures were selected for pot culture evaluation taking rice as test crop. The rice seedlings were inoculated with Methanotrophic bacterial cultures and grown for 35 days. The methane flux were recorded at tillering stage using closed acrylic chamber method. Methane flux recorded for different strains along with uninoculated control ranged from 3639.504 ± 2.254 µg CH_4/m^2/day Soil to 313.202 ± 3.314 µg CH_4/m^2/day Soil and also plant growth promotion was observed in all inoculated treatments over uninoculated control which was evident from increase in plant height, root length, tiller number, fresh weight and dry weight. Among the test organisms, MB 16 and MB 28 significantly reduced the methane flux over other Methanotrophs. The results further showed that other Methanotrophic cultures also performed better in reducing methane emission when compared with uninoculated control. Inoculation of MB 16 and MB 28 significantly enhanced the plant growth parameters while other Methanotrophs was either at par or higher than uninoculated control in some of the parameters. 16S rRNA gene sequences of seven methanotrophic cultures revealed that they belonged to the group *c-proteobacteria* and *á-proteobacteria* representing the genera *Methylomonas, Methylomicrobium, Methylosinus, Chryseobacterium* and *Methylocystis*. The resulted sequences of the organisms were deposited in NCBI, GeneBank with accession numbers. These strains possessed the particulate (*pmo*A) and soluble (*mmo*X) methane monooxygenase gene as functional marker for detection of methanotrophs.MB 16 identified as *Methylosinus* sp. (Type II Methanotroph) and MB 28 identified as *Methylomicrobium buryaticum* (Type I methanotroph) has been considered as efficient methane oxidizing bacteria having biofertilizer and bioremediation potential which could be exploited along with other potent novel Methanotrophs as future microbial inoculants.

Metribuzin persistence in soil as affected by its adsorption-desorption, soil characteristics and nutrient management in tomato

Hage Munth

Metribuzin adsorption-desorption in two soil types in laboratory experiments and its persistence in sandy loam soil with different nutrient management practices in tomato crop under field condition were studied. Two doses of metribuzin, *viz*. 250 and 500 g a.i./ha and four nutrient management practices, *viz*. unfertilized, recommended fertilizer dose (RFD) with 10 t/ha FYM, 1.0 t/ha vermicompost-½RFD mixture, and 3.0 t/ha FYM-½RFD mixture in eight treatment combinations were evaluated in a randomized block design with three replications. The extraction and determination of metribuzin were standardized for estimation using a gas chromatograph, and the limit of quantification (LOQ) and limit of detection were set at 0.05 mg/kg and 0.03 mg/kg, respectively. The adsorption of metribuzin increased with increase in clay and organic carbon content and highest adsorption was observed for sandy clay loam soil with higher organic carbon over sandy clay loam soil with lower organic carbon and sandy loam soil. The desorptions of metribuzin from soil showed similar trend to that of adsorption and high positive correlation with clay and organic carbon contents and adsorption or desorption was observed. The soils showed hysteresis effect for metribuzin adsorption-desorption which ranged from 77 to 90%. The half life of metribuzin varied from 19.8 to 25.3 days with longest persistence in unfertilized soil. The faster dissipation of metribuzin in fertilized plots was explained on the basis of microbial degradation and crop uptake over unfertilized soils. Application of RFD with FYM or FYM-½RFD mixture significantly increased growth, yield attributes and fruit yield of tomato compared to vermicompost-½RFD mixture. The difference in growth and yield of tomato was explained on the basis of enhanced mineralization and availability of nutrients in FYM and fertilizer applied soils. Application of metribuzin doses had no significant affect on the weed density or dry matter per unit area nor. Metribuzin application did not affect the microbial biomass carbon in soil after 30 days of application but decreased significantly in unfertilized soil at harvest of the crop. The microbial population count of *Azotobacter, Azospirillium* and PSB

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in soil significantly declined in unfertilized plot both at 30 days after application and at crop harvest. The pH and available nutrient contents of soil were not affected by the treatments after harvest of the crop. Application of RFD with FYM or ½RFD-FYM mixture significantly increased Lycopene and ascorbic acid content in tomato fruit compared to ½RFD-vermicompost mixture but did not affect the total soluble solids. Among the fertilizer treatments, nutrient uptake in RFD with FYM 10 t/ha and ½RFD-FYM mixture was higher than ½RFD-vermicompost mixture. The weed density and dry weight at various crop growth stages were neither affected by metribuzin doses nor nutrient management practices. It is concluded that metribuzin 250 g/ha was effective for weed management in tomato crop and sustenance of yield with optimum nutrient management, and its persistence in sandy loam soil up to 500 g/ha would not adversely affect the succeeding crop.

GIS-based evaluation of water quality index of groundwater and identification of arsenic vulnerable zone for possible mitigation in rice ecosystem of Nagaon district, Assam

Imdad Hussain Thakuria

Water Quality Index (WQI), a technique of ranking water quality, is an effective way to assess quality and ensure sustainable safe use of water. The present work is aimed to assess groundwater arsenic along with the status of other parameters, their distributions, establishing relationship and evidently finding low cost less arsenic loading technology in irrigated rice field of Nagaon district of Assam for understanding the suitability of water by calculating the WQI and Geographical Information System (GIS) techniques. Eight hundred and eighty three groundwater samples were collected during post-monsoon, 2014-15 and 2015-16 for comprehensive water quality analysis. The spatial distribution maps of 14 decisive parameters viz., arsenic, pH, electrical conductivity, total dissolved solids, calcium, magnesium, carbonate, bi-carbonate, nitrate, sulphate, fluoride, iron, aluminium and manganese having desirable and undesirable classes based on BIS and WHO standards were prepared using Arc GIS 9.3 software. The results of spatial variability maps to identify vulnerable risk zone of different groundwater quality parameters indicated an increase in the percentages of contamination levels especially for arsenic (40.4% – 99.5%), aluminium (99.8%), iron (89.6) and manganese (73.5%). Total Dissolved Solids, calcium, magnesium, carbonate, bi-carbonate, nitrate sulphate and fluoride were recorded within the desirable limit and considered to be safe. The concentration of Fluoride in certain areas (33 per cent) of the district was found far below the lower threshold limit suggesting the concerned agencies to opt for suitable less fluoride management strategies. The overall Water Quality Index was found to be 96.48 distinguishing the ground water as "GOOD WATER" with a tendency to fall in "POOR WATER" category. Spatial autocorrelation for all the quality parameters were found distributing in three patterns *viz.* CLUSTER for pH, EC, As, F, Fe, Al, Mn, HCO_3; RANDOM for Mg, Ca, CO_3, NO_3, SO_4 and DISPERSED for TDS, and

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thus paving a way to address these important parameters based on their space and values. Relationship between groundwater as well as soil arsenic content with other quality parameters showed that 39.1% of arsenic in ground water and 10.4% arsenic in soil could be predicted by the above mentioned parameters.In regards to arsenic distribution in irrigated *summer*rice, a location was identified from groundwater arsenic risk prone area from GIS-aided arsenic map. An *in-situ* low cost technology using biochars as strong adsorbent was developed from locally available bio-wastes from rice straw and *toria* stover. A farmers' friendly easy to use *kiln* for production of biochars in field condition was fabricated and accepted overwhelmingly by the local farming community. Application of biochars at 1 to 2 percent levels applied at the conveyance channel of 45 meter long and 43 cm width, irrespective of sources, reduced the root, straw and grain arsenic content and thus the technology would be helpful in reducing arsenic entry into food chain through rice without compromising the optimum rice yield.

Effect of crude oil spillage on soil physical properties and reclamation of the affected soils

Kasturi Goswami

The release of crude oil into the environment by oil spillage is receiving worldwide attention due to the potential risk posed to the environment. Crude oil spillage is a regular phenomena in the oil drilling sites and the areas through which oil transportation pipelines carries the crude oil either to the oil collecting station (OCS) or to the oil refineries. Due to raining and flooding the spilled oil and oily sludge spread to the nearby cultivated field causing soil pollution and heavy reduction in the crop yield. Therefore, the present investigation was aimed to study the effect of crude oil spillage on soil physical properties and the influence of organic amendments as remediants in reclaiming the affected soils. Five soil samples in triplicates at an interval of 50m from three directions (E,W& S) from the spilled areas and one samples each from adjacent unpolluted areas were collected from two oil fields of Assam *i.e.* MFN, Moran, Dibrugarh and HYR, Kathalguri, Duliajan, Tinsukia where oil exploration activities are conducted by Oil India Limited (OIL). The samples were characterized for their physico-chemical properties. A pot experiment was conducted in the Department of Soil Science, AAU, Jorhat, Assam with unpolluted soils from the above oil fields under factorial set of treatments having five levels of crude oil pollution (0, 60, 90, 120 and 150 ml) and seven amendment treatments *viz.* poultry manure (PM), farm yard manure (FYM), vermicompost (VC), poultry manure + farm yard manure (PM + FYM), poultry manure + vermicompost (PM + VC) and farm yard manure + vermicompost (FYM+VC) with one control. After 30 days of crude oil addition, the soils were treated for another 15 days with the amendments, and then rice seedling of var. Ranjit was transplanted and grown upto the harvest of crop for two consecutive years *i.e.* 2014-15 and 2015-16 repeating treatments in 2nd year. Soil samples were collected before crude oil application, after 30 days of pollution treatment, after 15 days of amendment treatment and after harvest and analyzed for their physico-chemical properties. All agronomical data were recorded after harvest of the crop. The results revealed that the soils of Moran and Duliajan oil fields at 0m distance were highly affected by the oil spillage. The bulk density of soils increased from 1.31 to 1.63 Mg m^{-3} and 1.25 to 1.62 Mg m^{-3} in Moran and Duliajan oil field respectively,

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while decreased the total porosity, water holding capacity and hydraulic conductivity. The pH of the soil remarkably dropped with decrease in distance from 5.40 to 4.91 and 5.45 to 4.92, respectively making the soil strongly acidic in nature whereas the organic carbon content increased from 7.12 to 27.36 g kg^{-1} in Moran and 7.39 to 26.35 g kg^{-1} in Duliajan oil field. The available N and P$_2$O$_5$ were low near the spillage point and substantially increased with distance. Conversely, Av-K$_2$O, exchangeable Ca^{2+} and Mg^{2+} significantly increased near the spilled point. The mean weight diameter (MWD) was maximum near the spillage point and decreased with increasing distance. The water stable aggregates (WSAs) were found higher in the coarser fraction (> 5mm) in soils of 0m and 50m distance whereas beyond 50m, finer fractions recorded the maximum WSAs. Similar trend was observed in organic carbon content in various fractions of WSAs. The total petroleum hydrocarbon (TPH) was maximum at 0m distance in both Moran (14.48 mg g^{-1}) and Duliajan (11.59 mg g^{-1}) oil fields and was negligible beyond 200m. Water retention capacity of soil was lowest at all the applied pressures in the vicinity of drilling point while the values increased with distance.

The results of the pot experiment revealed that addition of pollutant deteriorated the soil physico-chemical properties by increasing bulk density of soils while decreasing porosity and water holding capacity. The soil became more acidic and organic carbon and TPH content of soils increased with increased pollution levels whereas the available N, P$_2$O$_5$, K$_2$O and exchangeable Ca^{2+} and Mg^{2+} decreased significantly. The addition of organic amendments considerably improved soil parameters by decreasing soil bulk density and TPH content and increasing pH and available nutrient and exchangeable cations. The PM+VC combination amendment showed better results at all the pollution levels. Increase in pollution levels significantly and adversely affected yield attributing characters more pronouncedly at 150ml of crude oil. Addition of different amendment treatments improved the aforesaid plant characters with significant increase in grain and straw yield.

The present investigation reveals crude oil spillage as a major factor of soil quality deterioration in Moran and Duliajan oil fields of Assam and the impact was more pronounced in the vicinity of drilling point adversely affecting all the physico-chemical properties of soil. Addition of different levels of crude oil as pollutant also established unfavourable affect on physical properties of soil such as bulk density, particle density, porosity, water holding capacity *etc*. along with the chemical properties and nutritional status of the soil. Application of organic amendments in various combinations observed to improve soil physico-chemical properties specially reducing TPH content of the soil. Organic amendments *i.e.* poultry manure + vermicompost (PM+VC) exhibited its excellent capacity to reduce pollution level implying their potentiality as a promising bioremediant for reclamation of crude oil polluted soils. Further, this combination proved to be superior in maintaining crop yield and soil quality.

Assessment of carbon sequestration potential with respect to land use scenario in Jorhat District, Assam

Kripal Borah

Studies on carbon sequestration potential, as a means to mitigate global warming, is an emerging science in the world. Land use systems have a tremendous influence on the carbon sequestration potential. The present investigation was carried out in four agro-ecological situations within Jorhat District, Assam, *viz.,* High land, Humid alluvial flood free, Humid alluvial flood prone and Char areas. A total of 5 land use types (paddy cultivation, forest, bamboo, tea and homestead garden) had been considered. Nested quadrat sampling was followed in which data on tree and shrub layers were collected by allometric (non-destructive) method. The herb layer was completely removed, dried and biomass was determined.

All the soils are acidic in reaction and have bulk density less than 1.35 g cm^3. Three textural classes have found i.e. loam, silty clay loam and silt loam. Bamboo cultivation showed highest soil organic carbon (1.36%) and followed by forest (1.35%); homestead garden contained highest total soil carbon (7.90%) followed by forest (5.75%). A total of 28116.11 ha (10.11%) of total area showed total soil carbon at 850°c in the range of 5.43-5.53 per cent.

The forests contained highest biomass carbon density (525605.00 Mg/ha) followed by bamboo and tea, while in homestead garden showed the lowest (1320.91 Mg/ha). In Humid alluvial flood free zone, biomass carbon density was found highest in forest (229896 Mg/ha) followed by bamboo and homestead garden while tea (609.58 Mg/ha) showed the least. In Humid alluvial flood prone zone total biomass carbon was highest in forest (115896.00 Mg/ha) followed by bamboo and homestead garden, with paddy cultivation (1140.00 Mg/ha) showing the lowest. Since char areas did not have forest land, biomass carbon density was found highest in bamboo (1703.57 Mg/ha) followed by homestead garden. Thus forests showed the highest quantum of biomass carbon available in the district. Amongst the three components of biomass carbon, tree showed the highest biomass carbon in all the situations followed by shrub and herb. This is logically so, because of the presence of high level of

aerial portion present in trees. Also the district being in humid sub-tropical climatic region, is full of profuse evergreen trees.

Density of soil organic carbon (Walkley and Black), soil organic carbon at 430°C and total soil carbon at 850°C were in general highest forest followed by bamboo and tea cultivation in all the agro-ecological situations in the district. Amongst the four situations, highland contained the highest carbon density followed by humid alluvial flood free and flood prone situation with char areas showing the least. This was basically because of the effect of flooding and lighter texture in down slope areas.

Most of the soil profiles under study were grouped under class III or IV suitability as per Sys Manual of classification. Thus the soils showed a lot of promise in its potential for sequestering more carbon in soils. In general, the total carbon stock was found higher in tree layer followed by shrub layer and lowest in the herb layer. All the land use situations *viz.* paddy cultivation, forest, bamboo, tea and homestead garden were found to have potential to increase the total soil organic carbon stock from their existing stock in both class I and Class II suitability levels.

Thus, it could be seen that the Jorhat district has a vast potential for carbon sequestration through vegetation. Amongst the vegetation, forest vegetation was found to have the highest contribution towards the total carbon stock in the district. Bamboo cultivation is a major activity in the district through all the four agro-ecological situations. This tall grass has very good potential for carbon sequestration. Paddy, although cultivated in a very high portion of the total agricultural land, has very low potential towards carbon sequestration. This is obvious from the fact that most of its limited aerial portion is harvested and very little is left in the field. Also, being predominantly a monocropped district, potential for carbon sequestration from paddy is very limited. Similarly, contribution from homestead garden is also very limited. It appears that part of this homestead garden if converted to tea cultivation would be beneficial towards carbon sequestration. Besides the above ground, the below ground carbon stock in the district is also very significant. It is observed that the soils of the district still contain very less amount of carbon stock, indicating a huge potential for carbon stock below ground. Overall it appears that the district has a strong potential for acting as a sink for carbon both in above ground and below ground carbon stock.

Soil Quality Indicators under major crop sequences of Nalbari district of Assam

Manashi Chakravarty

The present investigation was carried out to assess valid soil quality indices (SQI) of major rice based crop sequences *viz*; rice-fallow, rice-oilseeds, rice- vegetables and rice pulses in Nalbari district of Assam [AESR (15.2 Q8B8) and (16.1C10A9)] through different statistical approaches to understand the impact of existing (*in field*) soil management practices on soil quality. A total of four hundred twenty eight georeferenced soil samples (composite) were collected from the four crop sequences under the agro eco sub units- humid alluvial flood free, humid alluvial flood prone and char areas of Nalbari district comprising of cultivated soils and nearby uncultivated upland soils. Twenty eight soil parameters (physical, chemical and biological) were analyzed using standard methods. Soil management practices and rice yield data were recorded from the identified farmers. Descriptive statistics was used for calculating the characteristics of analyzed soil physical, chemical and biological parameters.

The descriptive statistics for the four crop sequence illustrated that the mean bulk density (BD) value was significantly higher in cultivated soils ($1.40 Mg\ m^{-3}$) compared to uncultivated soils ($1.34 Mg\ m^{-3}$) for rice-fallow system, whereas higher mean BD values were recorded for uncultivated soils than the cultivated soils for the other three crop sequences *viz*; rice-oilseed, rice-vegetable and rice-pulse. The mean value of maximum water holding capacity (WHC) remained in high (>30%) status in all the crop sequences. The status of organic carbon (OC) was recorded as medium (0.5-0.75%) to high (>0.75%) in both cultivated and uncultivated soils under all the crop sequences, the mean OC content in the uncultivated soils was observed to be significantly higher compared to cultivated soils. In all the rice based crop sequences, more than 85% of the soil samples analysed exhibited low (<10.00 C mol (p+) kg^{-1}) cation exchange capacity (CEC) for both cultivated and uncultivated soils. The mean value of available N content of the soils under rice based crop sequences were in between 220.54 and 287.89 kg ha^{-1} (± 82.43) compared to > 368.21 kg ha^{-1} (± 52.83) in uncultivated soils. Medium status (22.50-56.00 kg ha^{-1}) of available P

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were recorded in >80% of cultivated soils under the sequences compared to high (>56.00 kg ha⁻1) level of Av. P in 3-25% of uncultivated sites. In cultivated sites 29-70% and 30-70% soils exhibited low (<136 kg ha^{-1}) to medium (136.00-337.50 kg ha^{-1}) status of Av. K compared to 3-46% (<136 kg ha^{-1}) and 53-96% (136.00-337.50 kg ha^{-1}) in uncultivated soils for the four rice based crop sequences. The results illustrated that more than 50% of soils under the four rice based crop sequences belonged to low (2-5 C mol (p+) kg^{-1}) to medium (5-10 C mol (p+) kg^{-1}) category in Exch. Ca and Mg content whereas more than 60% of soils under the four rice based crop sequences belonged to high (>44.8 kg ha^{-1}) category in Av. S content. Regarding micronutrients the results illustrated that more than 90% and 70% of soils under the four rice based crop sequences belonged to deficient in DTPA-Zn content. (<0.6 mg kg^{-1}) and Av. B content (<0.5 mg kg^{-1}). Except rice-oilseed crop sequence, the microbial biomass carbon (MBC) was recorded higher (e" 265.37 µ g^{-1}) in cultivated rice-fallow, rice-vegetable and rice-pulse sequence compared to uncultivated sites. While the bacterial and fungal populations maintained the high status (>5.0 log$_{10}$ cfu g^{-1}), the specific populations (*Azotobacter, Azospirillum,* and phosphate solubilising bacteria) observed to be at sub optimal level ((>5.0 log$_{10}$ cfu g^{-1}) in cultivated soils. Soil enzymes like dehydrogenase (DHA), Phosphomonoesterase (PME), fluorescein dicetate (FDA) hydrolysis and arylsulphatase (ARYL) activity were also appeared to be at sub optimal levels in cultivated soils under the crop sequences.

The SQI of four rice based crop sequences were developed integrating 27 soil (physical, chemical and biological) attributes based on the minimum data set (MDS) method. Principal component analysis (PCA) and expert opinion (EO) were used for selecting MDS from 27 soil attributes. The soil attributes covered under MDS was scored using scoring functions and finally SQI was developed. In the EO, three soil functions *viz*: nutrient cycling, water availability and biological diversity were chosen using 21 soil attributes which were primarily focused on sustainable crop cultivation. In order to make a comparative analysis of soils of different sites, the relative soil quality index (RSQI) was developed using 14 soil attributes with uniform weightage based on their relative roles in influencing crop yield, existing soil conditions and agro climatic conditions of the study area.

The PCA results for rice-fallow system showed that the mean SQI value was 0.67 (±0.116) and 0.66 (±0.112) for cultivated and uncultivated soils. Ten key indicators were selected, of which MBC showed the highest contribution (15.92 %) towards the mean value of SQI (0.67) in cultivated soils and OC contributed highest (13.49%) towards the mean value of SQI (0.66) in uncultivated soils indicating the importance of biological properties in maintaining soil quality. In rice-oilseeds crop sequence the mean SQI values were 0.64(±0.078) and 0.55(±0.093) for cultivated and uncultivated soils in which out of the selected key indicators, fungi and OC contributed highest (16.91% and24.30%) towards the mean SQI values under cultivated and uncultivated soils respectively. In rice–vegetables crop sequence the mean SQIs were 0.55(±0.117) and 0.60(±0.075) in which the key indicators OC and basal respiration (BR) contributed highest (19.74% and14.73%) towards the mean values of SQI under cultivated and uncultivated soils. In rice-pulses crop sequence

the key indicators CEC and WHC contributed highest (18.62% and 16.08%) towards the mean SQI values of 0.59(±0.122) and 0.75(±0.063) under cultivated and uncultivated soils respectively.

The EO-SQI computed for the crop sequences exhibited the mean values of 0.64 (±0.14), 0.68 (±0.09), 0.74 (±0.13) and 0.71 (±0.10) in the rice-fallow, rice-oilseed, rice-vegetable and rice-pulse crop sequences respectively. Out of the three soil functions, nutrient cycling contributed highest towards mean value of EO-SQI under the sequences.

The RSQI based on 14 soil indicators (Soil texure, BD, soil pH, CEC, OC, Av. N, Av.P, Av.K, Av.S, DTPA-Zn, Av. B, Av. Fe, OC and MBC), illustrated that in rice-fallow system, 100.00% of the soils converted to medium (RSQI, 50-70%) categories. In rice-oilseed crop sequence, the RSQI values exhibited that only 6.30% soils remained as good category (RSQI, >70%) under cultivation. Similarly, in rice-vegetables and rice-pulse crop sequences due to cultivation, 88.00% and 100.00% cultivated soils converted to medium (RSQI, 50-70%) categories.

Correlation matrices between PCA-SQI with EO-SQI and RSQI of the rice based crop sequences illustrated the significant correlation (p<0.01) existed between PCA-SQI with EO-SQI (r=0.580**) and RSQI (0.532**) in cultivated soils of rice-fallow system. Similarly, in rice-oilseed crop sequence, the PCA-SQI significantly established the correlation with EO-SQI (r=0.694**) and RSQI (0.452**) for cultivated soils. In case of rice-vegetable sequence the significant correlation values were of r=0.564** and 0.453** between PCA-SQI and EO-SQI and RSQI respectively. With reference to rice-pulse sequence PCA-SQI established the significant correlation with EO-SQI (0.521**).

The regression lines were drawn between the percent relative yields (%RY) with SQI indices in cultivated soils under the rice based crop sequences were evaluated to understand the optimum values of SQIs for sustaining e"80% of the existing *in field* crop yields. In rice-fallow system, the optimum values obtained were e"0.61, e"50.80% and e"0.58 for PCA-SQI, RSQI and EO-SQI respectively to sustain e"80% (4.24 tha^{-1}) of the existing *in field* maximum rice yield (5.30tha^{-1}).The optimum value for rice-oilseed crop sequence indicates that the soils having PCA-SQI, RSQI and EO-SQI values of e"0.60, e"55.20% and e"0.62 respectively are likely to give e"80% (6.28 tha^{-1}, rice equivalent) of the maximum yield. The optimum values for rice-vegetables sequence were >0.54 , e"55.20% and e"0.62 for PCA-SQI, RSQI and EO-SQI respectively to sustain e"80% (18.0 tha^{-1}) of the maximum yield. With reference to the rice-pulse crop sequence the optimum values were >0.57, e"50.20% and e"0.58 for PCA-SQI, RSQI and EO-SQI respectively to sustain e"80% (8.92 t ha^{-1}, rice equivalent) of the maximum yield.

Quantitative pedogenesis and land evaluation in Golaghat District of Assam

Tantuja Nandy

In the present investigation, ten soil profiles were collected from Golaghat district of Assam using physiography maps (1:25000) prepared from satellite imagery by NESAC. Horizon-wise soil samples collected from each profile were studied for field morphology and analysed for physico-chemical characteristics and total elemental composition using standard procedures. The data were utilized for quantitative pedological evaluation, potential productivity and crop suitability assessment.

The results showed that hue of the soil colour was 10YR in all the profiles, value varied from 4 to 7 and chroma varied from 2 to 8. Mottles of redder hue (2.5YR to 10YR) and higher chroma (4 to 8) were observed in all the profiles except P2, P5 and surface as well as sub-surface horizons (up to 70 cm) of P9. A textural variation ranging from sandy loam to clayey was observed in the studied soils. Wide variations were observed in sand (20.0-74.8%), silt (4.4-38.0%) and clay (18.4-49.5%); organic carbon in the surface horizons (0.54-1.41 per cent), bulk density (ignited soil) (1.20-1.47 Mg m^{-3}), pH (4.4-5.9), CEC (3.6-13.8 cmol(p$^+$) kg^{-1}), base saturation (19.3-41.2 per cent). The sand/silt and silt/(silt+clay) ratios indicated uniformity of parent material. The soils were classified as per Soil taxonomy (Soil Survey Staff, 2010) as Aquic Dystrudepts (P1), Fluventic Dystrudepts (P2), OxyaquicDystrudepts (P3, P10), UlticHapludalfs (P4), Typic Dystrudepts (P5), Typic Epiaquepts (P6), Aeric Endoaquults (P7) and Oxyaquic Hapludults (P8, P9). Numerical classification of soils carried out by calculating Eucledian distance coefficient (djk) using 35 soil characters showed highest similarity between P7 (Aeric Endoaquults) and P8 (Oxyaquic Hapludults) and least similarity between P2 (Fluventic Dystrudepts) and P8 (Oxyaquic Hapludults).

Soil development indices *viz*., Relative horizon distinctness (RHD) and relative profile development (RPD) ratings calculated from selected field morphology showed RHD values from 1 to 11 and RPD values from 3 to 12. The trend of profile development with depth was more evidently observed in Ultisols (P7 to P9) and Alfisol (P4) in comparison to Inceptisols (P1 to P3; P5, P6 and P10).

Silica was found to be dominant in all the soils ranging from 66.62 to 79.44 per cent, followed by Al_2O_3 (10.46 to 16.69 per cent) and Fe_2O_3 (1.57 to 12.48 per cent), K_2O (0.22 to 2.08 per cent), CaO (0.05 to 1.05 per cent) and MgO (0.10 to 0.98 per cent). The weathering indices (WI_E, WI_M, Fe_d/Fe_t) showed more soil development in cambic and argillic horizons as compared to other horizons of a profile. Eluvial/illuvial coefficients (E/I) and total losses and gains of major elements calculated taking SiO_2 as internal index showed accumulation of Al_2O_3 (2.2 to 63.2) in P1, P5, P6, P10 (Inceptisols) and leaching of Al_2O_3 (-1.0 to -30.5) in P7 (Aeric Endoaquults) and P8, P9 (Oxyaquic Hapludults); accumulation of Fe_2O_3 (4.2 to 64.2) in P1, P4, P5, P6, P10 and leaching of Fe_2O_3 (-1.7 to -70.0) in P2, P3, P7 and P8, P9. In case of alkaline earth materials E/I coefficients varied from -73.4 to +79.1 for CaO, -71.2 to +44.6 for MgO, -50.7 to +33.4 for Na_2O and -80.9 to +76.7 for K_2O. Total losses or gains of Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, P_2O_5 and MnO varied from -33.79 to +10.45, -16.22 to +12.79, -373.61 to +129.88, -325.77 to +237.54, -319.15 to +22.45, -236.43 to +143.15, -302.49 to +285.41 kg m^{-2} respectively.

The productivity ratings index varied from 10.94 to 42.75 for crop, 34.47 to 45.79 for pasture and 4.38 to 68.40 for forest. The potential productivity index (P') ranged from 49.25 to 68.40 for crop, 55.40 to 62.33 for pasture and 27.36 to 85.50 for forest. The coefficient of improvement (CI) varied from 1.60 to 4.50 for crop, 1.36 to 1.61 for pasture, 1.25 to 6.25 for forest.

Land evaluation studies showed that soil-site characteristics are presently unsuitable but potentially suitable (N1) to moderately suitable (S2) for growing most of the crops like rice, tea, sugarcane, citrus, coconut, potato, tomato, pea, onion, green pepper, cashew, sesame and carrot. The soil related constraints for crop diversification as well as alternate land use options are mainly acidic soil reaction, low amount of basic cations and soil organic carbon content. The correlation studies among weathering indices, productivity and potentiality indices and soil-site suitability ratings revealed that they can be conveniently used to study the relationship between pedogenesis and quantitative land evaluation.

Assessment of some rice growing areas of Titabor Block of Jorhat district for crop intensification

Uddipan Rajkonwar

Rice occupies about two-third of the total cropped area in Assam and traditionally grown throughout the year *viz.,* winter, autumn and summer seasons, of which winter (*kharif*) rice as the main crop. However, the productivity of rice in Assam (1.35 t/ha) is well below the national average of 2 t/ha and farmers are not economically benefitted by cultivating rice (Barah *et al*., 2001). Therefore, at present crop-diversification/intensification of rice-based system is considered very pertinent as crop-diversification provides the farmers with viable options to grow different crops on their land. Therefore, it is felt necessary to address the problem of low productivity and high risk in rainfed rice based production system of Assam through a systematic approach of characterising the rice growing soils and evaluating its suitability for other crops.

A reconnaissance soil survey was carried out in rice growing areas in cluster of nine villages of Raidungjuri GP of Titabar block *viz.,* Raidangjuri gaon, Matikhula gaon, Sukanjan gaon, Annapurna gaon, Torani gaon, Nagabat gaon, Miri gaon and Kakodanga gaon. A base map of the study area was prepared after traversing various land units with the help of Survey of India Topographical sheet (83J/3) as well as Precision Geo coded Resourcesat-1 IRS P6 LISS-III imagery (Row 53 and Path 118-119) at 1:50,000 scale of Titabor block in conjugation with Google Earth images of the area. Based on the soil-site characteristics recorded from study of soil profile and surface samples, the soils were grouped into eight different Soil Series *viz.,* Raidangjuri (P1), Matikhula (P2), Sukanjan (P3), Annapurna (P4), Torani (P5), Nagabat (P6), Miri gaon (P7) and Kakodanga (P8) through soil correlation and assessed for potential productivity, capability index and crop suitability using quantitative approaches of land evaluation for ten different crops (Rice, wheat, maize, mustard, sesame, cabbage, potato, tomato, french bean and pea).

The dominant hue of soils colour was 10 YR however hue of 7.5YR and 2.5 Y was observed in the lowermost horizons of P1, P3, P4 and P5 soils. The value and chroma of the soils ranged from 5 to 7 and 1 to 8, respectively. The dominant value of most of the profiles

ranged between 5 and 6. The chroma of the paddy soils ranged from 1 to 8 but in most of the profiles dominant chroma was 1. The dominance of chroma 1 and hue 2.5 Y of the soils are indicative of the process of the gleization with aquic moisture regime. Mottles were observed in all the profiles with dominant hue 10YR, value 4 to 7 and chroma 1 to 8. However the upper horizons of profiles P1, P2 and P4 had hue 7.5 YR. Texture of the soils varied from clay to clay loam except in P5 soil where texture was sandy loam to sand. The texture of the soils exhibits the features of clay illuviation in most of the profiles leading to development of clay skins in soils P1 and P3. The structure of the soils of P1, P2, P3 and P4 was massive in surface horizon and medium, moderate to strong and sub angular blocky in the subsurface horizon. But in soil P1, P2 and P4 the lower most horizons were also massive in structure. The soils P5, P6, P7 and P8 had stronger structure which ranged from fine to medium, weak to moderate sub angular blocky. The sand, silt and clay per cent of the soils ranged from 18.10 to 81.10 per cent, 11.2 to 48.5 per cent and 7.70 to 55.3 per cent, respectively. The bulk density of the soils varied from 1.31 Mg m^{-3} to 1.64 Mg m^{-3}. In general, surface horizons of most of the soils exhibited lower bulk density as compared to subsurface horizons. Organic matter content of the soils was found to be higher in the surface horizons (0.99 to 2.60 per cent) and it decreases regularly with depth in all the profiles. The pH of the surface soils ranged from 4.9 to 5.6 with increases with depth of the profile to 5.2 to 6.5. Therefore, the surface soils are very strongly acidic to medium acidic in nature. The CEC of the soils ranged from 7.70 to 11.50 and 4.30 to 10.60 cmol(p$^+$) kg^{-1} in the surface and lower horizons ,respectively. Hence CEC of the surface soils was higher as compared to lower most horizons.

Among the exchangeable bases calcium was the most dominant (0.90 to 3.10 cmol (p$^+$) kg^{-1}) followed by magnesium (0.22 to 3.49 cmol (p$^+$) kg^{-1}), potassium (0.05 to 0.0.35 cmol (p$^+$) kg^{-1}) and sodium (0.002 to 0.32 cmol (p$^+$) kg^{-1}), respectively. Exchangeable Al^{3+} was the dominant acid forming cation ranging from 0.08 to 0.68 cmol (p$^+$) kg^{-1} and exchangeable H$^+$ ranged from 0.07 to 0.28 cmol (p$^+$) kg^{-1} in these soils. In general surface horizons contained higher amount of exchangeable Al^{3+} (0.28 to 0.68 cmol (p$^+$) kg^{-1} soil) and H$^+$ (0.18 to 0.28 cmol (p$^+$) kg^{-1} soil) as compared to subsurface horizons. Base saturation of the soils ranged from 22.90 (P5) to 67.00 (P6) per cent. In general base saturation per cent was higher in the subsurface soils as compared to surface soils.

On the basis of morphological and physicochemical characteristics soils were classified as *Typic Endoaqualfs* (P1 and P3), *Typic Epiaqepts* (P2, P6 and P7), *Aeric Endoaqepts* (P4 and P8) and *Typic Dystrudepts* (P5) as per Keys to Soil Taxonomy, 2014. Soil site suitability evaluation for different crops (Sys *et al.*, 1993) showed that all the soils of Raidangjuri GP were moderately suitable (S2) for rice except the soils of Torani (P5) series which were marginally suitable (S3) for rice. Raidangjuri (P1), Sukanjan (P3), Annapurna (P4), Kakodanga (P8) series were found potentially highly suitable (S1) for rice crop. All the soils were mostly assessed for potentially moderately suitable for wheat, maize, mustard, sesame, potato, tomato, cabbage, French bean and pea crops except the soils of Miri gaon (P7) and Kakodanga (P8) series which were marginally suitable for these crops.

Torani (P5) series is potentially highly suitable (S1) for mustard and both Torani (P5) and Annapurna (P5) series are potentially highly suitable (S1) for potato. However, many of the soil series *viz.,* P1, P3, P4, P5 and P6 were currently unsuitable (N1 – N2) for one of these crops *viz.*, sesame, cabbage and French bean. Capability index determined by modified Sys and Verheye (1975) approach showed that except for Kakodanga (P8) series all the soils were marginally suitable (S3) for rice .Wheat was found temporarily not suitable (N1) for any of the soil series and maize was marginally suitable (S3) only in Matikhula (P2) series. Mustard, sesame and French bean were marginally suitable (S3) in Matikhula (P2) and Miri gaon (P7) series. All the soils were marginally suitable (S3) for potato except Kakodanga (P8) series which was not suitable (N1) for potato. For tomato Raidangjuri (P1), Matikhula (P2), Torani (P5) and Miri gaon (P7) series were marginally suitable (S3) and others were not suitable (N1). All the soils were not suitable (N1) for cabbage and pea. Productivity index (Riquier *et al,* 1970) revealed that LP class of Raidangjuri (P1), Sukanjan (P3), Annapurna (P4), Nagabat (P6) and Miri gaon (P7) soil series were categorized under land productivity (LP) class good that of Matikhula (P2) and Kakodanga (P8) series under average and Torani (P5) series under LP class poor.

Conclusions may be drawn from this investigation that from Sys model most of the soils of Raidangjuri GP are potentially marginally suitable (S2) for maize, mustard, sesame, potato and tomato except Mirigaon (P7) and Kakodanga (P8) series. Soils of Torani series are potentially highly suitability (S1) for mustard and potato and that of Annapurna (P4) for potato. However, the same trend was not found by determining Capability index (Ci) of the soils. According to Ci, rice is found marginally suitable (S3) and all the soil series are not suitable for wheat. Therefore, considering both the approach alternative crops *viz.,* mustard, sesame, potato and tomato is suggested for all the paddy soils of Raidangjuri GP except soils of Mirigaon (P7) and Kakodanga (P8) series. Future field trials need to be undertaken for validation of these findings through land suitability evaluation approaches by evolving proper management for overcoming the constraints identified *viz.,* pH, texture and soil moisture conditions for cultivating the suggested alternative crops.

culturable Endophytic Actinobacteria: Isolation and Characterization from Rice Plants

Yumnam Bijilaxmi Devi

In the present investigation, endophytic actinobacteria were isolated from six different varieties of rice namely Aghoni Bora, Badshabhog, Basundhara, Ranjit, Joha andSolpuna. Samples were collected from 33 sites located at Golaghat and Jorhat districts of Assam. The isolates were assessed for morphological characterization, biochemical characterization and physiological features with special reference to antimicrobial activities against pathogenic fungi as well as bacteria. Finally, eleven selected isolates were subjected to 16S rDNA sequence analysis for establishment of their genotypic position. Altogether 57 isolates were obtained from six varieties of rice in Starch Casein Agar (SCA) and Casein Yeast Extract Glucose Agar (CYGA) medium. Overall, occurrence of actinobacteria colonies were more prominent in roots compared to stems and leaves. Among the six different rice varieties, the frequency of morphologically well recognized actinobacteria colonies were found to be significantly highest in Solpuna in roots (131.00 g^{-1}), stem (117.00 g^{-1}) and leaves (106.00 g^{-1}). Based on distinct colony morphology and prominent growth without contamination on SCA media, 24 isolates were selected for *in-vitro* plant growth promoting traits. The growth of all isolates was found to be optimum at pH 7.2 and at temperature 30^{0}C ranging from 4.78 to 7.94 log cfumL^{-1} and 5.00 to 8.67 log cfumL^{-1}respectively. Most of the isolates showed positive result for intracellular and extracellular enzymatic activities. 50% of the isolates showed positive result for gelatin liquefaction. All the isolates except AL2 and SL3W could hydrolyze lipid. 70.83% showed positive result for nitrate reduction. All the isolates except AL2 and SR4 showed negative reaction for catalase activity. Except AS1, SL3W and WNPR1, all the isolates illustrated positive urease activity. All the isolates displayed negative result for H$_2$S production except AS1. 62.5% isolates could produce siderophore and all the isolates could produce hydrogen cyanide. The ability of the isolates to solubilize P was recorded after 7 and 14 days of growth. After 7 days of growth, the value ranged from 0.067 to 0.500 µg mL^{-1} and 0.067 to 0.633 µg mL^{-1} after 14 days of growth. The isolates showed similar result in IMViC (Indole, Methyl red, VogesProskaur's and Citrate utilisation), 66.7 % isolates giving positive result for methyl red test.Rare utilization of carbon

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sources utilization was observed in all the isolates.Twenty two isolates showed antimicrobial activity against at least three pathogenic fungi. Isolate AS1, AL1, ABR1, BRL2, BRL3, BSS1, BSL1, SS1, SS3, SS5, SL1, SL2, SL3W, SL3Y and SL4 showed inhibition against all the four pathogenic fungi *viz.Fusarium oxysporum, Rhizoctoniasolani, Curvularialunata*and *Sclerotiniasclerotiorum.* Overall, isolates BSL1 and SL3W showed high inhibition against all the four pathogenic fungi tested.Six isolates out of twelve selected*viz.* ABR1, BRL2, BSL1, SL1, SL3W and SL4 showed high inhibition against pathogenic bacteria *Xanthomonasoryzae* and four isolates ABR1, BRL2, BSL1 and SL1 exhibited inhibition against *Erwinia sp.* The inhibition zone ranged from 17 to 24 mm against *Xanthomonasoryzae* and 19 to 30 mm against *Erwinia sp.* The isolates showing high antimicrobial properties showed antibiotic resistance against few common antibiotics. Taxonomic identity of selected 11 isolates belonged to *Streptomyces longispororuber, Nocardiopsis*sp., *Streptomyces rochei, Streptomyces finlayi, Nocardiopsisalba, Streptomyces* sp*., Streptomyces parvulus and Streptomyces coelicolor.* Most common genus was found to be *Streptomyces* (81.8%).In conclusion, it was established that rice plants of Assam harbors potential endophytic actinobacteria possessing multiple plant growth promoting traits with antimicrobial activities. These isolatescould be potential candidates for inclusion in integrated nutrient management and organic farming as a means of growth promoter as well as plant disease suppressor.

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Performance evaluation and identification of polymorphism of genes affecting growth and reproduction in Assam hill goat

Loopamudra Sarma

The present work was conducted to evaluate the performance in respect of growth and reproductive traits as well as identification of polymorphism of *FecB*, *POU1F1* and *BMP4* gene and their association with growth and reproductive traits of Assam Hill goat. Data on 960 animals for growth and morphometric traits, 324 animals for reproductive traits and 80 animals for molecular genetic analysis belonging to 3 populations of Assam Hill goat maintained at three field units *viz*., Batabari, Nahira and Tetelia were utilized. The least-squares means for body weight, height at withers, heart girth and body length were 1.166 ± 0.008 kg, 26.198 ± 0.070 cm, 26.695 ± 0.096 cm and 29.482 ± 0.119 cm at birth; 4.590 ± 0.083 kg, 36.850 ± 0.105 cm, 40.741 ± 0.115 cm and 39.703 ± 0.108 cm at 3 months; 7.557 ± 0.049 kg, 41.231 ± 0.121 cm, 44.621 ± 0.115 cm and 50.778 ± 0.172 cm at 6 months; 9.934 ± 0.044 kg, 43.902 ± 0.120 cm, 48.890 ± 0.099 cm and 55.552 ± 0.170 cm at 9 months, and 12.549 ± 0.046 kg, 46.791 ± 0.112 cm, 52.765 ± 0.090 cm and 58.392 ± 0.207 cm at 12 months of age, respectively. Location had significant effect on body weight and height at withers at all age groups; on heart girth at 3, 6, 9 and 12 months, and on body length at birth, 3, 6 and 12 months of age. Season of birth exerted significant effect on body weight at 9 and 12 months; on height at withers at 12 months and on body length at birth, 6, 9 and 12 months of age. Significant effect of sex was observed on body weight at 9 and 12 months, on height at withers at 6, 9, and 12 months, and on heart girth and body length at 3, 9 and 12 months of age. The least-squares means for kid size at birth, kid size at weaning, age at first kidding and gestation period (pertaining to first parity) were 1.142 ± 0.035, 1.140 ± 0.034, 410.147 ± 4.046 days and 147.135 ± 0.376 days, respectively, and for kid size at birth, kid size at weaning, gestation period, service period and kidding interval (pertaining to all parities) were 1.370 ± 0.030, 1.345 ± 0.030, 147.961 ± 0.246 days, 73.773 ± 2.111 days and 221.592 ± 2.134 days, respectively. Location and parity exerted significant effect on kid size at birth,

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kid size at weaning, service period and kidding interval, and season of kidding exerted significant effect on service period and kidding interval. The heritability estimates for body weight and body measurements were moderate, whereas; heritability estimates for reproductive traits were low. The phenotypic and genetic correlation among body weights and body measurements at birth, 3, 6, 9 and 12 months of age were positive in direction and high in magnitude. Positive and high phenotypic and genetic correlation were observed between kid size at birth and kid size at weaning, and service period and kidding interval. The phenotypic correlations between other reproductive traits were either low or suffered from high standard errors. All reproductive traits under study exhibited low genetic correlations except between kid size at birth and age at first kidding. PCR-RFLP analysis of *FecB*, *POU1F1* and *BMP4* gene revealed monomorphic banding pattern. In sequencing, no restriction site was found for *AvaII* in *FecB* gene, four restriction sites were found for *DdeI* in *POU1F1* gene and one restriction site for *HaeIII* in *BMP4* gene. In case of *BMP4* gene, an SNP was observed at position 159 (A'!T) in goats with history of multiple births. This finding reveals that the animals with a history of single birth have A nucleotide instead of T as observed in animals with history of multiple births.

Upscaling of Bovine Infertility Countering Technologies

Lakshya Jyoti Dutta

A study was conducted on a total of 909 crossbred cows maintained in 60 private farms of Kamrup, Darrang and Lakhimpur districts of Assam with the primary objectives of identification and characterization of common reproductive disorders and studying fortification needs of commonly practised therapeutic techniques for the treatment of infertility. Incidence of reproductive disorder was determined based on breeding history provided by the animal owners and clinico-gynaecological examination of 133 problem breeder cows. The study revealed that overall incidence of infertility was 14.63 per cent comprising 5.28 per cent for repeat breeding with uterine infection, 3.41 per cent for repeat breeding without uterine infection, 2.97 per cent for true anoestrus, 2.53 per cent for silent oestrus and 0.11 per cent for each of pyometra, ovarian cyst, infantile genital organ and ovario-bursal adhesion. Out of the total number of infertile cows 59.39 per cent suffered from repeat breeding and 37.59 per cent anoestrus. Poor management system in respect of flooring, drainage, sunlight exposure, ventilation and roofing of the cattle shed was associated with higher incidence of infertility with the frequency of occurrence of 58.69, 28.10, 17.11, 51.28 and 21.47 per cent respectively against 12.28, 11.0, 12.60, 12.98 and 9.38 per cent for good flooring, good drainage, good sunlight exposure, good ventilation and good roofing system respectively. Feeding condition was normal in 48.33 per cent and poor in 51.66 per cent cattle farms. Incidence of infertility was 13.36 and 15.78 per cent under normal and poor feeding conditions respectively. Of the infertile cows 53.38 per cent had body condition score between 2.5 and 3.5 and 46.61 per cent had the score less than 2.5. Out of repeat breeder cows with uterine infection 43.66 per cent had good body condition and 27.41 per cent poor body condition. Level of serum calcium, zinc, leptin, ghrelin and IGF-1didnot vary significantly between types of infertility. Level of phosphorus and iron was low in cows affected with repeat breeding due to infection. Serum oestrogen level remained significantly low in cows affected with silent oestrus and true anoestrus while level of progesterone was significantly higher in cows affected with silent oestrus. Treatment of silent oestrus in crossbred cows with double

injection of PGF_2á 11 days apart resulted in 100.00 per cent oestrus response and 66.66 per cent conception rate. Fortification of PGF_2á with supportive treatment comprising oral bypass fat and mineral mixture and injectable phosphorus and vitamins did not improve conception rate. Supportive treatment alone when used in true anoestrus cows resulted in 83.33 per cent oestrus response and 50.00 per cent conception rate. Fortification of GnRH with supportive treatment did not improve conception rate in treating true anoestrus in cows. Fortification of intrauterine Lugol's iodine with supportive treatment used for treating repeat breeding due to uterine infection resulted in higher post treatment conception rate of 83.33 per cent against 66.66 per cent obtained with Lugol's iodine alone. The hormone hCG was the choice of drug for treatment of repeat breeding without uterine infection resulting in post treatment conception rate of 83.33 per cent which increased to 100.00 per cent when fortified with supportive treatment.

Phytochemical Analysis of Medicinal Plants and Their Effect on Oxidative Status, Rumen Enzymes and Biochemical Profile of Goat

Purabi Thakuria

In this study, three medicinal plants viz. *Artocarpus heterophyllus* (Jackfruit), *Carica papaya* (Papaya) and *Terminalia bellerica* (Bhumura) were investigated for the presence of phytochemicals and their effect on the rumen enzymes, oxidative status and blood biochemical profile was evaluated. The preliminary phytochemical screening of *Artocarpus heterophyllus*, *Carica papaya* and *Terminalia bellerica* revealed the presence of phytochemicals such as tannin, saponin, flavonoid, terpenoid, alkaloid, glycosides and protein in methanolic extract. Quantitative analysis revealed that the highest concentration of tannin (%) was found in *C. papaya* (0.638 ± 0.05) followed by *T. bellerica* (0.562 ± 0.09) and *A. heterophyllus* (0.253 ± 0.06). However, the flavonoid concentration (mg QE/ g) was highest in *T. bellerica* (0.825 ± 0.001). But there was no significant ($P<0.01$) difference in saponin concentration among all the three plant leaves and the highest concentration of saponin (mg/100g) was found in *T. bellerica* (2.67 ± 0.07).

The antioxidant activity in terms of DPPH (2, 2- diphenyl-2- picryl hydrazyl hydrates) radical scavenging activity was highest in *A. heterophyllus* ($70.23 \pm 0.0.50$ %) followed by *C. papaya* (65.57 ± 0.27 %), *T. bellerica* (62.70 ± 0.06 %) and Vitamin C (27.04 ± 0.01 %) respectively at concentration of 110 µg/ml. Similarly, in superoxide radical scavenging activity *A. heterophyllus* showed highest radical scavenging activity (83.35 ± 0.09 %) followed by *C. papaya* (81.08 ± 0.04 %), *T. bellerica* (75.36 ± 0.14 %) and vitamin C (14.50 ± 0.05 %) at concentration of 110 µg/ ml. Reductive ability was highest in *A. heterophyllus* (0.137 ± 0.001) compared to standard Vitamin C (0.134 ± 0.001) respectively at concentration of 110 µg/ml. On the otherhand, the highest nitric oxide free radical scavenging activity (%) was recorded in vitamin C (56.16 ± 0.03) followed by *T. bellerica* (40.43 ± 0.12), *A. heterophyllus* (36.05 ± 0.57) and *C. papaya* (26.01 ± 0.23). The highest concentration of hydroxyl radical scavenging activity (%) was found in *C. papaya* (76.64 ± 1.11) followed by *T. bellerica*

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(83 ± 0.08) and *A. heterophyllus* (70.36 ± 0.17) when compared with vitamin C (13.12 ± 0.01) at 110 µg/ml concentration. The vitamin C content was highest in *C. papaya* (39.71 ± 0.24 mg/100g).

In the present study, eighteen (18) Assam Hill (local) goats of 3-4 months of age were procured and reared in the Experimental Animal Shed, Department of Veterinary Physiology, C.V.Sc., AAU, Khanapara, Guwahati-22. The animals were divided into three groups. One as control, receiving substrate ration, T_1 with plant leaves @ 5% level and T_2 @ 10% level of total mixed ration (TMR). The duration of the experiment was 90 days. Rumen liquor analysis revealed that out of the three rumen fibrolytic enzymes, Carboxymethylcellulase showed better enzyme activity in T_2 group. The blood glucose level (mg/dl) was within the normal physiological range but apparently decreased in T_1 and T_2 groups indicating hypoglycemic effect of the plant leaves. The serum total protein level (g/dl) was also within the normal range and the level was significantly (P<0.01) higher in T_2 group. The level of blood creatinine (mg/dl) increased significantly (p<0.01) in 0 to 90 days from 1.02 ± 0.08 to 1.80 ± 0.08 in all the experimental groups of animals but the observed values were within the normal range. The values recorded for blood urea nitrogen concentration (mg/dl) in all the groups of animal during different days of experiment were found to be apparently higher but analysis of variance revealed no significant differences during the respective days of experiment. The ALT and AST values (U/L) were found to be apparently higher but the values differed non-significantly amongst all groups during the respective days of experiment and the values were within the normal range indicating no harmful effect of the plant leaves on liver. The values recorded for GGT (U/L) in the present experiment were apparently decreased from 37.10 ± 1.35 to 35.91 ± 1.07 in 0 to 90 days but analysis of variance revealed no significant differences during the respective days of experiment. The overall mean value of GGT in T_2 group was insignificantly lower than the values recorded in T_1 group which indicated normal hepatic condition of the animal. The serum calcium concentration (mg/dl) recorded during 0 to 90 days of experiment in all the groups of goat increased significantly (p<0.01) from 9.17 ± 0.16 to 11.73 ± 0.15. An increase level of phosphorus (mg/dl) was also recorded in T_2 group. The serum sodium concentration (mEq/L) was also within the normal physiological range and no significant differences were observed between the respective days of experiment in both T_1 and T_2 group. The observed value of serum potassium (mEq/L) increased significantly (p<0.01) from 0 to 90 days of experiment in control, T_1 and T_2 groups. The iron value ((ìg/dl)) recorded in the present experiment increased apparently from 0 to 90 days and insignificantly higher values were observed in T_2 group (173.69 ± 1.95 ìg/dl) as compared to T_1 and control groups. The average body weight (kg per animal) recorded in the present experiment showed significant trend (P<0.01) from 0 to 90 days of experiment. The blood malondialdehyde values (ìmol/L) in control group increased significantly (P<0.01) from 0.60 ± 0.06 to 0.80 ± 0.02 in 0 to 90 days of experiment but in T_1 and T_2 groups, blood MDA value decreased significantly (P<0.01) from 0 to 90 days of experiment. Analysis of variance revealed no significant differences during different days of experiment and also amongst the experimental groups of the animal

in respect of blood super oxide dismutase (SOD) and glutathione peroxidase (GPX) concentration. The levels of vitamin C (ìg/ml) were apparently higher from 0 to 90 days of experiment but analysis of variance revealed no significant differences. From this study, it can be concluded that three medicinal plants viz., *A. heterophyllus*, *C. papaya*, *T. bellerica* are rich source of phytochemicals with good antioxidant properties and do not have any harmful effect on normal functioning of the rumen, liver and kidney. Thus, the plant leaves can be incorporated in the diet up to 10% of the total mixed ration.

Therapeutic potential of bone-marrow derived mesenchymal stem cells in wound healing

Mousumi Hazorika

The present experiment was carried out to explore the therapeutic potential of rabbit bone-marrow derived mesenchymal stem cells (rBM-MSCs) in wound healing in New Zealand White rabbits.

The experiment was conducted in the Department of Veterinary Biochemistry, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-781022. Eighteen numbers of clinically healthy male New Zealand white rabbit of 3-4 months with mean body weight of 1.52 kg were randomly divided into three different groups of six animals each *viz.* Gr-I (Control group), Gr-II (Test group-1) and Gr-III (Test group-2). A total of thirty-six surgical wounds were created on the skin of eighteen rabbits with two in each. The Gr-I rabbits received no treatment and was considered as Control group. Gr-II rabbits were treated with a standard drug *i.e.* Povidine iodine ointment (Betadine®, USP 10 % w/w) while Gr–III rabbits were treated with cultured BM-MSCs topically. They were raised under standard laboratory conditions and veterinary supervision throughout the experimental period and were given standard pellet feed. The experiment was conducted in a 2x2 factorial design for a period of 30 days. Bone marrow was collected from rabbits to culture and characterize the BM-MSCs. Blood was collected from all the animals of each group on days 0, 3, 7, 15 and 30 to estimate haemato-biochemical constituents *viz.* haemoglobin, PCV, ESR, TEC, TLC and DLC; serum glucose, total protein, triglycerides, SGOT, SGPT, alkaline phosphatase, uric acid, Ca^{2+}, P, Mg^{2+}, Na^+, K^+, Cl^-, iron, copper, zinc, cytokine proteins: TNF-á, IL-1â, IL-4, IL-6, IL-10 and to study cytokine gene expression pattern during wound healing. Wound area was measured on days 1, 3, 7, 15, 21 and 30 of each animal, of different experimental groups. Tissue was collected on day 10 and day 20 of surgery from each animal of different experimental groups to estimate certain granulation tissue markers *viz.* LPO, NO; SOD, CAT, GSH, vitamin A, vitamin C, vitamin E; MPO; protein and DNA; and connective tissue markers *viz.* HYP, HXA, HUA, collagen and

elastin. The tissue was also collected on days 1, 10 and 20 of surgery to observe the histopathological changes during wound healing.

The rBM-MSCs was isolated, cultured and characterized as per the standards set by ISCT. The rBM-MSC treated group showed complete healing of wound by day 21 whereas complete healing of wound was observed on day 30 in both Gr-I and Gr-II. All the haemato-biochemical constituents were found within the normal range throughout the experimental period. However, the levels of certain parameters significantly increase or decrease amongst the groups with the advancement of time. The rBM-MSCs significantly increased the antioxidants' levels and reduced the generation of free radicals' and acute inflammatory marker on day 10 and day 20 of surgery. Significant increase observed in the content of granulation tissue biochemical markers (protein and DNA) and connective tissue markers (HYP, HXA, HUA, collagen and elastin). Histopathologically, the BM-MSCs treated group showed early tissue changes compared to other groups and approximately resembles the adjacent normal skin on day 20.

On the basis of macroscopic, biochemical and histopathological evaluation of wounds, it can be concluded that the rBM-MSCs can be used successfully for the treatment of surgical wounds without any significant adverse effects on the animal.

Exploration of cytokine profiles for prediction of successful pregnancy and lactation and manipulation of cytokine level using certain stimulant in cross bred cows of Assam

Juri Barkakati

The present study was conducted to explore the cytokine profile of crossbred cattle of Assam for the prediction of successful pregnancy and lactation and to manipulate the level of cytokine by using certain cytokine stimulants/ regulators/plant leaves. Selected animals was divided into five groups keeping six in each in accordance with the feeding of different cytokine stimulator/regulator. All cows included for the experiment was in similar managemental practices and were offered same type of ration throughout the study. Group I was control without any treatment. Group II was treated with neem leaves (*Azadirachta indica*) at the rate of 3gm per kg body weight, Group III was fed with bogori leaves (*Zizyphus mauritiana*) at the rate of 300 mg per kg body weight orally. Group IV and group V were fed Restobal, a herbal immunomodulator at the dose rate of 50 ml orally and bamboo leaves (*Bambusa bambos)* at the rate of 3gm per kg body weight daily from the last three months of pregnancy to three months after parturition. Inflammatory indices, liver specific biomarkers, energy metabolism indices, protein metabolism index, oxidative stress response, different serum minerals etc. and different hematological parameters were estimated. Estimation of different cytokine profiles was carried out namely TNF-á, IL-1â. IL-6, IL-10 in serum. And record of daily milk yield and growth performance of calves with different cytokine stimulator/regulator/plant leaves. A non significant rise in the level of RBC count was seen in group IV (Restobal treated) in the late gestation than that of the control group. All the groups showed a similar trend of increase in RBC count till late gestation and then a decline on the day of calving and thereafter. Overall mean showed that there was a higher level of haemoglobin in group II followed by group IV, group III and II. All the groups showed an apparent rise in the level of haemoglobin than that of control

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group. Overall mean of WBC count in Group II and III were found to be higher than that of the control group but the increase was not significant. No significant difference was observed between the control and treated groups. A higher level of protein was found in group II and group V as compared to the control group which was non significant. A significantly higher (P < 0.0001) level of protein was recorded 30 days after parturition than that of the day of calving. Group II (Neem fed) and group IV (Restobal treated) had a significantly higher (P <0.001) level of globulin as compared to that of the control group. A non significant reduction in the level of creatinine in group IV after parturition . Almost all the groups showed a higher level of albumin during the late gestation which showed a slight decline around calving and on the day of calving and then there was gradual increase in the level of albumin after around one month post parturition. Lower level of total bilirubin was recorded in the experimental groups as compared to the control group. The pre partum values of the paraoxonase enzyme was found to be higher than the level at calving and at postpartum .No significant difference in the overall mean between the experimental groups and that of the control group was recorded. The experimental groups showed a higher level of GGT enzyme activity upto the day of calving and then thereafter showed a reduced level at postpartum . There was a non significant decrease in the level of ALP in the experimental groups as compared to that of the control group. Significant difference   (P<0.01) was found in between group I and III and in between group I and V. (P<0.05).The groups showed a higher level of SGOT at parturition which declined after calving. There was non significant decrease in the level of SGOT in the neem treated group.Lower level of NEFA was found in group III and IV as compared to the control group. The groups showed a higher level of NEFA during early lactation. Group I, II and III showed a lower level of beta hydroxyl butyric acid as compared to the control group. However, an increase in the level of BHBA was recorded in group V than that of the control group. Group II (neem leaves fed) and III (Bogori leaves fed) showed a higher level of SOD as compared to the control group. Antioxidant enzyme activity was found to be higher at prepartum, then showed a reduction in the level at calving and thereafter there was gradual increase in the activity of enzyme at early lactation. Enhanced antioxidant activity was observed in the treated groups as compared to the control group. Dietary Neem leaf meal did not significantly (P>0.05) affect the calcium, sodium and potassium levels but significantly (P<0.05) decreased the phosphate level while significantly (P<0.05) and steadily, increasing the chloride level as its level increased.   Group II that was fed with neem leaves showed a high preparum level of TNF -á and the peak level (1248.33±226.53 pg/ml) on the day of parturition. The increased level of tumor necrosis factor alpha (TNF-alpha) might be due to the cytokine and immune system stimulating property of neem plants. Significantly lower level of IL-6 was recorded in group III (*Bogori* leaves fed) and group V (bamboo leaves fed) than that of control. IL-6 level increased non significantly in the Restobal treated and Neem treated group. The level of IL-10 showed an increased level up to the day calving and then a decline was recorded approximately 15 days after calving. Significantly higher level of IL- 1â was recorded in group II (neem treated) (P<0.001) and in group V (P<0.01) than that of the

control group. The level of (IL-1â) showed a high level during the advanced stage of pregnancy.Overall mean level of milk yield (litres) was found to be 9.25± 0.115 in group 1, 9.7 ± 0.137 in group II, 9.3±0.139 in group III, 9.6± 0.133 and 8.63±0.085 in group IV and V respectively.All the experimental animals differed significantly from that of the control group, except group IV .The highest average milk yield was recorded in group II (neem fed) followed by group IV (Restobal treated) and then group III (Bogori leaves). A lower level of milk yield was found in group V (bamboo leaves fed). The highest body weight was recorded in group IV (Restobal treated) followed by group II (neem fed) and then group III and V. supplementation of neem leaves , Restobal, Bogori leaves has a positive effect on the performance of the animals. The cytokine regulators/plant leaves used in the study can be given to the animals during pregnancy which might play an important role in enhancing immunity, maintenance of pregnancy and a successful lactation period.

Molecular marker for diagnosis of canine breast cancer and antitumour effect of synthesized cationic peptide to corresponding cancer cell line

Deekshita Rajkhowa

Canine Mammary Tumour (CMT) is the most common neoplasm in dogs, sharing many similarities with human breast cancer and so used as animal model for human breast cancer research. Owing to the lack of prompt diagnosis with effective treatment for CMT, present study was taken up to detect a molecular marker for diagnosis of CMT and to study the antitumour effect of a designed cationic anticancer peptide (ACP1) in corresponding cancer cell line. DNA was isolated from a total of 30 dogs. Histopathological sections from mammary tissue samples of 10 tumour positive dogs showed some of the characteristic changes depicting signs of mammary tumour. Since mutations in *BRCA1* and *BRCA2* genes, have been found in most cases of inherited CMT, the identification and analysis of these markers were done to detect the presence of tumour. The size of the PCR products for *BRCA1*(exon 9) gene was 475 bp and that for *BRCA2* (exon 27) was 535 bp . Nucleotide sequence analysis by MEGA 5 software revealed a change of a -› c in the *BRCA2* cancer sample as compared to the normal, that resulted in the creation of a new restriction site for SsiI restriction enzyme. On further digesting the PCR products with SsiI, two fragments of 392 bp and 143 bp were yielded from the 535 bp *BRCA2* (exon 27) amplicon. Whereas polymorphism of the *BRCA2* (exon 27) gene could not be documented with SsiI from tumour free dog. One cationic peptide predicted from the genomic sequences of Cathelicidin of reproductive tract of buffalo (*Bubalus bubalis*) was selected to design an 'Anticancer Peptide1' (ACP1), the anticancer characteristics of which were predicted by 'Anti CP' web-based peptide prediction server. MCF-7 (Breast cancer) and HeLa (cervical cancer) cell lines were used to study the anticancer efficacy of the designed peptide, along with Piroxicam and Cisplatin as standard anticancer drugs, at various concentrations. The morphological appearance of the cells after 48 hours of post treatment showed an increase in number of rounded cells (indicating apoptosis) when compared with untreated control

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cells in both cell lines. The inhibitory effect of the drugs were studied by their IC50, calculated by linear regression. IC50 of peptide was 810.394 ìg/mL ± 28.008 and 118.675 ìg/mL ± 19.422 on MCF-7 and HeLa cells respectively. Piroxicam showed similar result with IC50 of 74.234 ìg/mL ± 0.855 in MCF-7 and 62.266 ìg/mL ± 4.831 in HeLa cells. Cisplatin too showed a dose dependent inhibition with IC50 of 57.603 ìg/mL ± 3.054 and 12.146 ìg/mL ± 0.112 in MCF-7 and HeLa respectively. Further, staining the cells with Hoechst stain solution showed numerous cells with dense, pyknotic nuclei (the brighter fluorescence) in treated, but not in control MCF-7 cells when viewed using an inverted phase-contrast microscope, confirming apoptosis. Based on these results it can be concluded that presence of a novel SNP in the exon 27 of *BRCA2* gene can be used as diagnostic tool for CMT. The significant cytotoxic effects exhibited by the ACP1 against breast cancer cells *in vitro* suggest an attractive approach for the treatment of canine mammary tumour. Further, *in vivo* clinical studies should be considered before recommending their clinical use either alone or in combination with other agents for treatment of mammary tumour in dogs.

Critical component analysis of climate, sustainability, preference and performance of livestock in Assam

Jupi Talukdar

A "Critical Component Analysis of Climate, Sustainability, Preference and Performance of Livestock Sector in Assam" has been planned with a random sampling technique in Kamrup, Dibrugarh and Bongaigaon districts of Assam to fulfill the above specified reasons. The method of random sampling technique got established when the Deputy Commissioners of each district were discussed. Further after going to the Block office, the villages were also selected as per the directive and facilitations provided by the block/field officials. It was in the village where Snow Ball sampling method was adopted. Based on the needs PCA method was also applied for getting the information relating to the social dynamics of animal husbandry in the study. Data were collected in three sets of pre-tested, reliable and valid interview schedule containing the features of climate, sustainability, preference, and performance. Collection of data were done based on the person actually who is involved in farming, considering analysis on the basis of 20 per cent confidence level and then finding the critical factors, analysis were done. The data such collected were arranged, tabulated, and analyzed so as to arrive at useful conclusion and interpretation so that they become benchmark for animal husbandry policies with regard to production system, supply chain and promotional livestock rearing. Results showed that the average age of the respondents was around 39 years. A good number of the respondents (45.67 %) had medium family size as high as 66.00 per cent of the respondents had nuclear type of family. The average educational qualification of majority (44.33%) of the respondents was of lower primary level. Educational status of majority (63.00 %) of the other member of the family of the respondents was higher secondary level. Average 14.58 numbers of livestock in the pooled sample could be considered towards a healthy sign considering the fact that large majority of farm people in whole of the districts had landless to marginal categories of

farmers. The average annual family income of the respondents was Rs.1, 62,095/- and majority of them fell in middle income group. The average respondents own income was found to be Rs.116393/- and majority of them fell in middle income group. Majority (74.00%) of the respondent's received medium income of Rs 29056 from livestock farming. The major sources of personal income of the respondents was Agriculture (29.80%) followed by animal husbandry (22.18), business (10.55%), fishing (8.28), art and culture (7.37%) , handicraft (5.90%), transport of item (5.62%), services (5.48) and household items (4.82%). Food (35.36%) and Education (22.66 %) were the two main areas in which maximum expenditures were made by the respondents in this study. Most of the respondents were having medium social participation with 3.47 numbers of times per year with the society and bringing it at a reflection of development, proliferation or non-orthodox atmosphere among the people of the districts. Most of the respondents were having medium to higher level of extension contact with 7.07 numbers of times per year among the respondents in different districts, which was definitely an encouraging phenomenon. More than 80 per cent of the farmers were having awareness about different farm related problems. Farmers involved in mass media contact belonged mostly to medium level category with 6.62 average numbers of areas per year. Majority of the respondents (76%) were involved in progressive livestock rearing practice. Land ownership was the most preferred indicator of progressive livestock farming in all the three districts. Different indicators of progressive livestock farming can be listed from highest to lowest impact as follows- Land ownership (6.19%), Association with the society (5.97%), Innovativeness (5.95%), Ideal family members to help farming (5.76%), More time to spend with animals (5.75%), Entrepreneurship Habit (5.73%), concern for quality (5.58%), Enduring livestock keeping (5.55%), Leadership Quality (5.51%), Willingness of people for farm products (5.27%), Contact with extension worker (5.18%), Economic orientation (5.06%), Self employment (4.87%), Religious mindedness (4.85%), Good market (4.83%), Educational qualification (4.72%), Good size of the farm (4.50%), Keeping hope for future generation (4.44%), Mass media contact (2.65%) and Political affiliation (1.64%). Most of the farmers realizing factors that affected animal husbandry development belonged to medium group level. Flood has been recognized as the most important factor affecting Animal Husbandry in all the three districts. Different micro-climatic factors affecting animal husbandry can be ordered in terms of their impact as follows- Flood (6.09%), Less availability of grass (5.82%), Parasitic infestation (5.72%), Education (5.66%), Draught (5.56%), Increasing cost of animal husbandry (5.39%), High temperature (5.37%), Less per capita availability of land (5.16%), Misunderstanding with neighbors (5.03%), Low rainfall (4.96%), Land used for infrastructure (4.83%), Social standing (4.71%), Lack of technical people in field (3.82%), No departmental support (3.66%), Pollution in water (3.62%), Soil erosion (3.41%), Job in public/private sector (3.22%), Frequency of visiting dignitaries (3.15%), General atmosphere (2.95%), Pollution (2.88%), Traditional rituals and festivals (2.78%), More dust in air (2.34%), Vehicular traffic (2.11%), Stringent rules and regulations (1.77%). Cattle was the highest preferred species in all the three districts, Kamrup (70.00%), Dibrugarh (65.00%), Bongaigaon (62.00%) while Bee keeping remained the least preferred farming

practice in all the cases. Number of years of involvement in farming by the farmers of the Dibrugarh district was highest against Kamrup district to be the lowest. The overall ranking of the six different livestock species in terms of their profitability was as follows, Cattle (1575.00), Pig (692.33), Goat (503.67), Buffalo (453.00), Sheep (128.67) and Bee keeping (95.33). Flood was regarded as the most serious problem by the respondents of Dibrugarh and Bongaigaon districts while the same for Kamrup was the scarcity of fodder. The average degrees of changing status of livestock farming were 2.56. This in equivalent value revealed that the sector was slowly progressing. Association of the respondent with the market of the district Kamrup was highest and for Bongaigaon was found to be the lowest. The price of the farm product of the district Kamrup was highest and for Bongaigaon was found to be the lowest and the mean prices in the three districts varied significantly from each other. The mean transaction in market among the respondents in the districts of Kamrup was significantly higher than that of Bongaigaon district but it was marginally lower than that of Dibrugarh district. Most of the respondents preferred to sell their livestock product and produces to whole sellers. The mean satisfaction of the Kamrup district was found to be highest and the same for Bogaigaon was the lowest. Whenever and wherever animal husbandry produces and products were traded, there was no difficulty in selling them off and as such the chance of spoilage was minimum. The local sources in different extent and that could be ranked (overall) in terms of the gradually decreasing local procurement as follows Cattle (79.49%), Pig (52.13%), Goat (47.50%), Honey bee (24.37%), Sheep (23.50%) and Buffalo (11.97%). Cattle enjoyed highest demand and high profit oriented, because of traditional more acceptance of cattle milk over the milk produced by other species. Majority of the changes taking place in livestock sector were in medium group of distribution i.e. 71.67%. Marketing (6.91%) is the highest degree of changes occurring in the livestock sector.

Geodynamics and tribal livestock farm women's transition in Assam

Monosri Johari

Different ethnic groups of farm women in hilly tracks of Assam are trying to earn their livelihood against all hopes. The study was conducted in the two hill districts of Assam namely, the Karbi Anglong and the Dima Hasao district with the displaced women numbering 200 to find out the frequency of social displacement and hardship, knowing the status of animal health, disease distribution and resilience in terms of changing role, strategies adopted to combat with dynamics of geo and socio-ecological systems and working out a pro-poor value chains: market access and sustainability. The relevant data to fulfil these objectives were collected through a pretested, reliable and valid interview schedule. The study revealed that the average age of the respondents was about 37.72 years with education level up to middle school having about 4-5 number family size and the order of concentration of occupation was agriculture, followed by animal husbandry, business, weaving and craft. Majority of the displaced women were Dimasas and Karbis. Best thing in their earlier place of stay was rearing of livestock was easier and better while the new place had good road connection. The frequency of social displacement in terms of distance (k.m.) varied from about 3 Km to 200 Km and length of time of displacement in terms of years varied from 4-28 years The features of earlier place were "Earlier livestock could be reared in zero inputs", "There was a sense of community care for the livestock while letting the animals loose or bringing them back home. Hardships faced due to displacement were "The total agricultural land has become lesser causing food crisis for livestock", "There is always a danger of predators, their number is more now" and "Production and productivity of the available land are lesser affecting food availability for livestock". All the respondents had "free access to community land" and had "fully settled" down in new place. Majority of the respondents had medium level of land used for housing, for growing staple crop and vegetables but there were marked variations in land use pattern in construction of livestock shed. Condition of respondents' house and animal/poultry shed were "man and animals

share same courtyard", "kaccha floor", "wooden planked floor", "animal sheds are at a distance from main house", "iron sheet roof" and "thatched roof". Majority of the respondents' reason of displacement were "For better mobility of men and works", "Communal clash" and "Landslide". The average score on number of times per year animals suffered from diseases was 2.07 with occurrence of "FMD", "Humpsore", "Mastitis" and "Parasitic infestation" in cattle, "FMD", "Humpsore", "Calf scour", and "Parasitic infestation" in buffalo, "Contagious ecthyma", "Goat pox", "Mastitis", "Enterotoxaemia", "Mange" and "Parasitic infestation" in goat, "Swine fever", "Scrotal hernia", "Piglet anaemia" and "Piglet diarrhoea" in pig , "Ranikhet", "Cocciodiosis" and "Fowl Pox" in local chicken and Duck plague in duck . Only sometimes doctors were called mostly local treatment was given by the displaced farm women. Those treatment were Hanserong (Roselle, *Hibiscus sabdariffa*) leaves and seed is boiled and its water is mixed with rice grain and then fed to the bird for treating fever and diarrhoea", "Turmeric paste is mixed with rice grain and then fed to the bird during fever", "Distill wine is given to the bird when they suffer from fever", "Kerosene mixed with rice and fed to the bird for treating fever", "Mishimao (*Clerodendrum infortunatum*) leaves cook along with the feed and fed to pig during fever", "Dry fish were fed to the cow during bloat", "Crushed chilly applied on the eye during infection", "Jackfruit leaves (*Artocarpus heterophyllus*) were fed during abdominal pain in goat"," Raw turmeric and salt applied in the affected area during scabies in goat", "Chilly and tamarind were applied in the tongue during F.M.D", "Salt and chilly rubbed in the tongue during F.M.D", "Misaghi leaves (*Sarcochlamys culcherrima*) and banana flower cooked along with the feed and fed to pig for treating diarrhoea", "Opium (*Papaver somniferum)* leaves rolled in the tender banana leaves and then fed to cow for curing diarrhoea", "Guava (*Psidium gujava*) and (*Paederia foetida*) leaves were fed during diarrhoea in goat, cow and buffalo" and "Crushed mugungrema (*Blumea lanceolaria*) leaves were mixed with mud and then applied on the wound in buffalo, goat and pig". Roles women played were "Preparation and collection of feed for livestock", "Caring of disease animals", "Milking of animal", "Bring the animals from grazing area in evening", "Separation of sick animals", "Pregnant animals are taken care of by women with full efficiency", "Cleaning of feed mangers and water troughs occasionally" and "Cleaning of animals shed occasionally". Roles women play when livestock died were "Throw the bird in forest", "Clean the place where bird or animal was found dead", "Bury the bird in ground" and "Consume the bird if large". For animal health "Only kitchen wastes are provided to animals once in the evening", "No feed supplement is given to animals", "Animals go out and come in at their own free choice regularly" and "Separation of sick animals". For animal resilience the displaced farm women "Kept the animals together in safer place whenever required", "Maintained regularity in free grazing", "Provided supplementary feed when in scarcity" and "Taking special care for pregnant animals in feeding and husbandry practices". Efforts taken by displaced farm women to combat with geo and socio-ecological change were "The houses have been made in accordance with the social needs and demands", "Now a days livestock remain under observation even when they graze freely", "Increased the number of livestock reared

so that income is increased" and "The house making is in accordance with the geo-ecological location". Effects on livestock and their produces/ products were there was increase in "Scope of self -employment", "Transport and communication for livestock and products", "Interest of youths for livestock rearing", "Socialization by women for different official and organizational activities" and "Cost of production per unit". Problems of farm women rearing livestock were "Lack of market information", "Lack of business management skills", "Economic problem", "Medicines and vaccines are costly", "Lack of easy approach to veterinarian", "Insufficient access to capital and credit", "High cost of animal feed", "Less training on scientific training", "Limited access to extension service" and "Transportation cost". Measures adopted with excess produces or the limited produces for value addition and better remuneration "smoke pork", "smoke carabeef", "smoke chicken", "smoke fish" and "fermented fish" product were prepared. Issues distressing women farmers' access to market were "Insufficient access to capital and credit", "Lack of market information", "Lack of business management skills among women farmers" and "Arranging one vehicle for the sale of one's own products is not economic and other women do not come together". For sustainability steps was taken only in social dimension "Gender equality", "Status equality", and "Community relationship".

Growth performance of crossbred pigs maintained on azolla protein substituted feed

Dhrubajit Hazarika

An experiment was conducted at the National Agricultural Innovation Project (Component-2) sub-project on "Value Chain on Novelty Pork Products under Organized Pig Farming System", College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-781 022 during the period from September, 2013 to February, 2014. A total of thirty (30) weaned crossbred (Hampshire ´ Assam local) piglets (irrespective of sex) of an average age of 50-60 days were randomly selected and divided into five (5) groups depending upon propinquity of body weight and age in such a manner that each group consisted of six (6) piglets with almost similar group average in terms of body weight. The experiment was carried out to study the growth performance, carcass characteristics and meat quality of Crossbred Hampshire pigs fed on Azolla protein substituted feed *viz*., conventional ration (C), sun dried Azolla feeding by replacing 25 per cent GNC of conventional ration (T_1), sun dried Azolla feeding by replacing 50 per cent GNC of conventional ration (T_2), ensiled Azolla feeding by replacing 25 per cent GNC of conventional ration (T_3) and ensiled Azolla feeding by replacing 50 per cent GNC of conventional ration (T_4). At the end of the experiment, 3 animals from each group were slaughtered to study the carcass characteristics and meat quality traits by following the humane slaughter method.

The average daily and final body weight gain, linear body measurement of crossbred Hampshire pigs of present study was found to be non significant (P>0.05) among the treatment groups. However, a slightly higher value was recorded in respect to daily (0.386±0.013kg) and final body weight (83.15±1.92kg), linear body measurement *viz*., body length (0.245±0.013cm), height at wither (0.232±0.004cm) and heart girth (0.228±0.003cm) for pigs reared under T_4 group.

The body weight and linear body measurements of pigs was found to be highly correlated (P<0.01) to each other. On regression analysis of body weight on height at wither, body length and heart girth it was revealed that, for per kg weight gain of pigs significantly (P<0.01) highest contribution was made by height at wither.

The total feed intake per pig per day on dry matter basis was found to be almost similar among all the groups, however, better feed conversion efficiency (3.26) was recorded for T_4 group of pigs while the highest was revealed by control group (3.37) of pigs. From the present study it was found that Azolla contain a high percentage of protein (25.40±0.19 and 25.67±0.24 per cent for sun dried Azolla and ensiled Azolla, respectively) with a well balanced proportion of mineral profile.

The slaughter weight, hot carcass weight, dressing per cent, whole sale cuts (*viz.*, ham, bacon, loin, picnic, boston butt and jowl), meat : bone ratio, weight of expelled blood, weight of edible (*viz.*, heart, liver and kidney) and inedible offal (*viz.*, head, fore and hind feet, spleen, lung, tail and stomach), morphometry of intestine (length, diameter and weight), carcass measurement and WHC revealed non significant (P>0.05) difference among the treatment groups. However, slightly higher values were recorded in respect to all the above parameters for pigs reared under T_4 group. The mean pH value of *L. dorsi* muscle of pigs were revealed highly significant difference (P<0.01) within different treatment groups and between various time intervals. The ultimate pH of *L. dorsi* muscle for group of pigs reared under T_2, T_3 and T_4 attained at 18 hours whereas for group of pigs reared under C and T_1 attained at 24 hours after slaughter. The colour characteristics and textural properties of *L. dorsi* muscle had no significant (P>0.05) difference among the treatment groups. For Sensory evaluation, the panelist rated samples of pork from all the treatment groups almost equally.

Proximate composition of *Longissimus dorsi* muscle revealed non significant differences for pork samples among the treatment groups. However, mineral profile of *L. dorsi* muscle of pigs under different treatment group revealed that manganese, zinc content was significantly (P<0.01) higher in Group T_4 pork samples than the other groups while iron and copper was significantly (P<0.01) higher in Group T_4 pork samples than C and T_1 group. However, no significant (P>0.05) differences was recorded for magnesium content of pork samples between groups.

The study on comparative economics on feeding revealed that the lowest cost of production per kg live weight gain was recorded at Rs. 58.09 for T_2 group of pigs followed by Rs. 59.81 for T_4 group of pigs, while the highest cost of production was recorded at Rs. 64.00 for C group of pigs. The lowest cost for per kg pork production was recorded at Rs. 134.00 for T_2 group of pigs followed by Rs. 137.00 for T_4 group of pigs, while the highest cost of production was recorded at Rs. 142.00 for C group of pigs.
Hence, it may be concluded that for economic pig production, dried Azolla at 50 per cent may be recommended as a substitute of GNC. But for the increased cost of production, ensilaged Azolla may also be recommended for GNC substitution at 50 per cent to ensure year round availability of this protein rich feed resource alternative in the ration of crossbred (Hampshire x Assam local) pigs.

Effect of modified housing on growth performance and certain reproductive traits of crossbred cattle

Deepak Kumar Borah

Fifteen numbers of healthy crossbred female calves of similar age (around six months) and body weight (average 68.18 kg) were randomly selected and assigned to three different housing systems i.e. T_1 - house with conventional manger, T_2 - modified house with lower ventilation and with elevated manger and T_3 - modified house with lower and upper (ridge) ventilation and with elevated manger . The Statistical analysis of the experimental data were done as per standard Statistical method with the help of the computer program, SAS Enterprise guide 9.4 Version.

The growth performance of crossbred cattle raised in T_3 group (0.208±0.004kg/day) and T_2 group (0.198±0.006kg/day) were higher to that of a comparable group of cattle raised in T_1 group (0.181±0.005 kg/day) and highly significant (P<0.01) differences was observed in daily body weight gain (kg) among the treated groups(T_1, T_2 and T_3).The changes in linear body measurements revealed increase in body length (41.197±0.357 inches) and increase in heart girth (44.249±0.273 inches) as well as height at withers (41.22±0.33 inches) in T_3 group of cattle and highly significant (P<0.01) differences were observed in respect body length (inches), heart girth (inches) and non-significant (P>0.05) differences were observed in respect height at withers (inches) in all the treated groups .The correlation of seasonal average body weight (kg) of crossbred cattle with linear body measurements viz. body length (0.976), heart girth (0.990) and height at withers(0.992) in T_3 were observed highly significant (P<0.01) differences among the treated groups.

The data for overall of the study period was found to be 28.52±0.73 and 17.89±1.01 for macro environment, 29.52±0.71 and 18.89±1.03 29.02±0.72and 18.39±1.02 and 27.52±0.70 and 16.89±1.06 for micro environment, for, T_1, T_2 and T_3 groups respectively. The critical difference test revealed non-significant differences in regards to macro and micro environment in different season in both maximum and minimum environmental temperatures both during stage 1 and stage 2. The overall average morning RH (%) inside

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and outside of the experimental sheds (T_1, T_2 and T_3) were found to be 90.22±0.74, 87.89±0.72, 86.56±0.75 and 93.56±0.73, respectively and significant (P<0.01) differences were observed in overall seasonal morning RH (%) inside and outside of the experimental sheds (T_1, T_2 and T_3). The overall average evening RH (%) inside and outside of the experimental sheds (T_1, T_2 and T_3) in all seasons were recorded as 62.47±1.40, 60.31±1.51, 59.17±1.52 and 65.67±1.47, respectively and non-significant (P>0.05) differences were observed in overall seasonal evening RH (%) inside and outside of the experimental sheds (T_1, T_2 and T_3).

A significant (P<0.05) differences were observed in average concentrate intake (kg) in all the treated groups (T_1, T_2 and T_3), in all seasons and showed lowest average concentrate intake (kg) in T_1 group and highest in T_3 group and highly significant (P<0.01) differences were observed in average green fodder consumption (Kg) in all the treated groups (T_1,T_2 and T_3), in all seasons and moreover, non significance (P>0.05) differences were observed in average dry fodder (paddy straw) consumption (Kg) of cattle in all the treated groups (T_1, T2 and T_3), in all seasons. Non significant (P>0.05) differences were observed in overall average water intake (litre) of crossbred cattle in all the treated groups (T_1, T_2 and T_3), in all seasons and showed lowest average water intake (litre) of crossbred cattle in T_3 group and highest in T_1 group. Moreover, highly significant (P<0.01) differences were observed in average Feed conversion ratio (FCR) of cattle in all the treated groups (T_1, T_2 and T_3), in all seasons and showed lowest Feed conversion ratio (FCR) of crossbred cattle in T_3 group and highest in T_1 group.

Respiration rate, pulse rate and rectal temperature of the crossbred cattle subjected to various treatments were not significantly different from each other but slightly higher values were revealed by the group of cattle reared under T_1 in comparison to T_2 and T_3 and non significant (P>0.05) differences were observed in average respiration rate, pulse rate and rectal temperature of crossbred cattle in all the treated groups (T_1, T_2 and T_3).
The overall age at puberty (days) and the age at first conception (days) were 714.80±5.96 and 769.07±5.93 respectively and highly significant (P<0.01) differences were observed in respect of the age at puberty (days) and the age at first conception (days) of the experimental crossbred cattle. In the present study the age at puberty (days) was shorter and the age at first conception (days) was earlier in crossbred cattle reared under T_3 than T_2 and T_1 group. Both age at puberty and age at first conception differed significantly (P<0.01) in all the groups.

The total expected return during the study periods (630 days), in T_1, T_2 and T_3 groups were found to be Rs. 3988.95, Rs. 5999.75 and Rs. 9428.10 respectively. The maximum return was observed from the animals housed in the shed with lower and upper (ridge) ventilation with elevated manger i.e. T_3 group followed by T_2 group where the animals were housed in the shed with lower ventilation with elevated manger while minimum return was recorded in T_1 group where animals were housed in conventional manger. From the economics of return, it is clearly showed that the positive impact of modified housing system for rearing of crossbred cattle which has also been reflect on growth, micro climatic

environment, feed consumption and efficiency, physiological effect and on reproductive performances.

Considering the growth rate, feed intake, feed conversion efficiency, physiological and reproductive performances as well as economics of rearing, it was observed that T_3 group animals performed better in comparison to T_1 and T_2 groups. Hence modified housing system with lower and upper ventilation with elevated manger may be recommended on the basis of this experiment.

Dietary supplementation of ascorbic acid on performances of swamp buffaloes under farm condition

Dipanjali Konwar

To study the effect of ascorbic acid supplementation on changes in body weight, certain reproductive parameters, physio-hemato-biochemical, hormonal parameters and immune status, 18 swamp buffaloes (336.24 Kg) were divided into 3 groups (T_1, T_2, T_3) of six each. The T_1 group was control, T_2 group and T_3 groups were supplemented with ascorbic acid at a dose rate of 10g/animal/day and 15g/animal /day, respectively.

The mean maximum and minimum temperature recorded inside the shed ranged from 24.18^0 C to 35.39^0C and 13.08^0C to 27.82^0C, respectively. The mean RH% and THI at 6:00 hrs and 14:00 hrs ranged from 83.75 to 91.24%, 59.85 to 80.90 and 65.42 to 88.74%, and 72.40 to 85.92, respectively. The daylight ranged from 10.54 to 13.43 hrs. The overall mean maximum and minimum body weights of T_1, T_2 and T_3 groups were recorded in the month of August and January, respectively, and no significant differences were observed among the groups. Significantly (P<0.05) highest and lowest overall mean DM intake was recorded in the month of January and June, respectively, and no significant difference in DM intake were observed among the groups.

The percent of animal coming in estrus, conception rate and service per conception were 66.67, 50 and 1.5, respectively, in T_1 group, 83.33, 60 and 1.3, respectively, in T_2 group and 83.33, 60 and 1.0, respectively, in T_3 group.

The overall mean respiration rate (breath/minute) recorded at 6:00 hrs was highest (P<0.05) in the month of August (16.60±0.57) and lowest (P<0.05) in the month of January (7.33±0.18). At 14:00 hrs the highest (p<0.05) and lowest (p<0.05) respiration rates were observed in the month of June (26.35±0.45) and January (10.83±0.31), respectively. The overall mean respiration rates in T_1, T_2, and T_3 groups differed significantly (p<0.05) and T_2 and T_3 groups showed significantly (p<0.05) lower respiration rate as compared to T_1 group at both 6:00 hrs and 14:00 hrs. At 6:00, hrs the overall means pulse rate (per minute) were significantly (p<0.05) highest and lowest in July (48.85±0.70) and November (39.71±0.65),

respectively, and significantly (P<0.05) higher in T_2 and T_3 groups as compared to T_1 group. At 14:00 hrs the overall mean pulse rate of T_1, T_2 and T_3 groups was significantly (p<0.05) highest in the month of June (57.52±0.68) and lowest in the month of January (48.44±0.51) and the overall mean pulse rate of T_1 was numerically higher than to T_2 and significantly (P<0.05) higher than in T_3 group. The overall mean rectal temperature (^{0}C) recorded at 6:00 hrs was significantly (P<0.05) highest in August (37.95±0.01) and lowest in January (36.90±0.00) and at 14:00 hrs significantly (P<0.05) highest in June (38.47±0.06) and lowest in January (37.69±0.18). The T_2 and T_3 groups showed significantly (P<0.05) lower overall mean rectal temperature than T_1 group at both 6:00 hrs and 14:00 hrs. The decrease in physiological responses in T_2 and T_3 groups was concurrent to the increase in the dose rate of ascorbic acid.

Significantly (P<0.05) highest and lowest overall mean haemoglobin (g%) of T_1, T_2 and T_3 groups were observed in the month of August (11.59±0.14) and November (10.15±0.13), respectively. The T_3 (11.23±0.12) group showed significantly (P<0.05) higher overall haemoglobin level compared to T_1 (10.67±0.15) and T_2 (10.92±0.14) groups. The overall mean value of Packed Cell Volume (PCV) % was significantly (p<0.05) highest was in the month of August (36.85±0.29) and the lowest (p<0.05) in the month of November (33.43±0.35) and significantly (P<0.05) higher in T_3 (35.89±0.32) group relative to T_1 (34.83±0.32) and T_2 (35.20±0.34) groups. Significantly (p<0.05) highest and lowest overall mean of Mean Corpuscular Haemoglobin Concentration (MCHC) g% of T_1, T_2 and T_3 groups were recorded in the month of July (31.53±0.28) and November (30.38±0.34), respectively. The overall mean MCHC were non-significantly higher in T_2 (31.01±0.23) and T_3 (31.28±0.14) groups than T_1 (30.60±0.25) group.

Significantly highest (p<0.05) and lowest overall mean serum glucose (mg/dl) of T_1, T_2 and T_3 groups were recorded in the months of June (61.98±7.87) and November (51.30±7.16), respectively, and T_2 (56.03±1.06) and T_3 (55.31±1.17) groups had significantly (p<0.05) lower overall mean serum glucose level as compared to the T_1 (59.64±0.94) group. The overall mean serum total protein (g/dl) of T_1, T_2 and T_3 groups was significantly (p<0.05) highest in November (7.52±0.19) and lowest in July (6.63±0.15) and non-significantly lower in T_2 (7.00±0.14) and T_3 (6.87±0.16) groups as compared to the T_1 (7.29±0.13) group.

Significantly (p<0.05) highest and lowest overall mean serum AST (IU/L) of T_1, T_2 and T_3 groups was recorded in the month of June (104.99 ± 5.28), and November (83.47 ± 4.49), respectively. The overall mean value ALT (IU/L) of T_1, T_2 and T_3 group were not significantly affected by months. The overall mean serum AST and ALT were lowered in ascorbic acid supplemented groups but differences among the groups were non-significant.

There was no significant effect of months on overall mean serum triiodothyronine (nmol/l) concentration. The overall mean serum triiodothyronine concentration in T_2 (2.54 ± 0.01) and T_3 groups (2.55 ± 0.01) were significantly (P<0.05) higher compared to the T_1 group (2.47 ± 0.01). The overall mean concentration of serum thyroxin (nmol/l) was significantly (P<0.05) highest in June (181.72±0.68) and lowest in October (157.14±9.14) and November (157.14±9.10). The serum thyroxin level was numerically higher in T_2 group

(167.18±4.28) and significantly (P<0.05) higher in T_3 group (177.05±1.39) as compared to T_1 group (159.59±6.50). The overall mean serum cortisol (nmol/l) of T_1, T_2 and T_3 groups was highest (P<0.05) in the month of June (72.00±0.24), lowest (P<0.05) in the month of October (64.40±0.80) and significantly lower in T_2 (65.97±0.69) and T_3 (64.97±0.70) groups relative to the T_1 group (70.60±0.42).

The overall mean Leucocyte count (TLC) thousands/cmm in T_1, T_2 and T_3 group were significantly (P<0.05) highest and lowest in June (8.27±0.31) and November (6.24±0.33), respectively. The T_2 and T_3 groups had non-significantly lower TLC in than the T_1 group. The overall mean lymphocyte (%) were similar among the months, but significantly (P<0.05) lower T_1 (58.57±0.43) as compared to T_2 (59.70±0.28) and T_3 (59.80±0.39). Neutrophil (%) showed no significant variation either among the months or treatments. The overall mean eosinophil (%) was not affected of months and non-significantly higher in T_1 group than T_2 and T_3 groups. The values of % monocyte were relatively constant and no significant difference were observed either month wise or among the treatments. Basophils could not be detected during the experimental period.

Status of livestock marketing in Assam

Rupam Bhattacharjya

An investigation was undertaken to ascertain the present **status of livestock marketing in Assam.** For systematically conducting the research work a preliminary survey was undertaken by the researcher throughout the entire state in order to have an idea about livestock marketing. Besides this secondary data were also collected from different sources and a comprehensive list of livestock markets in Assam was prepared, which included a total of twenty six livestock markets. From these twenty six markets, thirteen markets were randomly selected for the present study. From each market a total of 40 respondents were selected to make the sample size 520. They were in the lower Brahmaputra Valley Zone - Nine mile cattle market, Bhutnath goat market, Sonapur livestock market of Kamrup district, Dhamdhama livestock market of Nalbari district and Gauripur livestock market of Dhubri district, the North Bank Plain Zone - Banglaghar livestock market of Darrang district and Dhalpur market of lakhimpur district, the Central Brahmaputra Valley Zone - Jaluguti livestock market and Buragaon livestock market of Morigaon district), the Upper Brahmaputra Valley Zone - Rajmai livestock market of Sivasagar district and Behora livestock market of Golaghat district, the Barak Valley zone - Nitainagar livestock market of Hailakandi district and the Hills Zone Parokhowa livestock market of Karbi Anglong district were selected. The survey work was undertaken for a period of one year i.e. from September 2014 to August 2015. The purpose of livestock marketing in Assam is exclusively socio-economic. 58.07 per cent of farmers used to sell their animals at times when there is urgent need of money. Further need of money during festivals, fear about sickness and natural calamities like flood and draught etc were also the factors for sale of animals. A major portion of animals purchased by buyers (40.00 %) were solely meant for meat purpose and a small portion for agricultural, selling to other customer or for sacrificing purpose.

In Assam, majority of the animals were marketed during winter season followed by autumn and spring seasons. The summer season happened to be the lowest marketing season.

Cattle and buffaloes are generally transported on foot, by pickup van or by trucks. Sheep and goat are transported on foot, by bicycle/rickshaw, by water route, by mini truck or by auto van. Similarly pigs are transported by pickup van, auto van etc. All the livestock arrived in the market are not sold off the same day. There is a clear pattern in sold animals as a proportion of the number of their arrivals. The percentages are higher in the case of pigs and small ruminants, while the percentages are lower in the case of cattle and buffalo. Most of the markets are not having sufficient facilities for keeping the animals overnight; rather these markets facilitate direct distribution of animals within the market hours.

The most common marketing channel in case of cattle, Sheep and Goat was found to be channel – III i.e. Producer – Wholesaler – Retailer – consumer, and in case of buffalo and pig it was channel – I i.e. Producer – consumer.

Age / Dentition were the most common method for price fixation of cattle and buffalo, but in case of goat, sheep and pig health/ weight were the most common methods for price fixation in Assam.

In Assam majority of the markets are situated in rural areas within a range of 21.38±5.25 kilometers away from their respective district head quarters and except few markets majority of the markets are accessible round the year.

Majority of the livestock markets of Assam are in dire need of availability of different types of marketing facilities such as animal sheds, drinking water (both for animals as well as men), veterinary facilities etc.

In Assam the major constraints in selling livestock were lack of infrastructure, high market charges, lack of adequate space and local "bandh". Similarly lack of suitable animals, involvement of middle man, lack of adequate space, high buying price and local "bandh" were the major constrains in buying livestock.

Development of ready-tocook solar and mechanically dried pork products

Sadhana Chowdhury

Pork is one of the most popular meats in North Eastern Region (NER) and there is a growing demand for Ready-to-Cook meat products in recent years in the country including NER. Because of highly perishable nature of fresh meat at room temperature, high cost involved in maintaining refrigeration, necessity of cold storage facility, presence of energy deficient areas in NER, disadvantages of traditional drying methods to increase the shelf-life etc. an approach was undertaken to develop dry Ready-to-Cook pork products, which could be stored at room temperature for a considerable period without affecting its quality. Keeping in view the above facts, the proposed study was undertaken with the following objectives viz. to develop ready to cook solar and mechanically dried pork products with the addition of phytoingredients viz. amla, carrot, mint, round lemon and pomegranate and to study their different physico-chemical, microbiological, oganoleptic qualities by storing with two packaging methods along with their shelf-life and cost of production.

A total of five batches of meat cube and meat balls were prepared with different formulations with or without addition of the phytoingredients. A control group was there for each treatment group. The raw pork were collected from nearby local market and separated in two parts for meat cubes and balls. Meat was cut into small pieces and cured overnight and then marinated with non meat ingredients containing phytoingredients and dried in solar and mechanical dryers. The control group was also dried along with the treated group which contained only cured meat. The meat balls were prepared by curing the minced meat overnight and then bowl chopped with other non meat ingredients and then shape was given as meat balls. They were also dried in solar and mechanical dryers along with the control group. The temperature of the mechanical dryer was maintained at 60° C, whereas in solar dryer it was fluctuating between 50-60°C. The products were packed in food grade High Density Polyethylene (HDPE) and stored at room temperature. The same packaging material was used for both aerobic and vacuum packaging of the products. For sensory evaluation of the products they were rehydrated to a certain period till saturation. The results of the investigation are as follows-

The mean percent of proximate composition of products showed similar trend for both the products as well as in both aerobic and vacuum packaging. Moisture and total ash

Abstract of Ph. D. Thesis
Department : Livestock Products Technology
Major Advisor : : Dr. Mineswar Hazarika

percent showed an increasing trend during storage, whereas crude protein and ether extract showed a deceasing tend during storage. For moisture and crude protein there were no significant differences between control and treated groups but the mean values of ether extract and total ash showed significant differences among control and treated groups. There were significant differences ($p<0.01$) during the storage period up to 180 days for moisture, crude protein, ether extract and total ash in all the samples and in both the drying methods. But no significant difference could be seen in the vacuum packaged products.

The amino acid profile study reveals that the amino acid content was higher in solar dried products than mechanically dried products and control samples had higher values than treated groups. This trend was similar for both meat cubes and balls, whereas meat cubes showed higher values than meat balls and it was observed in both the drying methods. After storage period of 180 days there were changes in all the amino acids and this was not similar for all the amino acids for both the products. The vacuum packaged products showed lesser changes than the aerobically stored products.

The mean values of texture profiles also showed similar trend for both meat cubes and meat balls. The drying methods did not show any difference in texture profiles of the products. Significant differences ($p<0.01$) could be observed in the control and treated groups for hardness, fracturability, cohesiveness and springiness. There were significant ($p<0.01$) decrease for hardness, fracturability and cohesiveness during the storage period whereas significant ($p<0.01$) increase was observed for springiness in storage period. In vacuum packaging, during storage differences were non-significant.

The mean values of colour profile showed significant differences ($p<0.01$) among control and treated groups for both meat balls and meat cubes. Similar trend could be observed for both the products as well as in both the drying methods. The Lm and bm value showed a significantly ($p<0.01$) increasing trend during storage for all the samples, whereas am value showed a significantly ($p<0.01$) decreasing trend. There were significant difference ($p<0.01$) between the control and treated groups. In vacuum packaging, during storage significant differences were not observed.

The shelf-life studies of meat balls and cubes were studied on the basis of water activity, TBARS value and their microbiological studies (TPC, Yeast and Mould count, Presence of Sulphide reducing *Clostridium*). The mean value of water activity showed a significant ($p<0.01$) increasing trend during the storage period in acerbic packaging. It was similar for both meat balls and meat cubes in both the drying methods. There were significant differences ($p<0.01$) between control and treated groups. In vacuum packaging the increase during storage was non-significant.

As the storage period was increasing a significant ($p<0.01$) increasing trend was observed for all the products in all the storage periods. There were significant ($p<0.01$) differences among the control and treated groups i.e. mean values of treatment groups were lower than control groups. In vacuum packaging, the increase was non-significant during storage. The trend of the results was similar for both meat cubes and balls and for both the drying methods.

The microbiological quality studies revealed that in TPC and Yeast and Mould counts were absent in all the storage periods. It was seen in all the samples of meat cubes and balls under both the packaging methods and for both the drying methods also. The Sulphide Reducing *Clostridial* organisms were also found to be absent in all the samples in all storage periods. The results were similar in both the packaging methods. However, after 150 days of storage periods, problems of yeasts and moulds were observed in the meat cubes in aerobic packaging.

The shelf-life of meat cubes and balls were six months at both aerobic and vacuum packaging method of storage. It was similar for both the drying methods.

The dry products were rehydrated until a point of saturation was observed and for meat cubes it took one and half hour to two hours whereas meat balls took three to three and a half hour for saturation. The rehydrated products absorbed 60-65% water until saturation. The dry products were rehydrated in order to study the physico-chemical and sensory qualities of the rehydrated products. There were no significant differences for cooking loss and rehydration capacity (percent) for control and treated groups for both meat cubes and balls. The drying method had also no effect on these two parameters but the meat cubes showed a higher rehydration capacity (percent) than meat balls. Significant differences ($p<0.01$) were observed for pH and a_w between control and treated groups for meat cubes and balls.

The proximate composition (moisture, crude protein, ether extract and total ash) of the rehydrated products revealed that there were significant differences between control and treated groups for both cubes and balls. The texture profile (hardness, fracturability, cohesiveness and springiness) study showed significant differences ($p<0.01$) between the treated groups in both cubes and balls. The colour profile (Lm, am and bm) study also showed significant differences ($p<0.01$) between the samples at both drying methods.

The sensory evaluation studies (appearance, flavour, juiciness, tenderness and overall acceptability) of rehydrated meat cubes showed no significant differences between the samples whereas for meat balls significant differences ($p<0.05$) were observed for juiciness, and overall acceptability. However, the sensory scores were higher for meat cubes than meat balls.

The yield of dried products was found to be 18-20% and after drying one kg of fresh product it could be served upto 8-10 persons. The dry products can be served deepending on method of preparation such as soup, curry etc. Cost of production studies for meat cubes and balls at both drying methods revealed that solar dried products were cheaper than mechanically dried products. The cost of control products per kg were Rs. 1310.81 for solar dried products whereas Rs. 1449.54 for mechanically dried products. The cost of meat cubes were Rs. 1432.22 (solar dried), Rs. 1603.33 (mechanically dried) and the cost of meat balls were Rs. 1410.28 (solar dried), Rs. 1725.57 (mechanically dried). From the above study, between the products solar dried treated group was cheaper than mechanically dried products.

Based on the above study, it can be concluded that microbiologically and organoleptically acceptable dry pork products can be prepared economically with the use of low cost solar dryer.

Studies on the therapeutic potential of a few medicinal plant extracts as memory enhancers on experimentally induced cognitive dysfunction in laboratory animal models

Beenita Saikia

The present study was undertaken to explore the cognition-enhancing activity of different extracts of few medicinal plants. Ethanol, hydroethanol, aqueous, petroleum ether, n- hexane, ethyle acetate and chloroform extracts of seeds of *Zanthoxylum alatum* and leaves of *Conyza bonariensis* were experimentally used to treat scopolamine-induced amnesia in rats and mice. Four (4) different models, universally used for learning and memory studies, were utilized in the present study, *i.e.*, Elevated plus maze (EPM) and Morris water maze (MWM) in mice, Radial arm maze (RAM) and Barnes maze (BM) in rats. The study was targeted to develop plant-based anti-amnesic agents. Preliminary behavioural studies were performed for all the extracts using Morris water Maze. Hydroethanolic extract of *Z. alatum* (HEZA) and petroleum ether extract of *C. bonariensis* (PECB) were found to be more active than other extracts. The extracts were further subjected to detailed biochemical and molecular analyses in order to assess their mechanism of action. The animals were divided into nine (9) groups, each consisting of 6-10 numbers of animals. Tacrine (3 mg/kg; intra-peritonial) was used as standard nootropic drug. Scopolamine (0.4 mg/kg, intra-peritonial) was used to produce amnesia. Phytochemical studies revealed that HEZA contains terpenoids, tannins and saponins; whereas PECB contains alkaloids, flavonoids, terpenoids, saponins and glycosides. HEZA and PECB exhibited cognition-enhancing activity as indicated by a significant reduction in the transfer latency (TL) and increased in inflexion ratio (IR), in the EPM. Likewise, reduction in escape latency (EL) and path length and increased time spent in target quadrant (TSTQ) in MWM; decreased WME (working memory error) and RME (reference memory error) in RAM; decreased escape latency (EL) in BM, indicated protection from loss of memory after treatment with HEZA and PECB. Standard drug tacrine showed similar result.

Abstract of Ph. D. Thesis
Department : Pharmacology and Toxicology
Major Advisor : Dr. Chandana Choudhury Barua

Pretreatment with standard drug tacrine and test drug HEZA and PECB significantly decreased the AChE activity and also prevented scopolamine-evoked oxidative stress by improving reduced glutathione (GSH), catalase (CAT), superoxide dismutase (SOD) and decreasing lipid peroxidation (LPO) and nitrite (NO) level. HEZA and PECB also inhibited the scopolamine-induced â amyloid accumulation and pro-inflammatory cytokines (TNF-á, IL-1â) and also significantly increased the anti-inflammatoty cytokine (IL-10). HEZA and PECB also significantly increased the mRNA expression of *Nrf2*, *HO-1, PP2A* and decreased the mRNA expression of *AChE*, *Tau*, *NFêB* in the hippocampus of mice and rats. The same results were also observed after treatment with tacrine, when compared with scopolamine-treated animals. The immunoblotting assay showed significant up regulation of BDNF and TrkB protein expression with simultaneous down regulation of caspase-3 and Bax protein expression in the hippocampal tissues of mice and rats similar to tacrine, as compared with scopolamine treated group.

In conclusion, HEZA & PECB exhibit multiple pathways for cognition enhancement in scopolamine-induced amnesia in mice and rats. The mechanism by which HEZA & PECB performs anti-amnesic activity could be through inhibition of the key enzymes AChE, preventing Tau aggregation, impending neuro-inflammation, increase BDNF level and its antioxidants property. HEZA showed more potency than PECB in cognition enhancement where as tacrine, showed the best activity in all the models comparable to *Z. alatum*. Therefore, it might be suggested that these two test plants might go a long way in the management of cognitive dysfunctions in human and animal subject. However, further studies are required to isolate the active compounds responsible for cognition-enhancing property.

Identification of *lactobacillus* species as probiotic strain from indigenous chicken and its effects on the performance of broiler chicken

Dr. Gaichamdinliu Gonmei

The present study was aimed to isolate and identify *Lactobacillus spp.* from different segments of gastro intestinal tract of indigenous chicken of Assam of different age group *i.e.* chick, grower and adult followed by the screening of isolates for its probiotic potency tests. Initially, a total of eighty isolates were harvested from crop, proventriculus, jejunum, ileum and caecum, out of which thirty one *Lactobacillus* isolates were characterized through morphological (colony morphology and Gram staining) and biochemical (catalase and sugar fermentation tests) tests. From among the thirty one isolates, five promising *Lactobacillus* were selected for further screening of probiotic properties. For judging the efficacy of *Lactobacillus* as probiotic candidate*, s*creening was carried out through various *in-vitro* probiotic quality assessment tests like aggregation test, resistance to bile salts and acidic conditions, enzymatic test (protease test), cell surface hydrophobicity, co-aggregation test and antagonistic test. From among five isolates, two displayed high aggregation within first 15 to 30 min. upon keeping for 2 hrs. In the acid tolerance test, four isolates were found to be resistant to pH 3. The ox bile of 0.15 and 0.3 % concentration supported growth of all isolates which indicates that *Lactobacillus* isolates can tolerate up to 0.3 % bile salt. In enzymatic activity, all isolates showed almost similar protease activity. Cell surface hydrophobicity ranged from 47.60±1.34 % to 88.00±1.65 % indicating high hydrophobicity and the ability of isolates to adhere to mucus membrane. Co-aggregation between *Lactobacillus* isolates and *E coli* was observed indicating adhesion ability of *Lactobacillus* isolates with pathogenic bacteria. Antagonistic activity tested against *E coli* through well diffusion assay indicated the inhibitory property of *Lactobacillus* isolates.

Based on the results, the isolates which scored highest points *i.e.,* ACE5 and AJ3 were subjected to partial 16S rRNA sequencing and BLAST analysis to identify them at species level and found 99.72 % genetic identity with *Lactobacillus reuteri* for both the

isolates. The isolate is registered as *L. reuteri* PIA16 with the accession no. KX260961under NCBI. Then, the two isolated *L. reuteri* were put into *in vivo* growth bioassay treating as two individual entities as their site of isolation differed. 20 % of daily ration for broilers (starter and finisher) was fermented with 20 % of broth culture having *L. reuteri* 10^8 cfu/ ml. Five treatment groups were provided with different dietary treatments *i.e.,* T_1-basal diet (Control), T_2- basal diet + 1.85×10^8 cfu of *L. reuteri* (ACE5)/ gm fermented feed,T_3- basal diet + 1.89×10^8 cfu of *L. reuteri* (AJ3)/ *gm* fermented feed, T_4-1.85×10^8 cfu of *L. reuteri* (ACE5)/gm fermented feed+ Mannan oligosaccharide(MOS) @ 0.25 % and T_5-1.89×10^8 cfu of *L. reuteri* (AJ3)/gm fermented feed+MOS @ 0.25 % of feed. Through feeding trial, parameters like body weight change, body weight gain, FCR, feed consumption, carcass characteristics, immunity (cell mediated and humoral) were studied. Effect of dietary supplements on carcass traits, livability and economics were also studied. The *L. reuteri* PIA16 at 10^8 cfu dose improved body weight gain, feed consumption and FCR in broiler chickens. The beneficial effect was further improved when supplemented along with prebiotic, MOS. Dietary *L. reuteri* PIA16 along with MOS showed better carcass traits on the basis of organ weights and cut-up parts and also found to enhance humoral and cell mediated immunity. The Broiler Performance Efficiency Index (BPEI) increased from 14.87 to 15.58 per cent in *L. reuteri* PIA16 alone fed groups and from 25.44 to 30.13 per cent in *L. reuteri* PIA16 groups supplemented with prebiotic when compared to control counterpart.

The cost of production was higher in all the broiler chickens fed with dietary *L. reuteri* PIA16 in comparison to control group which was due to higher body weight. However, despite the higher production cost, the gross profit was increased by 0.56 to 0.78 per cent in both the *Lactobacillus reuteri* PIA16 alone fed groups whereas, in the *Lactobacillus reuteri* PIA16 with prebiotics fed groups, the profit increased from 1.29 to 1.50 per cent as compared to control counterpart. Furthermore, the study revealed that the two identified *L. reuteri* strains isolated from different parts of the GIT (caecum and jejunum) was found to be non-site specific. It may be concluded that isolated *L. reuteri* PIA16 from indigenous chicken of Assam has positive effect on growth, FCR, carcass yields and immunity and proves to be a potential probiotic agent.

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Ph. D. Home Science

- Extension and Communication Management (H.Sc)
- Family Resource Management (H.Sc)
- Food Science and Nutrition (H.Sc)
- Human Development and Family Studies (H.Sc.)
- Textile ans Apparel Designing (H.Sc.)

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An Analysis of Work Education Programme under Elementary School Curriculum of Assam

Mrs. Bisnupriya Saikia

Work Education is the pedagogic medium which integrates different need based productive cum economic activities and community service programmes in school curriculum from preschool to senior secondary stage. The goal of education is to bring all-round development of human being which is best possible by inclusion of work education programme in school curriculum. But work education is considered as extracurricular and being neglected in majority of the schools in Assam. Hence the present study was undertaken to explore systematically the existing status of implementation of work education curriculum and various factors affecting proper functioning of work education programme in elementary schools of Assam and also planned to develop a model for effective implementation of work education programme in elementary schools. The present study was carried out in three district of Assam namely: Dibrugarh, Jorhat and Marigaon. Three blocks from each district were selected randomly and from three educational block of each district, fifty (50) upper primary schools were selected. Two respondents (the head master and the teacher concerned) from each fifty selected schools from each district comprised of 100 respondents and finally the total of 300 respondents from the three districts of Assam constitute the sampled respondents of the study. Findings of the study revealed that majority of the schools (99.30%) were fulfilled the minimum norms of 'Right to children for free and compulsory education Act' 2009 (RTE, 2009) in terms of numbers of teachers (one teacher for each class i.e. 3) and teacher pupil ratio (1:35) for upper primary school (96.00%).The percentage of professionally trained teachers in the sampled schools were only 36.78 percent . The study highlighted that the highest percentage (44.15%) of students were from the family having daily wage earning as a means of livelihood and 54.97 per cent students in the sampled schools were girls. About 83.30 per cent schools have pucca building, and on the other hand, permanent boundary wall was found in 26.00 percent only. It is revealed from the study that the schools did not posses any equipment necessary for productive activities other than cleaning equipment (jharu, barhoni kor, Pasi) and cooking uten-

sils for mid day meal. It is noted that a large majority of the teachers (73.30%) used to collect different products at the time of examination for work education which violets the principles of work education. A large majority of the schools (86.00%) had separate periods for work education in their class routine and the rest (14.00%) did not have the provision of work education period in their class routine. Another important aspects observed in the responses of the teachers that all the activities (Total=73) under different areas of work education covered by the study were found to be important for the student of upper primary classes with programme important score (PIS e"1). But the percentage of implementation was found very low. Lack of fund, lack of proper guide book on work education, lack of necessary equipment, lack of boundary wall, lack of laboratory, lack of awareness among parents were the major problems as expressed by the teacher for which the work education was not being implemented in the schools. While considering the knowledge and attitude of teachers it was found that high level of knowledge was found only in 9.70 per cent and a large percentage (59.00%) of the teachers were found to have unfavourable attitude towards work education programme. The study revealed that the training of teacher and level of importance showed highly significant relationship (r=0.202), which indicate that the teachers with professional training found to have high level of importance in comparison to untrained teachers. Teaching experience and problems of teachers was found to have a negative and highly significant correlation with (r= %0.142), which means that teachers with longer period of teaching experience have faced less problems in implementing work education programme in their school. Again, teachers' knowledge and implementation of work education programme have shown positive and highly significant correlation (r=0.206). This relationship indicates that teachers' knowledge has a pronounced influence on implementation of work education programme. The model of Work Education showed effective and proved that special training and exposure is essential for developing knowledge, skill and attitude of teachers which builds confidence to carry out any innovative programme in schools.

Technological empowerment rural women of Assam in Rice production system

Pompi Saikia

The present investigation on "technological empowerment of rural women of Assam in rice production system" was undertaken with the objectives of i) to find out the work profile and time use pattern of rural women in rice production system, ii) to assess the existing knowledge of rural women on recommended rice production system and iii) to enhance the technical knowledge of rural women on improved practices of rice production system through interventions and assess its impact. The study was conducted in two agro-climatic zones of Assam. A multistage random sampling design was followed for sample selection. One district from each zone namely Jorhat of Upper Brahmaputra Valley Zone and Nagaon from Central Brahmaputra Valley Zone were selected randomly. Altogether 400 farm women were included as sample of respondents who were mostly engaged in rice production. Data collection was done by using structured interview schedule. The findings revealed that majority of the rural women (47.75%) belonged to middle age group, married (86.00%) and belong to medium socio economic status (56.00%). Majority of the respondents (94.25%) did not have contact with Extension Officer, source information was husband and 75.25 per cent of the respondents did not participated in any formal training, 52.75 per cent of the respondents were localite and 60.50 per cent had medium level of innovation proneness. Lack of transportation and organization of training in peak season were the major problems faced by the respondents for attending training, which were ranked I and II. Majority of the rural women were involved independently in activities like processing (62.25%), transplanting (57.75%), cleaning (55.50%), drying (54.25%) and winnowing (52.00%). Furthermore, joint participation with husband was reported by more than seventy per cent of respondents in engagement of labour (84.75%), management of cash earned (82.50%), retention of grain for sale (82%), storage of grain (71.5%), seed treatment (70.25%) and more than half in retention of grain for seed (57.75%), and seed selection (55.50%) and the respondents had medium level of knowledge in rice production (61.75%) followed by low level knowledge (24.00%) and high level of knowledge (14.25%). Less than fifty per cent of the respondents

took independent decision in all most all the activities of rice production and had medium level of participation in decision making. Non availability of suitable high yielding varieties was the most important constraint reported by 94.50 per cent of respondents followed by lack of awareness and knowledge about certain technologies (83.50%). Overall a rural woman spent almost 8 hours per day in household work and care of family members followed by almost 6 hours in farm work and only one and half hours was spent for her personal care. Based on the existing technical knowledge of respondents on rice production technology an intervention was given. Before interventions mean score of their knowledge was 11.73 and after intervention at immediate mean score was 19.43. Impact of the intervention programme was found to be significant in terms of gain in knowledge leading social and technological empowerment.

Capacity Building of Rural Women in Homestead Garden for Sustainable Horticultural Development

Pritimoni Gogoi

The present investigation on capacity building of rural women in homestead garden for sustainable horticultural development was carried out in two agro-climatic zones of Assam. A multi stage purposive cum simple random sampling design was followed for selection of sample. One district from each zone namely Sivasagar district of Upper Brahmaputra Valley Zone and Kamrup (R) district of Lower Brahmaputra Valley Zone were selected randomly. Total 300 rural women from 12 villages of the selected zones and who were mostly engaged in fruits and vegetable cultivation were selected as respondents for the present study. Data collection was done by using structured interview schedules. The study revealed that majority of the rural women (54.00 %) were of middle aged group, married (87.67%), educated upto middle school level(54.32%), had farming as their main occupation (67.25%), had less than 1 hectares of cultivable land (70.33 %), had more membership in group organizations (65.81 %), had poor contact with extension personnel (87.33%) , took agricultural advice from friends and neighbours (58.10%), had not attended any intervention programme (57.62%). Among the rural women who had attended intervention programme earlier, majority 85.03 percent attended on the aspect piggery. Majority of the rural women had independent participation in selected farm and non-farm activities such as transplanting and weeding (79.02%), weeding (66.00%), cooking (65.66%) and weaving (69.67%). Majority (74.67 %) of rural women took independent decision on amount of food to be kept for consumption, preservation of fruits and vegetables (41.00 %) and weaving (73.64%). Majority of rural women had low level of knowledge in aspects like nursery raising (76.30%), land preparation (67.00%), production practices (80.00%) and plant protection (52.70%). The problems faced by rural women in participating in different horticultural activities which got first ranks in their respective categories of problem were lack of irrigation facility, growth retardation of plants due to higher weed growth, high cost of labour, lack of proper training, household workload and natural calamities. The outcome of the intervention programmes indicated that there were changes in knowledge gain and

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retention in rural women and technology adoption behavior. The knowledge retention by rural women in three aspects of production technologies of fruit and vegetable crops namely plant protection, nutritional management and land preparation were given first, second and third ranks after analysis. In case technology adoption, aspects plant protection measures, nutrient management and nursery raising practices got the first, second and third ranks respectively.

Environmental Sanitation in Assam- An Analysis for rural helth upliftment

Shyamalima

The study entitled "Environmental Sanitation in Assam- An Analysis for rural health upliftment" was undertaken with the objectives: i) To explore the institutional arrangement of government on environmental sanitation, ii) To assess existing knowledge and practices of rural women regarding environmental sanitation, iii) To identify the problems faced by the rural women in adopting different governmental measures for environmental sanitation, iv) To explore the problems faced by the field functionaries in proper implementation of the governmental measures for environmental sanitation and v) To find out suggestions from the field functionaries for proper functioning and improvement of the environmental sanitation programme. The present study was conducted in Jorhat and Sivasagar district of Assam. Purposive cum simple random sampling method was adopted for selecting the sample of 360 rural women as respondents. Field functionaries of Public Health Engineering Dept. (PHED) and also contractual functionaries of Swachh Bharat Mission- Gramin (SBM-G) of both Jorhat and Sivasagar district were selected as another set of respondents for the present study to explore theproblems faced by the field functionaries in proper implementation of the governmental measures for environmental sanitation. Both primary and secondary data were collected for the present study. Secondary data was collected to explore the institutional arrangement of government on environmental sanitation. Primary data was collected through scale developed by the researcher, interview schedule and questionnaire. The study revealed that the Ministry of Drinking Water and Sanitation (MDWS) is the nodal ministry for the overall policy, planning, funding and coordination of programs of environmental sanitation in the country. The key programs of the Ministry providing thrust to the Rural Water Supply and Sanitation (RWSS) sector are the National Rural Drinking Water Program (NRDWP) and the Swachh Bharat Mission- Gramin (SBM-G) which were implemented in Assam by the nodal department Public Health and Engineering Department (PHED). Both National Rural Drinking Water Program (NRDWP) and Swach Bharat Mission –G has a 5-tier structure at the National, State level, District level, Block level and Gram Panchayat (GP) level with definite roles and responsibilities at each level. The study

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also revealed that majority of the rural women (48.10%) belonged to the middle age group, 88.90 per cent were married and majority of the respondents (65.80%) had marginal land holding. Majority of the respondents had education up to high school level (34.16%). Only 2.5% rural women had pucca house and cent per cent of rural women had low cost latrine at their houses. Source of drinking water of majority of the respondents (41.11%) was piped water supply from a public source. Farming was the main occupation of head of the family for 47.50 per cent of rural women. Majority of the rural women (75.3%) were from nuclear family and 33.61 per cent rural women had no membership in any organization. The findings also highlighted that majority of the rural women belonged to medium socio-economic status (65.84%). Data also revealed that the majority of the rural women (70.00%) had medium level of knowledge and also majority of the rural women (64.44%) had moderate level of practice regarding environmental sanitation. Lack of systematic approach to the family was ranked as I problem by the rural women in adopting low cost latrine as a governmental measure for environmental sanitation. Field functionaries under environmental sanitation programme namely Assistant Engineer, Junior Engineer of PHED and District consultants, Block resource coordinators, cluster resource coordinators faced different problems while implementing the programme for the beneficiaries among which the problems related to finance were found as moderate and severe by both permanent and contractual functionaries respectively. 'Less involvement of PRI members' was expressed as moderate problem by both permanent and contractual functionaries under problems related to management. 'Lack of proper vehicle' under Infrastructure Problems was also expressed as moderate problem by both permanent and contractual functionaries. 'Awareness generation and demand creation at community level for access to safe drinking water and sanitary toilet through use of mass media' and 'Behavioural change among community through motivational programme should get first priority than mere construction of toilet' was suggested by all the functionaries for proper functioning and improvement of the environmental sanitation programme.

Physiological Cost of Storage of Paddy and Ergonomic Intervention for Drudgery Reduction

Mira Kalita

Storage of paddy grains is one of the most drudgery prone post harvest activity of Assam, which is predominantly performed by rural women. The present study entitled 'Physiological Cost of Storage of Paddy and Ergonomic Intervention for Drudgery Reduction' was proposed with the following objectives – (1) Development of scale for assessing occupational health hazards of farm women in post harvest activities (OHHPA scale). (2) Assessment of physical fitness of the farm women involved in paddy storage activity. (3) Assessment of physiological workload of farm women in storage of paddy. (4) Design modification of conventional bamboo basket for enhancing comfort and efficiency.

Both survey and experimental method were used for the study. Survey method was conducted on three hundred farm women of six different villages of Jorhat district. Women samples were selected at three stages viz – 60 for item analysis, 60 for testing reliability and 300 samples for administering the developed scale. After establishing validity and reliability of the scale, the scale was administered on 300 farm women for assessing health hazards in post harvest activities. Experimental method was conducted on thirty subjects in the age group of 25-35 years who were with normal health, non-pregnant and non-lactating having normal blood pressure and without any major illness were selected for the purpose of assessing physical fitness, physiological workload and postural stress of farm women. Electronic tread mill was used for assessing physical fitness of the farm women. Heart rate was recorded with heart rate monitor and postural stress in different regions was measured with inclinometer. For postural analysis ovaku work posture analysis system (OWAS) method was used. Rating of perceived exertion (RPE) was calculated by using 5 point rating scale developed by Varghese *et al.* Body map was used to identify the body part discomfort (BPD) in different parts of the body. Engineering control was applied for design modification of conventional bamboo basket for storing paddy grains.

Personal and demographic characteristics of farm women revealed that cent per cent respondents were literate and sixty six per cent respondents belonged to nuclear families. Majority of the respondents (82%) belonged to marginal farmers having 1 acre of land for

paddy cultivation. As regards to age of the respondents, 88 per cent falls in the age group of 30-40 years. Occurrences of biological, physical, accidental and environmental hazards were common among Assamese farm women. More than 47 per cent of the respondents were in the category of 'high' incidences of different types of hazards and respondents' belonging to 'severe' incidences of hazards were nil. The findings also showed that 58 per cent of the farm women were in the category of 'high' incidence of hazards in post harvest activities. The findings on physical characteristics of the respondents revealed that mean age of the respondent farm women were 32 years of age. Average height of the respondent farm women was 151.42 cm, average weight was 45 kg. Lean body mass (LBM) of the respondents was 32.35 kg. Body mass index (BMI) of the selected respondents was 20.87 and VO_2 max (ml. $kg^{-1}.min^{-1}$) was found to be 26.73. Fat percentage of the respondents was 28. Most of the respondents (47 per cent) belonged to 'ectomorphic' group. Thirty three per cent of farm women had 'very good' level of physical fitness. The physiological workload of farm women in storing paddy grains by using conventional basket was categorized as 'heavy' activity indicating that design modification is necessary for storing paddy grain. It was found that work postures had a distinctly harmful effect on musculoskeletal system of the farm women. The angles of average flexion was highest in upper arm (90.62^0) and extension was in thoracic was observed to be 115.30^0 indicating deviation of body parts. The farm women performed the storage activity under acceptable level of temperature and humidity except illumination. The average weight of the load was found to be 14.03 kg. The recommended weight limit (RWL) for storage activity by the use of conventional basket was found to be 6.54 kg. The lifting index of storage of paddy grains by farm women was found to be 2.14 which indicates that farm women suffers from lot of work related musculoskeletal disorders (WMSDs) or injury and design modification is necessary for reducing health hazards and work related musculoskeletal disorders (WMSDs) of farm women in storage of paddy grains.

Engineering control was applied for preventing and controlling occupational health hazards and work related musculoskeletal disorders (WMSDs) of farm women in paddy storage activity. The design criteria selected for modifying conventional basket were load capacity, frontal length, depth, weight, base and grip of the basket. Physiological workload of storage of paddy grains in the use of modified baskets was found to be 'moderately heavy' activity. The use of modified basket-3 for paddy storage activity minimized postural stress, musculo-skeletal disorder, body part discomfort of farm women to a considerable extent. The recommended weight limit (RWL) for storage activity by the use of modified basket-3 was found to be 10 kgs. The lifting index of storage of paddy grains by the use of modified basket-3 was found t be 0.97, which indicates that all the healthy farm women could carry 10 kgs of loads without any risk of work related musculoskeletal disorders (WMSDs). Use of modified basket for paddy storage activity increase output, enhance efficiency, comfort, workable life and reduce ergonomic cost, drudgery and health hazards of farm women.

Process development for production and quality evaluation of banana powder

Nimi Barooah

The present study was aimed to optimize the process for producing spray dried banana powder using response surface methodology, from the most commonly available banana variety, i.e., Jahanji (*Musa paradisica*). Apart from optimizing the spray drying of banana juice to powder, the other specific objectives included studying of the physicochemical parameters of the optimized powder and its shelf life studies.

Initial studies conducted on the characteristics of banana pulp revealed moisture, protein, crude fibre, fat and total ash content to be 77.52%, 0.81g 100^{-1}, 0.25g 100^{-1}, 1.12g 100^{-1} and 1.31g 100^{-1} respectively. Potassium and iron content were found to be 17.6mg 100^{-1} and 2.53mg 100^{-1} respectively. Total sugar and reducing sugar were found to be 8.15g 100^{-1} and 2.15g 100^{-1} respectively of the banana pulp.

A laboratory scale spray dryer (Model LSD-01) was used in optimization of the banana powder. Using response surface methodology, 15 experimental trials were developed with the independent variables of inlet temperature, atomization pressure and feed rate. The responses evaluated for deciding the optimum conditions were product yield, bulk density, tapped density, particle density, porosity, flowability, cohesiveness, pH, water activity, wettebility, dispersibility, hygroscopisity, degree of caking, water absorption index, water solubility index and non enzymatic browning.

Out of all the responses, based on the deduced values of moisture content, bulk density, tapped density and hygroscopisity were selected to optimize the independent variables in spray drying of the banana juice powder. The derived optimum conditions of inlet temperature (175.8°C), atomization pressure (0.57mPa) and feed rate (6ml/ min) were used for further production of spray dried banana powder.

Banana powder properties and process parameters yielded best quality powders with a yield of 71.63%. Moisture, protein, crude fibre, fat and total ash content of the optimized powder were 2.44%, 4.26g 100^{-1}, 0.44g 100^{-1}, 0.092 g 100^{-1} and 1.86 g 100^{-1} respectively. Potassium, iron, total sugar, reducing sugar and titrable acidity content were recorded to be 30.1mg 100^{-1}, 4.07mg

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Department : Food Science and Nutrition (H.Sc)

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100^{-1}, 196g 100^{-1}, 25.73g 100^{-1} and 2.98% respectively. The physical parameters analysed were: bulk density (0.32g/cm³), tapped density (0.41 g/ cm³), particle density (1.39 g/ cm³), porosity (1.39%), flowability (65.6), cohesiveness (21.30), pH (4.95), TSS (18), a_w (0.33), dispersibility (73.37%), wettebility (192 secs), hygroscopisity (23.89%), degree of caking (96.67%), water absorption index (44.44%), water solubility index (42.67%) and non enzymatic browning (0.037) in banana powder. Second order polynomial regressions equations were developed to establish a statistically significant relationship between the independent and the dependent variables.

Storage studies were conducted on the optimized banana powder for a period of 90 days starting from 0 day at an interval of 30 days across all the three types of packaging materials *viz*., aluminium foil laminated pouch, high density polyethylene and low density polyethylene. Physico chemical parameters studied on the optimized powder revealed that moisture content increased significantly at 60 days (F=9.50) and 90 days (F=15.05) of storage at 5% probability level. Thus irrespective of packaging material, banana powder could be stored upto 30 days without deterioration in quality.

Reducing sugar depicted a non significant increase in all the three types of packaging materials across storage. However, total sugar content of the banana powder depicted a significant increase at 90 days (F=4.08). Acidity of the powder declined non significantly across storage whereas browning too depicted a non significant increase in all the three types of packaging material.

Organoleptic properties in terms of taste and flavor did not have significant effect in all the three types of packaging materials across storage. Colour had a significant effect (F=5.56) on the storability of the banana powder at 90 days of storage. Texture of the optimized banana powder showed a significant change from 30 days of storage in all the three types of packaging materials (F=6.33).

As of microbiological assay, significant increase in the microbial load was evident in the sample from 30 days of storage at 5% probability level upto 90 days. At 0 days though, the microbial count depicted non significant increase among all the three types of packaging materials. At 30 days, microbial load was found to increase significantly (F=4.7931) from 0 to 0.40×10^{-6} cfu/ ml at 5% probability level in all the 3 packaging materials, aluminium foil laminated pouch being the best packaging material owing to low cfu count of microorganism. Significant increase in microbial load was observed at 60 days (F=7.8876) and 90 days (F=3.4059), where AFLP too exhibited low microbial count. It can therefore be concluded that aluminium foil laminated pouch was the best packaging material owing to lower microbial count. However, comparing with the FSSAI standards for permissible limits of microbial count for dehydrated products, the microbial load in the present study was much higher than the FSSAI standard of 40,000 cfu/ ml. It could be therefore concluded that good quality banana powder was produced with the optimised parameters by using maltodextrin as a drying aid. The optimised banana powder was rendered edible for a period of one month. Beyond one month, caking started in all the three packaging materials. Browning started in HDPE and LDPE packaging materials beyond 90 days. Microbial load was beyond the permissible limit in all the three types of packaging materials except for AFLP, which showed lower microbial count in the initial period of storage study.

Physico-biochemical characterisation and value addition to selected minor fruits of Assam

Syeda Nishat Firdusi

The present investigation entitled "Physico-Biochemical Characterisation and Value Addition to selected Minor Fruits of Assam" was carried out in order to study the physico-chemical properties of the selected minor fruits namely *Rhus semialata* (Local name- Nagatenga), *Baccaurea sapida* (Local name- Leteku), *Flacourtia gangomos* (Local name - Poniol) and *Garcinia cowa* (Local name – Kujithekera) and products were developed from these selected fruits. The qualities of the developed products were also evaluated. The entire study was sectioned in four well defined separate parts i.e.

1) Evaluation of the physico-chemical composition of the selected minor fruits. 2) Development of products from the selected fruits and their quality evaluation, 3) Quality evaluation of the developed products across storage, 4) Microbial load of the developed products was studied to determine the shelf life of the products. The physical parameter of the minor fruits was studied and found that all the fruits possess good amount of edible portion except Leteku. The shelf-life of *Nagatenga* (*Rhus semialata*), *Leteku* (*Baccaurea sapida*), *Poniol* (*Flacourtia gangomas*) and *Kujithekera* (*Garcinia cowa*) was recorded as 1.83±0.28, 6.00±1.00, 4.00±1.00 and 2.33±0.57 days respectively under ambient temperature. The shelf life of fruits can be extended by processing it to different food products like jam, jelly and squash. In case of value addition to *Leteku* (*Baccaurea sapida*) only those products should be considered which required juice of fruits such as beverages as the pulp content (26.16±1.25 g/100g) of the fruit is very low with high juice content (40.00±2.64 ml/100g). The acid content of *Nagatenga* (*Rhus semialata*) (3.46±0.25%) and *Kujithekera* (*Garcinia cowa*) (4.87±0.19%) are high with good amount of pulp content and so can be consider for pickle, chutney and sauce making. The juice content of *Poniol* (*Flacourtia gangomas*) was found to be low (20.33±4.04 ml/100g) but the TSS content of the fruit was highest (21.33±3.21°Brix) and thus can be preferred to develop beverages products from the fruit. A considerable amount of pectin was present 0.94±0.10%, 0.64±0.07%, 1.55±0.05% and 0.43±0.07% in the selected minor fruits - *Nagatenga* (*Rhus semialata*), *Leteku* (*Baccaurea sapida*), *Poniol* (*Flacourtia gangomas*) and *Kujithekera* (*Garcinia cowa*) respectively which are enough to develop jelly but due to pH below 3.0, fruits other than *Poniol* (pH -

3.28±0.15) do not produce good jelly. The selected minor fruits are lauded for their pleasing flavor and colour as well as therapeutic properties and encompassed with most of the nutritional qualities. All the selected minor fruits *Nagatenga* (*Rhus semialata*)*, Leteku* (*Baccaurea sapida*), *Poniol* (*Flacourtia gangomas*) and *Kujithekera* (*Garcinia cowa*) can be considered as good source of fibers (3.51±0.21 g/100g, 2.37±0.31 g/100g, 8.40±0.33 g/100g and 10.34±0.44 g/100g respectively), minerals (iron -26.33±1.15 mg, 7.16±1.44 mg, 29.83±1.44 mg and 15.16±2.25 mg per 100g respectively, calcium - 250.44±5.05 mg/100g, 143.24±4.00 mg/100g, 65.83±3.52 mg/100g and 192.81±2.44 mg/100g respectively and potassium - 111.0±7.0 mg/100g, 59.00±4.00 mg/100g, 44.00±3.00 mg/100g and 33.33±4.04 mg/100g, respectively), vitamins (ascorbic acid -216.66±14.40 mg, 24.16±7.21 mg, 43.33±7.21 mg and 67.78±3.40 mg per 100g of fruits respectively and carotenoids - 126.60±0.06 ìg/100g, 50.76±0.99 ìg/100g, 190.16±0.33 ìg/100g and 890.33±0.94 ìg/100g respectively) and phytochemicals (the total phenolic content-538.83±5.01 mg, 149.5±2.17 mg, 261.16±1.04 mg and 347.00±3.04 mg per 100g respectively, flavonoid - 246.45±21.55 mg, 44.64±5.61 mg, 87.17±2.70 mg and 98.03±2.01 mg respectively and total alkaloid - 104.00±13.52 mg, 170.33±5.77 mg, 143.33±7.09 mg and 156.33±1.52 mg respectively) as well as low in fat (1.02±0.05 g/100g, 0.66±0.09 g/100g, 0.88±0.10 g/100g and 0.25±0.02 g/100g, respectively). Based on the quality characteristics of the selected minor fruits, following products were developed namely – squash, spicy squash and sauce from *Nagatenga* (*Rhus semialata*), squash and RTS from *Leteku* (*Baccaurea sapida*), squash and jelly from *Poniol* (*Flacourtia gangomas*) and squash, candy and pickle from *Kujithekera* (*Garcinia cowa*). The acceptability of the products was determined through organoleptic evaluation using 9 point Hedonic scale by 10 panel judges and found highly acceptable, except the colour and appearancee of Nagatenga sauce was scored low (7 point). The chemical parameters namely TSS, acidity and pH of the products was evaluated and was within the range of FSSAI specification (squash TSS- e•40 and acidity - d•3.5, sauce TSS- e•15 and acidity – e"1, RTS TSS- e•10 and acidity - e•0.3, jelly TSS- e•65 and acidity - 0.5-0.75 and candy TSS- e•70). The nutrient content of the products was evaluated and found good amount of nutrients, that help to improve nutritional status of the people. The present investigation reveals that the RTS is more susceptible to spoilage due to high moisture content (89.04±1.13%) and low sugar content (11.93±0.28%) followed by the squashes. Whereas sugar based products jelly and candy have low moisture content (40.26±1.37% and 37.59±0.36% respectively) and good amount of sugar (75.01±3.06% and 90.47±5.69% respectively) may be considered to have long shelf life. Again pickle contain good amount of oil (17.56±1.86%) and salt which enhance quality retention thus increasing shelf life. The results as per physico-chemical parameters, sensory evaluation and microbial assay across storage reveals that in case of *Nagatenga* squash stored in glass bottle, plastic bottle and standing pouch are safe for consumption upto 180 days, 150 days and 60 days respectively. The *Nagatenga* spicy squash stored in glass bottle, plastic bottle and standing pouch showed a shelf life of 180 days, 150 days and 60 days respectively. The shelf life of *Nagatenga* sauce was 180 days in all the packaging materials. The shelf life of *Leteku* squash stored in

glass bottle, plastic bottle and standing pouch are 180, 180 and 150 days respectively. The *Leteku* RTS can be consume safely upto 30 days when stored in glass bottle and get spoiled in other two packaging material on the 30 days of storage. The shelf life of *Poniol* squash stored in glass bottle and plastic bottle are upto 180 days and when stored in standing pouch the shelf life is till 150 days. The *Poniol* jelly stored in all the three packaging material showed acceptable shelf life across the entire storage period. The *Kujithekera* squash stored in glass bottle, plastic bottle and standing pouch are at safe and consumable state upto 180, 180 and 90 days of storage respectively in terms of physic-chemical evaluation. The *Kujithekera* candy was safe and within acceptable quality during all the storage period (0-180 days) stored in the all the three packaging material. The results depicts that in terms of sensory, physico-chemical (Significant at $P < 0.05$) and microbial evaluation of the developed products in different packing material across storage it can be concluded that glass bottle packaging is the best packaging materials for storing both liquid and solid products due to its highly inert, durable and chemical resistant properties. Plastic bottle can be considered next to glass bottle in terms of light weight and easy to handle properties and this packaging material also showed less prominent spoilage characters compared to standing pouch.

Effect of structural design on the performance of eri-union fabrics

Pomima Duarah

This study on "Effect of structural design on the performance of eri-union fabrics" was carried out with the following objectives:

1. To construct eri union fabrics of different structure using selected yarns.
2. To study the physical and comfort properties of the constructed fabrics.
3. To study the effect of laundering on the constructed fabrics.
4. To study the suitability of the fabrics for different garments.

For the purpose of the study eri, red eri, cotton, polyester, acrylic and rayon yarns were used to construct the eri union fabrics on the fly shuttle handloom to create plain eri union fabrics and using jacquard attachment with jacquard accessories like lingoes, mail eye etc. to create patterned eri union fabrics. Eri was used as warp and red eri, cotton, polyester, acrylic and rayon yarns were used as weft. Five plain weave eri union fabrics and five patterned eri union fabrics were woven. The constructed eri union fabrics were tested with standard test methods for mechanical properties (weight, thickness, thread count, cover factor), physical properties (strength, elongation, pilling, abrasion, tearing, and stiffness) and comfort properties (absorption, wicking, air permeability, and thermal conductivity), drapability test done and analysed using suitable statistical techniques. Visual assessment was also done for the woven eri union fabrics with the help of a structured questionnaire. Opinion of the respondents was taken regarding the general appearance, lustre, and handle, texture of the woven eri union fabrics and also the effect of laundering on the fabrics. Findings revealed that the patterned eri union fabrics highly suitable for garments. Laundering did not show noticeable change in the fabric samples.

Further, garments were designed and constructed using the woven patterned eri union fabrics and opinion of the respondents was taken on the suitability of the patterned fabrics for the garments which revealed that the patterned eri union fabrics are suitable for different garments.

Master of Science (Agriculture)

- Agricultural Biochemistry
- Agriculture Economics & Farm Management
- MBA (Agri. Business)
- Agrometeorology
- Agronomy
- Crop Physiology
- Entomology
- Extension Education
- Food Science and Technology
- Horticulture
- Nematology
- Plant Breeding & Genetics
- Seed Science Technology
- Plant Pathology
- Sericulture
- Soil Science
- Tea Husbandry and Technology

Blank

Variation and compositional quality of mango seed kernel

Kamal Das

Mango (*Mangifera indica* L.) is a very common tropical fruit which is native to Southeast Asia. Being a part of the center of origin of mango, Assam has a great diversity of mango germplasm. Mango seed kernel, a waste from mango processing factories, is a by product rich in starch, fat, protein, polyphenols minerals etc. Utilization of mango seed may be an economical way to reduce the problem of waste disposal from mango production. In the present investigation, the compositional quality of the mango seed kernel and mango seed fat of few locally grown germplasm was examined. Mango seed kernels were found varying significantly in different parameters studied. Moisture content ranged from 4.57 to 7.42%, crude fat from 7.44 to 12.82%, crude protein from 4.69 to 8.60%, crude fiber from 1.60 to 3.66% and ash content was varying from 2.16 to 3.63% on dry weight basis. The most prevalent mineral element in mango seed kernels was potassium which was as high as 158.70mg/100g dry weight. Of the other mineral elements, magnesium ranged from 20.44 to 22.43, iron from 7.54 to 11.21 and calcium from 6.38 to 9.31 mg/100g on dry weight basis. The chemical characteristics of mango kernel oil showed a considerable variation amongst the germplasm. The lipids extracted from all samples were light yellow and solid at room temperature. Mango seed oil had a high quality due to the low level of peroxide value. The iodine number of mango seed oil ranged from 38.86 to 48.89mg I_2/100g oil, while the saponification values varied between 143.22 and 204.44mg KOH/g oil. The most abundant fatty acid was oleic acid in all the germplasm studied. The content of total phenol, tannin and the antioxidant capacity of mango seed oil were evaluated. The total phenol content ranged from 23.21 to 28.59 (mg CE/g) and tannin content 21.42 to 16.54 (mg/g) on dry weight basis. The IC_{50} values ranged from 133.53 to 194.42 (ìg/ml).

Studies on chemical composition and medicinal property of *Amomum aromaticum* Roxb.- a rare species of cardamom found in North East India

Poulami Das

Wild cardamom (*Ammomum aromaticum* Roxb.) has been recently discovered in large patches of forests of Tripura by forest department during 2014-15. It is popularly known by the local tribals as 'Beering' in their vernacular language, whose stump is used in the local culinaries to induce aroma to the dishes. Botanically it belongs to Zingiberaceae family. Processed dry fruit is the economic produce which can be used largely as spice because of its sweet aroma and in the ayurvedic medicine because of its medicinal value. As per the available literature it is mentioned to be found in the eastern Himalayan track and Chittagong hill track. It is typically found in patches along the banks of streams and streamlets. It is a notified forest product and can be collected by the forest dwellers and after being processed (drying) on desi bhatta can be sold out to the authorized traders who are dealing with aromatic oils and medicinal products.

The present investigation was intended to study the chemical composition and medicinal property of *A. aromaticum* Roxb.- a rare species of cardamom found in North East India. The plant materials were collected from forest of Tripura- Kunjaban village, Kalyanpur block, Khowai district and authenticated. The morphological data were taken from the mature plant to narrate the botanical information. Leaf and seed samples of this species were analysed for total alkaloids and total phenolics. The essential oil was extracted from seed and the volatile components were identified. The antimicrobial and antioxidant activity of the plant extracts were determined.

From the results of the present investigation it was observed that a significant variation in the total phenolic content in the leaf and seed was obtained which were 12.7 mg/g and 10.1 mg/g, respectively. The alkaloid content of the leaf was found to be 1.27 g/100g and in case of seed it was 4.2 g/100g on dry weight basis. The essential oil was extracted from both dried & raw capsules of the matured plant by hydro-distillation method. The fresh

moisture content in capsules at harvest was 75 per cent and the moisture content reduced to 14 per cent in case of seeds which were sundried for 10 days. The essential oil content in seeds of *A. aromaticum* was found to be 2.0ml/100g in raw fresh capsules and 1.0 ml/100g in sun dried capsules. GC-MS analysis of essential oil revealed the presence of components such as. Myrcenol, D-limonene, P-mentha-1-en-9-ol, Linalool, Isopulegol, P-menth-8-en-1-ol, Linalyl acetate, Sabinene hydrate, á- terpineol, Eucalyptol, Terpinyl acetate, Menthol, Nanocosane and 2,3- pinanediol. In addition, a few new components have also been detected such as 4,6 di-tert-butylresorcinol, 5-iodo-2,7-dioxa-tricyclo{4,3,1,0(3,8)}decane, triacontane, 1 monolinoleoyl glycerol, trimethyl silyl ether, eicosanoic acid, di-N-decylsulfone and Pentatriacontane. The antimicrobial activity of different solvent extracts of leaf and seeds of *A. aromaticum* Roxb was evaluated against. *Escherichia coli, Staphylococcus aureus* and *Bacillus subtilis.* The essential oil extracted from the seeds did not show any antimicrobial activity against *E. coli, S. aureus* and *B. subtilis.* The hydrodistilled volatile oil from seeds and ethanol extracts of the seeds and leaves did not show antimicrobial activity. On the other hand, the methanol extract of seeds showed potential antimicrobial activity against these human pathogens. The antibiotic streptomycin was used as positive control and 80 % methanol was used as negative control in this experiment. The zone of inhibition for *E. coli, S. aureus* and *B. subtilis.* was found to be 15.2 mm, 17.4 mm and 14.5 mm, respectively. The antioxidant activity was determined in the methanol extract obtained from both leaf and seed of this species. Both the extracts showed antioxidant activity. The percent inhibition of DPPH was observed to be 74.1 for seed extract and 60.8 for leaf extract. The IC_{50} value for leaf and seed extract were 0.815µg/ml, 0.641µg/ml respectively. Moreover, the genomic DNA was extracted from the mature fresh leaf tissues of *A. aromaticum* Roxb and the extraction procedure was standardized. The quantity of the extracted DNA as determined by "Nanodrop-1000" (make: thermo-scientific) was 1282.09 ng/µl. The purity of the extracted DNA was determined from the ratio of optical density at 260 and 280 nm respectively which was found to be 1.79 $(A_{260:280})$.

Vast medicinal plant resources of North East India have not been fully identified, inventoried and characterized. It is of utmost importance that these should be characterized and evaluated in the light of modern scientific approaches, which may lead to the development of some new drug molecules that can combat various side effects of the commercially available synthetic drugs, and thereby reducing the cost of medication. So a detail study about this traditionally underutilized herbal spice species- *Amomum aromaticum* Roxb. will help to develop new drugs and a number of herbal tonic or feed additives. More studies will be required to find out the favourable conditions to achieve the full potential of the plant in order to establish this plant as one of the important spice species.

Phytochemical characterization of some ginger cultivars from Tripura

Pratul Kumar Nandy

Ginger (*Zingiber officinale* Rosc.), under the family Zingiberaceae, is one of the most famous spices all over the world. It is commonly known as *Ada* (Assamese and Bengali name), originated from South East Asia. Ginger plants are used for thousands of years in Indian health care systems for their biological activities. Ginger is also used as home remedy and is of immense value in treating various gastric ailments like constipation, belching, bloating, gastritis, epigastric discomfort, gastric ulcerations, indigestion, and vomiting. Ginger with spicy, penetrating, pungent, and slightly biting flavor finds extensive use in foods.

The present study was carried out to investigate the some major secondary phytochemicals of four different ginger cultivars from Tripura. The moisture content was highest in *Gandacherra* cultivar (86.167g/100g) and lowest in *Satpara* cultivar (82.580g/100g). Total phenol content was highest in *Belonia* cultivar (0.733g/100g) and lowest in *Gandacherra* cultivar (0.395g/100g).The total flavonoid content was highest in *Satpara* cultivar (0.379g/100g) and lowest in *Gandacherra* cultivar (0.103g/100g). The total tannin content was highest in *Belonia* cultivar (4.237g/100g) and lowest in *Satpara* cultivar (2.793g/100g).The total soluble sugar content was highest in *Gandacherra* cultivar (2.760g/100g) and lowest in *Dharmanagar* cultivar (1.243g/100g). The total crude fat content was highest in *Satpara* cultivar (8.267g/100g) and lowest in *Dharmanagar* cultivar (6.967g/100g). The total crude fiber content was highest in *Satpara* cultivar (6.040g/100g) and lowest in Gandacherra cultivar (4.685g/100g). The antioxidant activity (by DPPH, 2, 2-diphenyl-picrylhydrazide) reveals that the IC_{50} was highest in *Gandacherra* cultivar (0.853µg/ml) and lowest in *Belonia* cultivar (0.809 µg/ml). The total oil content was highest in *Dharmanagar* cultivar (4.180ml/100g) and lowest in *Gandacherra* cultivar (3.275ml/100g). The highest acid value was recorded in *Belonia* cultivar (19.635µg KOH/mg fat) and the lowest acid value was recorded in *Gandacherra* cultivar (11.220µg KOH/mg fat). The highest iodine value was observed in *Belonia* cultivar (71.063g I_2/100g fat) and the lowest iodine value was observed in *Dharmanagar* cultivar (64.719g I_2/100g fat). The highest saponification value is observed in the *Gandacherra* and *Satpara* cultivar (196.350 mg KOH/g fat) and the lowest saponification value was observed in *Belonia* cultivar (168.300 mg KOH/g fat).

Biochemical study on traditional rice products of Assam with special reference to resistant starch

Rajesh Banik

Rice is the most important food crop of the world after wheat. South East Asian countries are heavily reliant upon rice for their dietary energy supply. 70% of total arable agricultural land of India lies under the rice cultivation. In North Eastern region of India, rice is the main staple food and in Assam, there are several traditional rice based processed products which are also largely used in everyday life and during festivals. These are *bhojachaul*, sandahguri,*korai,hurum,komalchaul* (soft rice), popped rice, flaked rice and puffed rice.

The moisture content, on wet basis varied from 5.83-11.61%. On dry weight basis, the crude protein content of different rice products ranged from 7.74-9.40%, the lowest in puffed rice and the highest in popped rice. The total ash content was determined on dry weight basis and it ranged in between 0.61-4.33%; the lowest in *bhaja chaul* and the highest in popped rice.The crude fiber percentage was the lowest (0.63%) in popped rice and the highest (1.04%) in *bhoja chaul* and *sandahguri*. The crude fat content was the lowest in*hurum*(0.11%) and the highest in *korai* (0.31%). The total carbohydrate percentage of these traditional rice products ranged between 85.44-90.28%, being the lowest in popped rice and the highest in *komal chaul*. The total starch content (on dry weight basis) was found to be the highest (58.08%) in popped rice and the lowest (39.37%) in *korai*. The amylose content was found to be the highest in flaked rice (19.80%) and lowest in popped rice (16.73%). The resistant starch content was found to bethe lowest (3.24%) in puffed rice and the highest (5.42%) in *sandah*.

The present study indicated that the rice based traditional processed products of Assam are good sources of carbohydrate, proteins and minerals. The traditional products are also having good amount of resistant starch, known to be beneficial for health. In future, further studies are required for the determination of other nutrients such as different micronutrients, and physical properties of starch of the rice based traditional products of Assam, which may reveal useful information for the human health.Future study involving the biochemical analysis of raw rice and the rice products, both before and after processing may lead to generation of more precise information on effect of processing on particular rice variety.

Abstract of M. Sc. Thesis
Department : Biochemistry and Agricultural Chemistry
Major Advisor : Dr. P. Das

Study on *Banana Streak Virus* (BSV) genome integration in indigenous and wild cultivars of *Musa* spp. of Assam, India

Ananya Baruah

Pararetroviral elements found integrated in the genome of their host in a Mendelian fashion despite the absence of an integration step in their replication cycle is referred to as endogenous pararetrovirus (EPRV) and the process of integration is called endogenization. Banana streak virus (BSV) exists either as an episomal form, infecting plant cells or as viral DNA integrated within the B genome of banana (endogenous BSV) forming a viral genome for *de novo* production of viral particles.

The present study was conducted to detect the presence of BSV in the genome of 16 wild and indigenous cultivars of *Musa* spp. through sequencing of DNA fragments designed to amplify part of the three open reading frames (ORFs) present in badnavirus. Further, transcriptional status of the viral sequences was studied by observing methylation sites using the methylation dependent enzyme *McrBC*. Finally, to ensure that the results obtained were derived from the integrated BSMYV (eBSMYV) and not from its episomal counterpart an inverse polymerase chain reaction (PCR) was performed. The present study revealed that indigenous and wild cultivars of *Musa* spp. of Assam had integrations from eBSV except for a part of ORF3 in the case of *Ukhojahanji* and *Ketekixunda*. Some of these integrations were methylated, indicating that they might be involved in repression of transcription of the integrated BSV. Further study involving comparison of sequencing of badnavirus for full length ORFs coupled with border sequences among these *Musa* spp. may provide better insight to the problem.

Genetic engineering of confer resistance against geminivirus using tobacco as a model plant

Anupam Gogoi

Geminiviruses (Geminiviridae) comprise the largest family of plant viruses with single-strnded DNA (ssDNA) genome that is encapsidated in incomplete twinned icosahedral particles. Begomovirruses (type species: Bean golden mosaic virus, BGMV) comprise the largest and the most dominant genus within the family Geminiviridae. Sri Lankan cassava mosaic virus (SLCMV) belong to the genus Begomovirus was found to cause Cassava Mosaic Disease (CMD) in cassava; world third largest source of carbohydrate for human diet and a potential bioenthanol crop. SLCMV is more prevalent in the Indian subcontinent. They cause substantial yield loss in cassava production and have a wide host range, besides cassava. SLCMV was found to infect almost all tobacco species including *Nicotiana* benthamiana and N. tabacum producting clear visible symptoms upon infection. Although there is a growing concern about the infectivity and large host range of SLCMV, no conventional breeding technique was reported to be effective against control of CMD till to date.

The present study employs the genetic engineering approach to develop transgenic N. benthamiana and *N. tabacum* in order to determine whether these tobaccos become resistant to SLCMV. Upon positive in these heterologous hosts, the same constructs will be used for the generation of transgenic cassava plants. Two recombinant plasmid constructs were designed carrying *SLCMV_CP* gene in either sense or antisense orientation. The constructs were cloned in *E.coli* and later mobilized into Agrobacterium tumefaciens C58C1. Sequencing of the recombinant clones was found to have 100% nucleotide identity with *SLCMV_CP* gene (GeneBank:AJ579307.1). Agrobacterium mediated transformation of *N. benthamiana* and *N. tabacum cv*. Xanthi, using the leaf disc method, was performed. Analysis of the presence of the transgene was performed vid PCR and it was found that *SLCMV_CP* gene in sense orientation gave 26.66% and 25% transformation efficiency for N. *benthamiana* first and second transformation respectively. Similarly, for SLCMV_CP gene in the antisense orientation, transformation efficiency in *N. benthamiana* first and second transformation was 16.66% and 25% respectively. For N. *tabacum*, transformation

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Department : Agricultural Biotechnology
Major Advisor : Dr. B. K. Borah

efficiency of *SLCMV_CP* gene in sense and antisense orientation was 11% and 14% respectively. In this research effort, 39 lines with *SLCMV_CP* sense construct and 30 lines with SLCMV_CP antisense construct were developed for N. benthamiana and 11 lines with SLCMV_CP sense construct and lines with SLCMV_CP antisense construct for N. tabacum were developed. Collection of T0 transgenic seeds of N. Benthamiana and N. tabacum is underway.

Study disease progression and gene expression in a banana cultivar resistant Yellow Sigatoka

Banashree Saikia

Yellow Sigatoka disease caused by *Cercospora musae*, is an economically important disease of banana (*Musa spp.*). In Assam, it is a serious constraint predominantly for the Cavendish cultivars and management is highly dependent on the use of fungicides. There are certain cultivars in banana which are resistant to Yellow Sigatoka. However, molecular studies in interactions between the resistant cultivars with the pathogen are limited. Exploring an incompatible interaction would not only provide information on adequate defense mechanisms but also assist in the development of new control approaches.For the present study, the cultivars Kachkal and Sapor jahaji were selected, which have been reported to be resistant and susceptible to Sigatoka respectively, in Assam. Healthy suckers of both the cultivars were grown and maintained under shade net house in large pots. The causal fungus *C. musae* was isolated from infected foliar lesions, and characterized and identified for use in artificial inoculation of the plants. In the susceptible cultivar, symptoms were first observed on the 5th day of infection as yellowish green spots which gradually enlarged and turned into brown necrotic spots surrounded by yellow halos by the 15th day of infection. But in the resistant cultivar Kachkal, symptom development was late and was first observed after 25-30 days of infection. Moreover, further disease progression was restricted in the form of necrotic lesions. For semi quantitative RT-PCR analysis, collection of infected leaf samples was done at three time points *viz.* 24 hpi (hours post inoculation), 48 hpi and 72 hpi, along with water treated control for RNA extraction and cDNA synthesis. To analyze expression patterns of defense related genes involved in both the interactions analysis was carried out for 9 selected genes. In the resistant cultivar, RT-PCR studies revealed that, most of the defense and pathogenesis-related genes such as *PR-2, PR-4, LTP, GLP, IFR, and Osm* were upregulated after infection as expected. On the other hand, in the susceptible cultivar, expression was much lower and no significant upregulation was observed post-inoculation. Thus, the present study clearly differentiates an incompatible interaction from a compatible interaction. Differential transcriptome studies among resistant and susceptible genotypes would further reveal ample opportunities for genetic improvement in banana against Sigatoka.

Abstract of M. Sc. Thesis
Department : Agricultural Biotechnology
Major Advisor : Dr. P. Bharali

Molecular characterization of NBS-LRR resistant gene analogues (RGAs) from indigenous and wild banana (Musa spp.) germplasm

Geetimollika Hazarika

Commercial banana varieties are highly susceptible to fungal and bacterial pathogens, nematodes, viruses and insect pests. The largest known family of plant disease resistance (*R*) genes encodes proteins with nucleotide-binding site (NBS) and leucine-rich repeat (LRR) domains. Conserved motifs in such genes in diverse plant species offer a means for the isolation of candidate genes in banana that may be involved in plant defense. In the present study, an attempt was made to isolate and characterize the conserved region NBS of the NBS-LRR resistance gene analogues (RGAs) from locally cultivated indigenous and wild banana germplasms of Assam. The investigation was started with the isolation of genomic DNA from ten cultivated indigenous germplasms *viz*. Kach kol, Cheni champa, Ukho jahaji, Malbhog, Manuhor, Athiya kol, Bhim kol, Ketekihunda, Phesa manuhor and Ximolu manuhor and, five wild germplasms (designated as W1, W2, W3, W4 and W5). To target the NBS region of the banana germplasms, four pairs of PCR primers out of which two were degenerate primers, were designed from existing NBS-LRR sequences available in the GenBank. After successful isolation and sequencing of the PCR amplified NBS fragments from all the fifteen samples, confirmation about the identity of the sequences was done by homology search using BLASTn and BLASTp algorithms which revealed the sequences to be significantly similar to the NBS-LRR class disease resistance proteins available in NCBI. The sequence identity was further confirmed by checking for the Pfam NB-ARC domain, which is a protein domain characteristic of the plant resistance NBS-LRR protein. The NB-ARC domain was obtained in all the isolated NBS sequences. Finally, the presence of the consensus sequence for Kinase-2 motif (LLDDVW) and phylogenetic analysis of the isolated NBS sequences further provided evidence that the sequences belong to the typical non-Toll/interleukin-1 receptor- like domain NBS-LRR gene family, as expected. As a future prospect, upon cloning of the full length NBS-LRR sequences from these germplasms would open up possibilities for development of disease resistant cultivars through genetic engineering approaches.

Characterization and identification of potential Prbiotic Lactic Acid Bacteria (LAB) isolated from fermented dairy product of Assam *(Doi)*

Jaiba Fatma

Probiotics are the health promoting viable microorganisms that exhibit a beneficial effect on the health of human being by improving the intestinal microbial balance. Lactic acid bacteria (LAB) are important are well known agents. Fermented milk products like Dahi are known source of probiotic organisms.

In the present study, LAB was isolated from 25 different *"Doi"* samples collected from 8 different districts of Assam *viz*, Tinsukia, Dibrugarh, Sivsagar, Jorhat, Lakhimpur, Udalguri, Morigaon and Bongaigaon. A total of 30 bacteria were isolated initially but only 20 bacteria isolated from *Doi* meet the classification of LAB as Gram-positive and catalase negative (Salminen et al., 1993). These 20 LAB isolates were characterized based on their phenotypic, biochemical and molecular characteristics. Further, the isolates were screened for their potential probiotic properties based on conditions simulating human gastrointestinal tract (GI). These isolates were able to survive al low pH 2.5 which is similar to the pH of the human GI tract and able to convert lactose into lactic acid. Further studies revealed that these isolates were able to grow in a temperature ganging from 15-40^{0}C and grow at 9 % NaCl concertration. The antimicrobial activity of these isolates were tested against six pathogenic bacteria *viz, Escherichia coli, Pseudomonas putida, Staphylococcus aureus, Staphylococcus epidermidis, Salmonella enteric* and *Bacillus cereus*. Four isolates (ABT-Z2, ABT-Z3, ABT-Z4 and ABT-Z22) were able to inhibit the growth of all the tested six pathogenic bacteria. All the isolates produced Expolysaccharide (EPS) whose production was maximum at pH-6. Seven best LAB isolates were characterized by 16S rRNA gene sequencing and sequence analysis using nBLAST revealed that five of the seven isolates belonged to *Lactobacillus plantarum* and two belonged to L. Brevis. The results of the present analysis revealed that strain *L plantarum* is the predominant species of LAB found and *Assamese Doi*. The strain also displayed the best probiotic potential among the tested isolates. In future, this strain of bacteria can be used in preparing probiotic milk based fermented product and can be developed as an efficient starter culture to make *Doi*.

Study on linkage analysis for drought tolerance in Assam rice

Jyoti Prakash Sahoo

The rice plant is basically a tropical semi aquatic grass. Rice requires more water throughout its life cycle as compared to other crops. Intermittent drought is a major challenge limiting rice production. Thus, developing drought-tolerant rice cultivars is important to reduce climate-related risk, to increase productivity, and to alleviate poverty among rainfed farmers. Saturating the existing rice genetic map with highly informative, technically efficient, sequence-based markers will accelerate the integration. Linkage map construction is a pre requisite in molecular genetic studies that aim to identify or isolate genes of agronomic importance based on map positions in crop plants. In the present investigation, an attempt has been made to construct a linkage map of the Ranjit / ARC10372 recombinant inbred population (F_4) developed through single seed descent method based on microsatellite markers. Parental polymorphism survey with 215 SSR primer pairs identified 92 polymorphic markers between the parental lines Ranjit and ARC10372. The overall polymorphism level for the surveyed SSR markers was 42.79 % across the 12 chromosomes. The distribution of polymorphism across the rice genome was found to be non-uniform. Highest polymorphism was found in chromosome 11 (75%) followed by chromosome 2 (60%) and the lowest was recorded in chromosome 5 (26.31 %). All the 92 polymorphic markers was surveyed across the 85 lines of the mapping population and analysis of the marker segregation data has permitted the construction of a linkage map for the Ranjit / ARC10372 mapping population. The 12 chromosomes were represented along with the markers. Each linkage group contained 5–8 markers. The largest linkage group contained 8 markers and spanned 34.5 mb, while the smallest linkage group contained 6 markers and spanned only 10.1 mb. Total map distance was found to be 273.4 mb and avg. distance between the markers was 3.41 mb. An attempt was also made to map the SSR markers according to their LOD threshold values. In the present study, 7 linkage groups were found when various LOD scores were taken into account ranging from 1.0 to 8.0 to find out the linkage. Sufficient linkage was observed in

the linkage groups 2,3,4,6 and 7 to complete the map. But Group 4, 6 and 7 were only considered as the map was calculated at LOD threshold 3.0 and above. It is hoped that this genetic map will prove useful in locating and manipulating genes of interest in segregating populations. To complete the linkage map based on LOD score a larger segregating population will be required.

Shoot tip grafting for generation of virus free planting material of Khasi Mandarin (Citrus reticulata L. Blacno) for establishment of scion bank

Mallar Kanti Nath

Khasi mandarin *(Citrus reticulata)* is one of the most important fruit crop in citrus family. Total area under Khasi mandarin cultivation in North East (NE) India is 72.88 ha (NHB 2014-15). Among the eight states of NE India, production of Khasi mandarin was highest in Assam, which was 215.86 tons from 16.78 ha area (NHB 2014-15). Among the biotic stresses, one of the major biotic stress limiting the yield of Khasi mandarin is *Citrus tristeza virus* (CTV) infestation, commonly known as Tristeza, Stempitting, Hasaku Dwarf, Citrus Quick Decline, Seedling yellows, Lime Dieback. Wedge grafted CRS-4 Khasi mandarin plants infected with CTV was supplied by Horticulture Research Station, Kahikuchi. Bidirectional reverse transcriptase polymerase chain reaction (BD/RT-PCR) analysis revealed that CRS-4 plants were infected by both mild and severe strains of CTV. Apical meristem with apical dome and two primordial leaves collected from CRS-4 plants showed 72% survivability when cultured on modified semi solid MS medium supplemented with BAP 1.5 mg/L (primary establishment medium). After 7 days of culture on primary establishment medium, survived meristems were transferred on to filter paper bridge containing modified liquid MS medium (Treatment D) supplemented with doubled concentration of Mn (44.6 mg/L) and Zn (17.2 mg/L) , GA3 (0.50 mg/L) and Riboflavin (0.01 mg/L). *Citrus jambhiri* was used as a rootstock for shoot tip grafting. *C. jambhiri* seedling (14-16 days old) showed 41.3% successful micro grafts when the scions were inserted in the inverted T cut made on 3.5 cm long epicotyls. The grafted plants were transferred in dark for 15 days on modified semi solid MS medium (Treatment D). After 45 days of culture grafted plants were transferred in liquid medium of same composition for further growth of the shoot tips. After 65 days of culture, the successful micro grafted plants were transferred in soil mixture containing 25% Soil + 25% vermin compost + 50% sand for hardening and 52.6% micro grafted plants survived. These micro grafted plants showed free from CTV particles as evident by RT-PCR analysis using Coat Protein (CP) gene specific primers of CTV.

Abstract of M. Sc. Thesis
Department : Agricultural Biotechnology
Major Advisor : Dr. S. Singh

Identification of loci involved in salt tolerance by association analysis on japonica rice

Mousumi Hazarika

Soil salinity is one of the environmental constraints that affect crop cultivation worldwide. More than 800 Mha of land throughout the world and about 20% of the irrigated areas suffer from salinization problems (FAO, 2008). Among cereals, rice (*Oryza sativa* L.) is one of the most salt-sensitive although cultivars can differ in their response to salt stress (Horie *et al.*, 2012; Munns and Tester, 2008). In European coastal rice areas, salty raining and the salt water intrusion phenomenon caused by the rise in the sea levels due to climate changes are provoking a tendency toward salinization in the adjacent paddy fields where rice is grown (Yáñez, 2010.) Moreover, the island apple snail (*Pomacea maculata*) is becoming one of the major pest problems for rice throughout the world, including the European areas. Till date its only effective control measure is to flood the field with sea water, which even though kill the pest but leads to residual salinization problem. In India too, soil salinity is a problem in the coastal rice growing area. It has been estimated that an approximate area of 6.3 million hectares of land is covered by saline soil in India (Patel *et al.,* 2011). Taking into account the above statements, it is clear that the identification of elite rice varieties tolerant to salt stress is necessary. Salinity tolerance in rice is a very complex trait. Genome-wide association study (GWAS) is proving to be an effective approach for identifying loci controlling complex traits in plants (Ingvarsson and Street, 2011; Korte and Farlow, 2013; Huang and Han, 2014).

In the present work, a phenotyping activity for mid-salt stress has been performed on a subset of rice panel of 281 japonica rice accessions. Then, a GWAS was carried out in order to identify possible loci involved in salt tolerance in japonica rice. The measurement of phenotypic data highlighted variability among the genotypes in response to the treatment. This suggests that the panel might be a good resource for the discovery of traits related to salt stress response. The genome-wide association study identified significant associations between SNPs and the analyzed salt stress-related traits. A preliminary functional analysis of the identified loci by the GWAS has revealed many possible candidate genes involved in salt tolerance in *japonica* rice.

Abstract of M. Sc. Thesis
Department : Agricultural Biotechnology
Major Advisor : Dr. A. Baruah

Genomic diversity for early heading date in rice cultivars of Assam

Nayanjyoti Borah

Heading date (DTH) in rice is one of the most important indices in rice breeding and it is being governed by multiple genes known as quantitative trait loci (QTLs). This character along with grain yield determine the commercial potential of any rice cultivar. Early heading date (EHD) for some improved varieties of Assam such as *Ranjit* (especially for late sown condition) without compromising yield is a desirable trait. Genetic manipulation for this trait requires information linked to genomic regions contributing early headingand their allelic distribution in Assam rice to facilitate identification of suitable parents for this trait, which is lacking. The present study was conducted to understand the seasonal variations for DTH and allelic distribution for EHD related genes/QTLs in rice cultivars of Assam. A total of 46 diverse rice cultivars were grown in two seasons, *viz.*, *boro* and *ahu* in 2015-16 at Instruction cum Research Farm, AAU in triplicates. Based on distribution for DTH *boro* seasons, the cultivars were grouped into early, mid early and late showing varied DTH pattern. The mean differences for heading dates among the groups in both the seasons were found to be significantly different, indicating the cultivars were grouped unambiguously and differential response to the environmental cues. Increasing order of mean difference for heading date was detected in both the seasons from early (18.89), mid early (19.25) to late cultivars (22.42). Among the cultivars grown in Assam, earliest DTH was recorded for *IR 73005-23-1-3-3* (101 days in *ahu*; 122 days in *boro*) and the most late was *Joymati* (126 days in *ahu*; 150 days in *boro*), however, the difference for heading dates in *ahu* and *boro* ranged from 21 to 30 days in early, 22 to 30 days in mid early and 28 to 36 days in late cultivars. Regarding allelic distribution of these cultivars for EHD, a total of 19 markers linked to the genes/QTLs for EHD were used. The allele frequency in cultivars with late heading date (0.357) was lower than that in cultivars with early (0.399) and mid early (0.388) heading dates. The frequency of occurrence of *Hd16* allele was found to be highest (0.822) and *Hd17'* was the least (0.044) among the cultivars except *Hoshinoyume*. For *Hd10* and *Hd16'* the frequency of occurrence was in decreasing order

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Department : Agricultural Biotechnology
Major Advisor : Dr. A. R. Baruah

from early, mid to late groups while the reverse trend was observed for *Ehd3* only, indicating these genes/QTLs might interplay in contributing earliness or late in cultivars under study. The alleles linked to *Hd13*, *Ehd4*, *Hd8*, *Hd9* and *Hd2* were not detected in the rice cultivars grown in Assam and the rest of the genes failed to detect any trend of allelic distribution pattern. The marker (P548D) linked to *Hd17'* was only observed in two cultivars showing EHD, *viz.*, *Aifa* and *Mukta*, indicating usefulness of marker in detecting cultivar specific allele in the present set of markers. The present study generated information on adaptation of these set of rice cultivars for heading date and allelic distribution related to 19 genes/QTLs, which may be useful to formulate strategies in manipulating the trait. However, inclusion of more cultivars in each group, and gene specific sequencing may provide better insight to the problem.

Optimization of an *in vitro* regeneration and transformation protocol in Khasi Mandarin

Panchashree Das

Citrus species are the most widely grown fruit crops within the whole world. India is the fourth largest producer of orange in the world. North-Eastern India is considered as one of the centres of origin of many citrus species. Among them Khasi Mandarin is the most widely grown citrus species. According to Ministry of Agriculture and Irrigation, Govt. Of India, the yield of Khasi Mandarin is declining day by day drastically due to biotic and abiotic stress. Conventional breeding for overcoming this problem is limiting due to non-availability of resistant sources. Recent advances in genetic engineering have made it possible to incorporate desirable genes from alien sources to elite genotype mainly through *Agrobacterium*-mediated genetic transformation. Citrus cultivars vary in their response to *in vitro* organogenesis and genetic transformation. This results in need for a cultivar-specific optimization of an *in vitro* regeneration and transformation protocol.

Most of the plant regeneration processes in citrus, through tissue culture, involve use of Cotyledon, epicotyl segment, shoot-tip, internode, root meristem as explants. A study was conducted to develop a regeneration and *Agrobactetrium* mediated transformation protocol for Khasi Mandarin using zygotic seedling as explants obtained from six-week-old *in vitro* grown seedlings. Modified MS media containing 1 mg/l BAP, 0.5mg/l NAA and 0.4mg/l Kinetin shows the best result for multiple shoot induction with an efficiency of 68%. The number of multiple shoots developed was on an average 5. The modified MS medium containing containing 0.25mg/l BAP, 0.5mg/l NAA, 0.5mg/l IBA shows best result for rooting with an efficiency of 82% with an average root length 2 cm. Zygotic explants with injured shoot tip were used as explant for transformation with *Agrobacterium* strain AGL1, harbouring plasmid pCAMBIA1301 containing *hpt* as selectable marker gene and *gus* as a reporter gene. Modified MS media containing 100mM Acetosyringone was found to be most effective medium for co-cultivation. Regeneration and selection media containing 1 mg/l BAP, 0.5mg/l NAA, 0.4mg/l Kinetin and 30mg/l hygromycin and 250mg/l timentin

shows the best result. *In vitro* regenerated shoots that survived upto 3rd selection cycle were considered as putative transformants. Some of the putative transformed shoots showed positive result for *gus* in PCR analysis.

The present investigation is a preliminary study on optimization of an in vitro regeneration and transformation protocol in Khasi Mandarin. More and more concentrated effort is needed to establish a most efficient regeneration and transformation protocol considering various factors affecting genetic transformation and regeneration efficiency.

Screening of hydrogenase accessory genes *hyp*A and *hyp*B in few acid tolerant *Bacillus* sp.

Pooja S

The present investigation reports on the screening of hydrogenase accessory genes *viz., hyp*A and *hyp*B in previously isolated acid tolerant *Bacillus sp.* followed by differential expression study (pH 7.0 and pH 4.5) of the both genes in three selected strains and subsequent cloning of *hyp*A and *hyp*B gene of *Bacillus megaterium* into pET28b$^+$ vector. A total of 50 previously isolated acid tolerant *Bacillus* strains were considered for screening of *hyp*A and *hyp*B genes. Among the 50 isolates, 10 isolates tested positive for *hyp*A & *hyp*B genes. Three isolates *viz., B. megaterium* (GG1), *B. cereus* (GG2) and *Lysinibacillus fusiformis* (GG11) were considered for further study due to their ubiquitousness and higher acid tolerance. Bacterial RNA was isolated followed by synthesis of cDNA. A q-RT-PCR was performed in the above mentioned isolates to analyse the expression level of the said genes in acidic condition. The expression of *hyp*A and *hyp*B genes were significantly (P d" 0.05) up-regulated at pH 4.5 than in pH 7.0 in all the 3 isolates *viz.,* GG1, GG2, GG11. An 18 fold increase in the expression of *hyp*A and a 6.1 fold increase in expression of *hyp*B were observed in the isolate GG1 at pH 4.5 compared to pH 7.0. The expression of *hyp*A and *hyp*B genes in GG2 was found to be 4.6 and 3.8 fold higher respectively at pH 4.5 than pH 7.0. In GG11, *hyp*A showed 5.3 fold and *hyp*B showed 2.8 fold increased expression at pH 4.5 compared to pH 7.0. Maximum expression of both the genes was observed in *Bacillus megaterium*. These genes were further cloned into pET28b$^+$ vector. The transformation frequency obtained for the *hyp*A and *hyp*B was 1.5 x 10^6 and 3.2 x 10^4 CFU/µg respectively. Successfully transformed colonies were further validated through colony PCR as well as PCR on isolated plasmid DNA. The cloned *hyp*A gene was sequenced and BLAST analysis was performed. BLAST analysis revealed that the genes belonged to the respective genus. The results of the present study revealed that *hyp*A and *hyp*B genes may have role in conferring acid tolerance to soil bacteria.

Abstract of M. Sc. Thesis
Department : Agricultural Biotechnology
Major Advisor : Dr. M. Barooh

Cloning and characterization of gene encoding Cycloartenol Synthase (CAS) in *Centella asiatika* (Indian pennywort)

Priyanka Roy

Oxidosqualene cyclases (OSC) catalyzes the cyclization of 2,3-oxidosqualene, a common precursor of sterols and triterpenoids, and it situates at the branching point for the sterol and triterpenoid pathway. The enzyme cycloartenol synthase (CAS) is responsible for phytosterol biosynthesis. The gene has been widely studied in many plant species including many medicinal plants, such as *Panax ginseng, Glycyrrhiza spp, Fritillaria thunbergii* even in *Centella asiatica*. But, till now no reports of cloning and characterized of this gene in *Centella asiatica* in India have been found. Therefore, the present study aims at cloning and characterization of full length cDNA of *cas* gene from *Centella asiatica*. Initially the partial sequence was amplified using degenerate primers followed by RACE PCR to elucidate the full length CDS. Sequence analysis indicated that the cDNA was of 2528 bps, which had an open reading frame of 2273 bps and encoded a protein containing 757 amino-acids with a mol wt of 86.3 kDa.4 SNPs (Single Nucleotide Polymorphisms) are found and 2 changes are seen to change the amino acid residue. The Conserved Domain search divulge the presence of squalene cyclase domain in CaCAS.The multiple sequence analysis (MSA) based on BLASTp search against non-redundant (nr) protein sequence with 85% identity cut-off showed the presence of Active site motif ($_{483}$DCTAE$_{487}$). The phylogenetic analysis based on MSA shows close relationship with the CAS protein sequences of *Centella asiatica* already reported from Korea and with *Bupleurum kaoi* and *Panax quiquefolius*. (Cluster-I).The homology based 3D modelling of CaCAS revealed the presence of 33 á-helices and 6 â-sheets with a spatial structure similar to *Homo sapiens* OSC complex protein **(PDB id: 1W6J).** The obtained model was assessed for residue-by-residue stereo-chemical quality evaluation using Ramachandran plot analysis which revealed that the CaCAS model had 89.5% Õ and ø angles of its residues within the core region of the Ramachandran plot. Thus, the cloning of full length CDS and structure-function analysis of *cas* gene in *Centella* will facilitate to understand the CAS's functions and regulatory mechanisms involved in isoprenoid pathway in *C. asiatica* at genetic level.

Abstract of M. Sc. Thesis
Department : Agricultural Biotechnology
Major Advisor : Dr. P. Sen

Host range, incidence, and genetic variability of watermelon mosaic virus in Central Spain

Ricky Raj Paswan

Watermelon mosaic virus (WMV, *Potyvirus*) is an economically important pathogen common in cucurbits of temperate and Mediterranean regions worldwide. The presence of WMV in cucurbits in the Mediterranean basin has been known for decades. More recently, an emergent strain that causes more severe symptoms compared to classic strains has been recognized in France. The cultivation of melon is threatened by the spread of emergent strains of WMV. Diagnostic methods for detecting the host range, incidence and evolution of these emergent types are critical for developing control strategies to optimize agricultural production. In this study, next generation sequencing and RT-PCR approaches are combined to investigate the epidemiology of WMV in an agro-ecosystem of Central Spain. Four vegetation types, or habitats, including cultivated and adjacent land-use types were surveyed in the summer and autumn of 2015. Forty-three plant species were screened for WMV, 15 of which were WMV-positive across two habitats other than crops. The results indicated an increase in the extent of the WMVs known host range. The incidence of WMV ranged from 64% in *Cucumis melo* to 5% in a weed species, *Datura Stramonium*. Genetic analyses of the coat protein gene of 30 isolates from melon and 3 other 'weed' species sampled in crops showed population variation in nucleotide diversity, but pairwise fixation indices indicated negligible distinctions between them. Phylogenetic inferences showed both negligible and large branch length differences between isolates from different host species. When sequences of a number of different strains were added to the isolates from the melon crops, one clad clustered with an emergent group previously identified from elsewhere in Europe and Asia. This study reports the first instance of an emerging (EM) strain in Central Spain.

Screening and characterization of *vip* genes in *Bacillus thuringiensis* strains isolated from Assam soil

Shaswati Sharma

Bacillus thuringiensis(Bt) is a ubiquitous gram positive bacterium which produces parasporal inclusions known as vegetative insecticidal proteins (Vips) during the vegetative growth phase, while Cry proteins are produced during the sporulation phase. The *vip* genes do not share any homology with *cry* genes and reveal a different mode of action. Vip1/Vip2 protein confer toxic activity against some coleopteran insects, while Vip3A proteins exhibit insecticidal activity against a wide variety of lepidopterans. Recently, *vip3A* genes expressed either alone or in combination with *cry* genes (pyramiding) in genetically engineered cotton have shown enhanced resistance to target insects. In spite of the wide spectrum of Bt toxicity against insect pests, their extensive use may threaten the possible evolution of resistant pest. Thus, there is a need to isolate novel strains/toxins and discover insecticidal genes with broader insect host range.

In the present investigation, 189 isolates of *Bacillus thuringiensis* / *B cereus* were collected from 11 locations of two ecosystems within Assam. Morphological studies such as Gram staining and spore staining revealed that 162 isolates were *B. thuringiensis*. Of these, 30 isolates were subjected to 16SrDNA amplification using *B. thuringiensis* specific primers and 24 isolates yielded the expected amplicon. These 24 isolates were subjected to PCR amplification using *vip1*, *vip2, vip3* specific primers and 21 isolates showed expected amplicon for either one or more *vip* genes. The strain A25, which was isolated from the Kaziranga area showed amplifications for all three *vip* genes. We identified 3 isolates having *vip3*gene by PCR analysis and Western blotting confirmed the expression of 66 kDa truncated Vip3 protein in these three isolates. Thus, the above data revealed the presence of *vip* gene in the *B. thuringiensis* isolates of Assam soil. Further research is required to clone full length genes from Vip positive isolates, isolate large amount of Vip proteins in an expression vectors and confirm their efficacy against target pests.

Cloning of viral genome associated with leaf curl disease of Bhut Jolokia (*Capsicum chinense* Jacq.)

Sushmita Rajkhowa

Bhut Jolokia (*Capsicumchinense*Jacq.) is known as one of the hottest chilli in the world. It is cultivated as a major cash crop in Assam and other northeastern states, mostly Manipur and Nagaland. In the international market Bhut Jolokia has high value due to its high Capsicin content which has various important properties like anti-inflamatory, anti-diabetic, anticancerous, pain relief, gastro intestinal disorder etc. The fruit has got multiple uses in medicines, biological warfare,elephant repelling, pickles and culinary purposes. Around 1400-1500 tonnes of the fruits are exported annually from Assam. However,the productivity of the crop is hindered due to attack ofvarious diseases and pests. Viruses have been reported to be one of the major factors that affect Bhut Jolokia plants. Both RNA viruses (*Potyvirus, Cucumovirus, Tospovirus*) and DNA viruses (*Geminivirus*) incidence have been reported that infect Bhut Jolokia in Assam. Among the DNA viruses chilli leaf curl virus (ChLCV) and tomato leaf curl virus (ToLCV) have been reported to infect Bhut Jolokia which produces symptoms of leaf curling, mosaic symptoms, stunting growth and vein clearing. Some geminivirus also contains a satellite genome which functions as silencing suppressors and in symptom determinant. As such, to determine the genome sequence of the DNA virus(es) infecting the Bhut Jolokia plants with leaf curl disease, both universal and specific primers were used to detect the virus(es) associated with leaf curl disease. Partial sequences were obtained from ChLCV-specific primers designed from available sequences. The sequences were obtained from samples collected of AAU experimental farm, Lichubari and Teok, Jorhat. Multiple sequence alignment followed by phylogenetic analysis of the four sequences showed 98% identity with the chilli leaf curl isolate of Oman (Accession No.JN604500.1). The phylogeny could not establish a geographical grouping, possibly because of short length of the sequences. Meanwhile, the nucleotide similarity search for the sequences obtained from the universal primer and ToLCV specific primers did not amplify any viral sequence. Satellite-specific primers were used for detection of satellite genomes (both alpha-satellite and beta-satellite) possibly associated with the leaf curl disease of Bhut Jolokia. However, presence of any associated satellite could not be determined. Therefore, further works will be needed in these regards.

QTL Mapping for yield attributing traits under drought stress in a cross between rice varieties Ranjit and Banglami

Vinay Sharma

Drought stress is the predominant cause for rice (*Oryza sativa* L.) yield reduction and instability in production under rainfed and poorly irrigated rice ecosystems. Development of cultivars with improved drought tolerance is thus an important element in increasing productivity and alleviating poverty of communities dependant on rainfed ecosystem. The complex nature of drought tolerance, genotype x environment interaction, lack of understanding of inheritance of drought tolerance, poor understanding of physiological basis of yield under water limited condition, inefficient phenotypic selection and difficulty of effective drought tolerance screening complicate the development of drought tolerance varieties. Rice is highly sensitive to water stress at the reproductive stage as floral fertility in rice is extremely sensitive to water stress. Therefore, the present study was undertaken to identify QTLs for various yield related traits under reproductive stage drought stress. The F_4 mapping population were raised from the cross between 'Banglami' and 'Ranjit', and evaluated under drought stress and irrigated conditions. The drought stress was imposed during the reproductive stage. A total of 94 polymorphic SSR markers were used for genotyping of 90 F_4 plants. Among these, 56 markers fitted for the expected Mendelian ratio of segregation whereas, 38 significantly deviated from it (P<0.01). Only 63 SSR markers could be assigned to 12 linkage groups (LGs) covering a total of 1652.3 cM of the rice genome at an average marker density of 26.22 cM. The number of markers on each linkage group ranged from 3 (LG 10) to 7 (LG2 and LG 8). A total of 26 QTLs were identified for yield and physiological traits with the phenotypic variation ranging from 0.14% to 26.17%. Among these, 18 QTLs ((*qDTF12.2, qEBT3.1, qNOT6.1 qPH1.1, qPH7.1, qPL1.1, qPL1.2, qPL1.3, qPL9.1, qPL9.2, qNOG9.1, qGY1.1, qRLWC1.1, qRLWC6.1, qRLWC9.1, qRLWC9.2, qRLWC 9.3* and *qRLWC11.1*) were identified under drought stress and remaining 8 (*qDTF3.1, qDTF12.1, qPL3.1, qNOG6.1, qNOG6.2, qNOG9.2, qGY1.2,*

qGYl1.1) QTLs were detected under irrigated conditions. The QTLs for days to 50% flowering remained consistent in the marker intervals of RM519-RM3331 on chromosome 12 under both hydrological conditions. Further fine mapping of these QTLs may identify some novel genes associated with drought tolerance which can be used in MAB for the development of drought tolerant rice variety.

A study on the impact of microfinance through SHGs in the district of Sepahijala, Tripura

Abdul Kadir

The present study was carried out in Sepahijala district of Tripura to find out the impact of microfinance through SHG. A Multistage Stratified Random Sampling technique was used to select the ultimate sample size, i.e. selection of SHGs from Nalchar development block of Sonamura sub-division of Sepahijala district. Nalchar development block was selected purposively because highest number of SHGs was present at this block. Total sample SHG was twenty for collection of primary data. Selected SHGs were categorized as small, medium and large according to their membership strength.

The study reveals that 60.33 per cent of the SHG members were age of (25-35) range & 52.57 per cent of the SHG members had education of High School Leaving Certificate. It was found that 68.18 per cent member's family income was (₹ 5000-10000). Maximum number of SHGs were women SHG(85 per cent).

Tripura Grameen Bank had provided highest amount (55 per cent) of loan to the SHGs. The Study reveals that SHGs were mainly involved in crop enterprises, vegetable cultivation, dairy, goatery, piggery, fishery etc. Average amount of loan and subsidy were ₹ 156424.80 & ₹ 82655.20 respectively. Per SHG saving was ₹ 103360.60. From the total credit amount, 87.35 per cent was used for agriculture & allied activities & the rest (12.65 per cent) was used in other activities. Highest amount (36.78 per cent) of credit was utilized in fishery. Vegetable production has got highest B: C ratio(3.68) followed by fishery(3.23) in the small SHGs. Fishery and vegetable cultivation has more profit than other enterprises.

Insufficient amount of loan, complex procedure of loaning, high cost of inputs, delay in disbursement of loan by banks , lack of marketing facilities and lack of proper information about sources of fund were the major problems of microfinance through SHG in the study area.

SHGs connected a very large section of poor household with banks, which were out of reach from the conventional banking system. SHG will bring women empowerment if proper guidance, financial assistance, training is given to the rural women.

Impact of Backward Regions Grant Fund (BRGF) on the socio-economic development of small farmers in Morigaon district of Assam

Ankita Sahu

Concerned by the slow growth in development of the states, the Government of India designed a program to address regional imbalances in development and named it as Backward Regions Grant Fund (BRGF). The programme was launched by then Prime Minister Dr. Manmohan Singh in Assam with the initiative on 19th February 2007 in Barpeta district of the state. It was followed by further implementation of the programme in 13 other districts of the state including Bongaigaon, Cachar, Dhemaji, DimaHasao, Goalpara, Hailakandi, Karbi Anglong, Kokrajhar, Morigaon, North Lakhimpur, Baksa and Chirang. The programme of Backward Regions Grant Fund subsumes the Rashtriya Sama Vikas Yojana (RSVY), a scheme earlier being administered by the Planning Commission.

The present study was conducted in Morigaon district of Assam to study the impact of BRGF on the socio-economic development of small farmers. The study analyzed the existing inflow of fund and institutional arrangement for providing professional support to the beneficiaries. Performance evaluation of financial resources was carried out in addressing the persistent regional imbalances. The study observed different problems of sample farmers in the implementation of the programme.

The study observed that BRG fund had been distributed in the district through different institutions such as Zilla Parishad, Development blocks, Gaon Panchayats etc. However, the present study concentrated on the funds distributed through five development blocks namely Mayong, Kapili, Laharighat, Moirabari, Bhurbandha in Morigaon district of Assam. From the analysis it was observed that Mayong development block received the highest amount of fund being Rs. 202.04 lakhs during the plan period and gaon panchayat received highest allocation (50%) out of the total allocation for the Panchayati Raj Institutions (PRIs). In Agricultural sector, the total irrigated area of the sample farmers increased from 17.65ha to 25.19ha after the implementation of the BRGF programme.

Certain problems such as delay in release of fund, untimely submission of utilization certificate, lack of training, lack of human resource were identified by development blocks and zilla parishad. Majority of sample farmers (70%) were unaware about the implementation of the programme. Other problems faced by the farmers were lack of knowledge, untimely completion of work, supply of poor quality goods, unsatisfactory work etc.

Resource use and extent of adoption of improved technology in cultivation of major crops in Sonitpur district of Assam

Boishali Gogoi

The present study on the extent of adoption of improved technology in cultivation of major crops and its impact on farm returns was conducted in Sonitpur district of Assam with the objectives – (i) Study the resource endowment and utilization in cultivation practices of major crops, (ii) Examine the extent of adoption of improved technology and its impact on productivity and farm income, and (iii) Identify the problems faced by the farmers in adoption of improved technology and to suggest appropriate policy measures.

Altogether, 100 sample farmers were selected randomly and then categorized into 4 different size groups i.e. marginal (0-1 hectare), small (1.01-2.0 hectares), semi-medium (2.01-4.0 hectares) and marginal (above 4.0 hectares) farms. They were selected from 4 villages *viz*., Panibharal, Garehagi, Monabari and Disri villages from Biswanath Chariali development block and Baghmara development block. The samples were selected using multistage random sampling technique. Mostly primary data relating to the agricultural year 2016-17 were used in fulfilling the various objectives of the study. Data were collected from the sample farmers using interview method with the help of questionnaires. Data on socio-economic variables, resource endowments of the farmers, input-output data on major crops were collected to examine the extent of adoption of improved technology and its impact on productivity and farm income of the farmers. Data on the problems faced by the farmers were also collected to identify various constraints of adoption of improved technology in the study area.

Tabular method of analysis with average and percentage were used to study the resource endowment of the farmers, the extent of adoption of improved technology and the severity of various constraints faced by the farmers. Indices of adoption were constructed using 5 different functions.

The result of the study revealed that with respect to socio-economic variables and fixed capital assets value, the bigger farm sizes were better endowed with resources (excluding family labour) and economically better off compared to their other counterparts.

The extent of adoption of improved agricultural technology was the highest in case of *Boro* paddy followed by *Sali* paddy and potato. In case of pulses and oilseeds, the extent of adoption was very low. It was found that technology adoption was directly proportional to farm size.

A considerable impact of improved technology on farm income was observed for all size groups of holdings and the impact was the highest in semi-medium farmers, followed by medium, small and marginal farmers. Regarding the productivity of the farms, technological impact had similar kind of effect as for the farm income. Bigger farms were seen to adopt more of the improved technology in their cultivation practices which lead to higher productivity.

The various problems faced by the farmers on adopting improved agricultural technology were studied under 3 groups *viz*., technological constraints, economic constraints and social and other constraints. Of the various problems identified, lack of assured irrigation, lack of capital, unawareness and ignorance of recommended package of practice, high cost of HYV seeds and related inputs and climatic factors were more serious. These all indicated the need to strengthen the mechanism of resource supply and extension services in the study area.

Impact of institutional agricultural credit on farm production and productivity : A study in Gomati district of Tripura

Debabrata Chakraborty

Finance, considered to be the life-blood of any kind of enterprise, is the essential pre-requisite of every productive activity. Therefore, credit enables farmers to use various inputs and new technologies. It also keeps enterprise dynamic, develops products, keep men and machines at work and encourages management to make progress and creates value through increased employment opportunities. The present study on impact of institutional agricultural credit on farm production and productivity was conducted in Gomati District of Tripura. The study was designed specifically to examine the sources and terms and conditions of credit, amount of credit distribution, purpose of credit and its impact on level of resource input use, yield and profitability of farms in the study area.

A sample of 120 farmers comprising beneficiaries(60) and non-beneficiaries (60) were selected randomly from six villages of three selected blocks of Udaipur sub-division for study. Tabular analysis, averages and percentage analysis, the cost concepts and production function analysis were employed for analyzing the data. The results of the study highlighted the following.

1. In regards to amount borrowings in the study area it was observed that total credit disbursement by the institutional agencies to the sample borrowers was '5939000. All the size group of beneficiary farmers borrowed crop loans at 7 per cent interest per annum and interest subvention of 3 per cent was provided to the farmers for promptly repayment of loans.

2. The analysis of resource utilization pattern on the production of major crops between the sample beneficiary farmers and sample non-beneficiary farmers in the study area revealed that the quantities of resources used were more in case of borrowers in respect of almost all the major inputs for the production of major crops over the non-borrowers. This was possible due to availability of funds in the form of credit from various financing institutions.

3.   The study revealed that per hectare production of different major crops was higher on beneficiary farms as compared to non-beneficiary farms. The per hectare costs, returns and profits of beneficiary farms were also higher than non-beneficiary farms. The production function analysis indicated that the productivity of different resources on beneficiaries farm was higher than the non-beneficiaries farm.

Thus, the results of the present study have clearly demonstrated that there has been a positive impact of institutional agricultural credit on the levels of input use and thereby per hectare yield of the crops grown in the study area. Thus, the flow of farm credit has resulted in improving the economy of beneficiary farmers. This call for encouragement to the farmers for taking loan and to improve their farm economy by increasing productivity of farms. Simplification of the loan procedure by reducing the formalities, arranging loan rallies and NGO-Bank linkage programmes by different financial institutions for encouraging the farmers in extending credit facilities and proper documentation of land records and investigation for identification of real cultivators were the important policy implications which have emerged from present study.

Economics of potato marketing in east Khasi hills district of Meghalaya

Dulcie Ch Marak

Potato is one of the highly important crops in the state of Meghalaya where East Khasi Hills district is the highest Potato growing district in the state .The study on analysis of economics of potato marketing was undertaken for the year 2015-16 in East Khasi Hills district of Meghalaya. Both primary and secondary data were used. In the study area the classified categories of respondent farmers were 61 marginal farmers, 18 small, 13 semi-medium and 8 medium farmers. During the study two markets, *i.e.*, Mawiong regulated market and Iewduh Shillong market was selected and for each marketing channels was identified. In the Mawiong regulated market two channels identified were channel - I: Producer - Wholesaler- Distant wholesaler - consumer, channel-II: Producer - Wholesaler-Retailer- Consumer. Producer's share in consumer's rupee was 59.71% in channel - I, and 60.17% in channel-II which was slightly higher. And on the other hand in the Iewduh Shillong market four channels identified are channel - I: Producer - Consumer (90.97%), Channel - II: Producer - Wholesale -Retailer - Consumer (557.78%), Channel - III: Producer-Retailer-Consumer (69.59%), and channel - IV: Producer -Village trader - Wholesaler- Retailer-Consumer (51.45%). Producers share in consumers' rupee was higher in channel - I as there were no intermediaries involved.

During the study problems faced by the farmers were encountered. It was found that potato producers faced marketing problems like no asses to market information, inadequate storage facilities, Poor market infrastructure, unnecessary deduction, distant market *etc*. As production is adjunct with marketing, constraints for production were also enlisted, the sample farmers faced production constraints like high input cost, high incidence of disease, surfeit rainfall, continuous use of old varieties, lack of storage facilities *etc*.Therefore it is necessary to remove these bottlenecks for sustainable and efficient potato marketing and production in the study area. And also it is important that the concern authority should look through this issue and take effective steps to promote and strengthen the role of regulated markets in the state and establish more number of regulated markets.

Economics of production and marketing of black scented rice (*Chak-hao)* in Manipur

Elangbam Yaiphaleima Chanu

The present study was carried out in Imphal east and Thoubal district of Manipur to study the present status, marketing channels, marketing costs, marketing margins, problems and prospects of production and marketing of black scented rice in the state. A multistage purposive and random sampling method was used for the study in order to select 100 respondents. Both the primary and secondary data were collected. The primary data were collected from the respondent farmers using pre tested scheduled through personal interview method.

From the analysis it was observed that out of total rice area 237150 ha, black scented rice shared 0.06 per cent (150 ha).Total production of rice was observed 508500 MT of which black scented rice shared 0.07 per cent (360 MT). But black scented rice captures higher returns as its priced is three times higher (Rs.120000 – Rs.150000 per MT) over normal rice (Rs.28000-Rs.31000 per MT) in the domestic as well as international markets. Factors influencing the production of black scented rice were estimated using Cobb-Douglass production function. It was analyzed that the regression coefficients for seed (0.305) and hired machinery (0.556) was found to be positively significant. Three different marketing channels were identified in the study area. It showed that producer's share in consumer's rupee was highest in channel-III (97.29%) as no intermediaries were involved in this channel followed by channel-II (49.04) and channel-I (48.12). Similarly, for normal rice the producer's share in consumer's rupee was highest in channel-III (90.71) followed by channel-II (76.71) and channel-I (73.57). The study revealed that there is scope for increasing producer's price by reducing the middlemen margin for black scented rice.

The study identified a number of important problems influencing production and marketing of black scented rice in Manipur. The major production problems were lack of irrigation, soil testing facilities, inadequate credit facilities, lack of technical information, lack of high yielding varieties of black scented rice *etc*. Major marketing problems were

lack of producers' organisations, organic certification, lack of storage facilities, dependence on market middlemen, lack of government procurement policy and other related infrastructure for better marketing of the produce as such it is suggested and recommended to formulate a sound agriculture policy which can address to make available production technologies along with quality of seeds, other inputs and also creating sound marketing infrastructure so that the farmers/producers and consumers at the same time will able to reap the fruits of policies undertaken in the region in near future. This type of policy will also encourage taking up more production programme and which will in turn give a boost to the agrarian economy of the state.

Economic appraisal of Mandarin Orange cultivation in East Siang District of Arunachal Pradesh

Gevang Tamut

The present study was conducted in East Siang district of Arunachal Pradesh based on the sample of 120 Mandarin orange growers selected randomly using a multistage sampling technique to find out the growth rates, patterns and intensity of resource use, costs and returns of Mandarin orange cultivationand constraints faced by the Mandarin orange growers. For analyzing the data collected during the study, tabular analysis, growth rate analysis, investment appraisal, break-evenanalysis and sensitivity analysis were employed.

Compound growth rates of area, production and productivity showed a significant growth of 10.17 per cent, 11.86 per cent and 1.53 per cent per annum respectively for the period from 2004-05 to 2013-14.

Resource utilization analysis shows that small farms used different resources (land, human labour, tools and implements, plant protection chemicals and manure and fertilizer) with higher intensity compared to larger farms.Total costs of establishment(up to four years) per hectarewerefound to be Rs. 2,13,089.09.

The maintenance cost during thebearing period increased from Rs. 31,380.23 in thefifth year to Rs. 66,378.28 in thetwelfth year, and thereafter, the maintenance cost was found to remain more or less same in subsequent years. Investment appraisal reveals that at a discount rate of 9 per cent; the Mandarin orange cultivation had an NPV of Rs. 3,25,972.50, AAM of Rs. 30,302.27, IRR of 15.97 per cent, BCR of 1.54 and PBP of 11.485 years.Break-even analysis reflected ahigher level of existing area of operation, yield, production and prices of produce in all size groups, indicating the profitability of Mandarin orange cultivation. The sensitivity analysis showed that 60 per cent decrease in the existing level of production and prices would render the existing farms have to go for increasing the production and prices to obtain a no profit no loss situation.

High cost of manure and fertilizer, plant protection chemical, costly labour, disease and insect infestations, high-interest rate, non-remunerative price of theproduct and higher transportation charges were the main problems confronting the cultivators. Adoption of recommended cultivation practices, provision of adequate credit would help in expanding the area and also in increasing the productivity of Mandarin orange.

Study on the pattern of adoption of flood tolerant rice varieties in Jorhat district of Assam

Jammalamadaka Anusha

Flood is a havoc to farmers especially rice growers of Assam as sali rice is grown in a season threatened by flood. International Rice Research Institute, Philippines and Central Rice Research Institute (CRRI), Orissa released few Flood Tolerant Rice Varieties for the flood affected rice area of the nation. In Assam, RARS, Titabor has released two varieties Ranjit Sub1 and Bahadur Sub 1 for the submergence areas of Assam. In many farmers field, demonstrations are going on for the performance of these varieties under the supervision of the KVKs. It is reported that these varieties are performing very well in terms of yield performance in farmer's field (nicra, icar.in). In Jorhat district, some farmers have been growing Ranjit Sub1 and Bahadur Sub1 in their fields. However, all the flood affected rice growers are yet to adopt the flood tolerant varieties in their fields. In this study an attempt was made to examine the status of adoption of flood tolerant rice varieties in the district. The study found that in study area the adoption of flood tolerant rice varieties was 37.85%. The yield advantage of flood tolerant rice varieties was found to be 45.44% over normal flood tolerant rice varieties in the study area which was due to resistance of flood tolerant rice varieties towards the flood water. With more educated farmer and more extension contacts, the adoption of flood tolerant rice varieties was found to be increased. Although the cost of cultivation of flood tolerant rice varieties was comparatively more than normal flood tolerant rice varieties, due to yield advantage the return over cost was more in flood tolerant rice varieties. The gross returns obtained from rice flood tolerant varieties '51278.00 were higher than '35889.00 normal rice varieties. The return over cost ratio for the normal rice varieties was found to be 1.22 and the 1.35 return over cost ratio for the flood tolerant rice varieties. Seed was hampering the adopters to adopt the variety fully. Due to lack of awareness some of the farmers are not adopting flood tolerant rice varieties. Increase fertilizer might increase the yield of flood tolerant rice varieties. As received at the experimental plots. Awareness and training was needed by the farmers for adoption of flood tolerant rice varieties. Timely supply of seeds should be done to the farmers. More extension workers should be appointed for direct contact with the farmers. Proper utilization of strategic inputs, imparting trainings to the farmers about the benefits of flood tolerant rice varieties would certainly enhance the yield of the flood tolerant rice varieties in the study area and in the state and thereby can help to increase the farmers' income.

Dynamics of agricultural development and its determinants in Assam

Pratiksha Baishya

The economy of Assam has always been dominated by agriculture as major part of the population is involved in the activity. Agriculture sector has shown significant growth over the years considered in the study due to development of new technologies implementation of better policies in the state. The present study is an attempt to examine the performance of agricultural sector in Assam with respect to both input the output growth for the period from 2000-01 to 2014-15. The study was carried out using secondary data relating to nice principal crops of Assam and four determinants from various published sources. Compound growth rate, instability index, decomposition and multiple regression analyses were used to analyse the data to achieve at the concerned objectives. At present, the Net State Domestic Product (NSDP) of Assam is around Rs. 1752 crose, of which agriculture contributes around Rs. 313 crores, corresponding to about 17.85 per cent only. The growth in income from Agriculture was only 8.89 per cent as against 12.91 per cent growth in NSDP from 2001-01 to 2014-15. Hence, It can be said that although agriculture contribution is increasing, it is not at par with the increase in NSDP. Performance analysis of the nine principal crops of the state revealed that except wheat, all the other crops have shown an increase in production over the study period in the state. The increase in production observed for the crops could be attributed to either area expansion or highly yield. For the crops autumn rice, wheat and arhar production was found to have increased due to yield effect. Area expansion was mainly responsible for increased production in winter rice, summer rice, rapeseed and mustard, sugarcane and jute. The state data for area, production and yield parameters of the principal crops mostly showed low growth and low instability. In case of area under cultivation, most of the districts showed either low growth with low instability or negative growth with low instability. Performance of production of these crops had a similar trend. Yield performance however, had majority of the districts in the low growth and low instability class. Measures should be taken to increase the growth and lower the instability in order to promote agricultural development further in the state. Result of effect of determinants-

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cropping intensity, gross irrigated area, area under HYV rice and fertilizer consumption- on the aggregate crop output revealed that aggregate crop output in Assam was positively influenced by all the concerned determinants. However, the only determinant contributing significantly was cropping intensity. Some of these factors were shown to have negative impact on the aggregate crop output for a few districts. Negative effect of the determinants in some districts might be due to low growth of the concerned determinant in the respective district.

Marketing of Khasi Mandarin in Tinsukia district of Assam

Rajib Kumar Rana

The present study on "Marketing of Khasi Mandarin in Tinsukia District of Assam" was undertaken with the following objectives: (i) study the production status of Khasi Mandarin in the district. (ii) Identify the existing marketing channels and assess the marketing cost, margins, price-spread and marketing efficiency in different marketing channels. (iii) Study the marketing problems of Khasi Mandarin and suggest remedial measures. A multistage purposive cum random sampling method was adopted for the purpose of the study. Three ADO circle namely; Kakopathar, Hapjan and Margherita were selected purposively. From Hapjan four villages were selected whereas three villages were selected each from Kakopathar and Margherita. Ten farmerswere selected from each village.A sample of 100 Khasi Mandarin cultivators was selected for detailed study.The producers were categorised in to three categories namely; marginal, small and medium based on the operational land holding.

The present study revealed that the compound growth rate of area, production and productivity from year 2003-04 to 2014-15 was -1.42 per cent, -0.36 per cent and 1.08 per cent respectively. Three major marketing channels were identified in the study area for marketing of Khasi Mandarin *viz*. channel-I (Producer - Retailer – Consumer), channel-II (Producer – Merchant wholesalers – Retailers –Consumers) and channel-III (Producer – Pre harvest contractors – Wholesalers – Retailers – Consumers).Channel- I hadhighest marketing efficiency followed by channel-II and channel -III; respectively. The marketing efficiency under Acharya's approach for channel-I was highest with 1.02 followed by channel-II (0.58) and channel-III (0.26).Similar, results were found from Shepherd's formula also, where marketing efficiency of channel I was maximum (2.02) followed by channel II (1.58) and channel III (1.26). The producer's share in consumer's rupee was also maximum in channel-I (50.43%) followed by channel-II (36.55%) and channel-I (20.38%).

The various individual aspect wise constraints were worked out in the study area. These problems were categorized into four categories namely production problem, financial problem, marketing problem and institutional problemAlso, suitable suggestions and remedial measures were also suggested to overcome the constraints faced by the growers.

Abstract of M. Sc. Thesis
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Impact of Industrial Pollution on Economics of Rice Production – A case study in Karbi Anglong District

Rupmili Terangpi

Industrialization is considered as a main thrust for development due to which the scope for exploring and exploiting the natural resources and surrounding environment has gained importance. However, there have also been many negative consequences of rapid industrialization, particularly on agriculture and ecosystem health, because of the exploitation of natural resources and pollution. One of the most basic industries contributing to the rapid growth in industrialization is cement industry which is also one of the 17 most polluting industry listed by the Central Pollution Control Board. The main visible pollution generated by the cement industry corresponds to the dust. Air pollution negatively affects the yield and quality of crops, since the major cement industry pollutant is dust which settles on foliage.

The present study was conducted in Karbi Anglong district of Assam as Bokajan Cement Factory under Cement Corporation of India (CCI) Ltd., was located in this district in the Bokajan development block. This study examined the spatial changes in cropping pattern across different situations in the study area, changes in production technology, resource use and productivity in rice cultivation affected by industrial pollution and estimated the pattern of changes in cost and return from rice cultivation across different situations. In this study three situations were selected to study the impact of industrial pollution considering their distance from the Bokajan Cement Factory. Situation I included villages in the vicinity of Bokajan Cement Factory, Situation II included villages 5-10 km away from Bokajan Cement Factory and in Situation III villages over 10 km away from Bokajan Cement Factory were included. The total sample households were 120 for the present study.

The result of the study revealed that as the distance from the Cement factory increased, the net sown area increased from 56.67 ha in Situation I to 87.13 ha in Situation III. Sali rice was the most dominant crop in the cropping pattern in all the three situations. It was found that across the different Situations, the application of fertilizers was below the recommended level. The utilization of machine labour was found more than bullock labour.

The pooled data on productivity for Sali rice was lowest in Situation I with 32.86 q/ha and highest in Situation III with 42.56 q/ha. In Situation II the productivity was found to be 39.36 q/ha. The costs and returns was examined to see how the expenses incurred and returns obtained by the sample farmers from rice cultivation changes as the distance increases from the Bokajan Cement Factory. It was found that the net return was more in Situation II and Situation III with Rs. 6418.00 and Rs. 7848.64 and lowest in Situation I with Rs. 2734.72. The gross return, farm business income and family labour income were also lowest in Situation I with Rs. 46472.95, Rs. 24169.18 and Rs. 11194.93. In Situation II gross return, farm business income and family labour income were Rs. 54918.31, Rs. 30527.00 and Rs. 14992.00 and highest in Situation III with Rs. 58993.40, Rs. 33024.78 and Rs. 16939.97. These findings indicate the negative effects of the Bokajan Cement Factory on the profitability of farm production as well as the productivity of rice cultivation in the areas affected.

System of rice intensification in Sepahijala district of Tripura – An economic analysis

Saddam Hossen Majumder

Rice is the principle crop of Tripura. The present study is an attempt to assess the new technique of rice production i.e. System of Rice Intensification (SRI) with the objectives to study the status of SRI in Tripura, the comparative economics of SRI and the conventional methods of rice cultivation and to identify the various factors affecting the adoption of SRI. The study was carried out in Sepahijala district of Tripura. A multistage random sampling technique was followed to select the ultimate sample unit. A sample of 120 units was selected from Nalchar, Bishalgarh, Boxanagar and Melaghar blocks. Compound growth rate, Cobb-Douglas production function and logit regression were used to analyse the collected data to achieve at the objectives. The results of the study revealed that there was a significant growth in area, production and productivity of rice under SRI in the state. The comparative economic analysis between SRI and conventional method revealed that the gross returns obtained from SRI (' 122969.00, ' 135045.50 and ' 144849.30) were many folds higher than conventional method (' 71591.00, ' 81934.00 and ' 101735.00) in the marginal, small and medium farmers' category, respectively. The return over costs (based on gross return) of rice cultivation for SRI was found to be 2.03, 2.13 and 2.23 and the return over costs for the conventional method was found to be 1.46, 1.56 and 1.67 in the marginal, small and medium farmers' category, respectively. An analysis of the impact of the production variables on rice productivity revealed that human labour, machine labour, fertilizers, plant protection chemicals, irrigation and farm yard manure were found to have a highly significant and a positive impact upon the gross return of rice production both under SRI and conventional method. A logistic analysis for the factors affecting the adoption of SRI revealed that age, land holding had a negative impact upon the adoption while literacy, number of extension contacts and occupation had a positive effect. The present study concludes that SRI has a tremendous potential to increase the production of rice. It has got dual advantages for the farmers i.e. reduced costs and increased returns. Moreover, adoption of this technique by the farmers would give them higher yields which in turn will help them to earn more and improve their socio - economic situation.

Production, marketing and value addition of coconut in north bank plain zone of Assam

Simanta Das

The study was conducted in North Bank Plain Zone of Assam during 2016-17. The study area consisted of four districts *viz*. Sonitpur, Darrang, Lakhimpur and Dhemaji. The main objectives of the study were to examine extent of production of coconut by different size groups of farmers, pattern of marketing of matured and tender nuts in the zone and to study economics of value addition of coconut byproducts in the zone. Both primary and secondary data were collected for the study, multistage stratified random sampling technique was used to select the villages and the farmers. A total of 160 coconut growers were selected from 16 villages with area under coconut. Farmers were grouped into marginal, small, medium and large based on coconut area. Marketing of coconut was examined after collecting primary data from 40 different types of traders operating in eight different markets from the study area. To examine value addition of coconut "East India Coconut Project" located in the zone was purposively selected. Both tabular and functional analyses were used to obtain the parameters of the study. Investment appraisal was carried out by examining the economic and financial analysis of the processing plant.

The growth analysis of area, production and productivity of coconut in the zone showed that area and production of coconut grew at below one per cent rate of growth, while productivity growth was found to decline from 2001-01 to 2015-16. It was also observed that the area, production and productivity of coconut during this period were quite erratic in nature. District analysis showed that area and production declined in Darrang district, while production and productivity of coconut in Dhemaji and Lakhimpur district declined. Productivity was found to decline in Sonitpur district. The average area of coconut was 0.25 ha with average productivity of 9531 numbers per hectare, which was higher in large farmers. Productivity of coconut was higher in rabi season. Marketed surplus of mature and tender coconut varied from 96 per cent to 99 per cent. The average productivity of coconut in the zone was 9531 number of coconut per hectare which was lower than average productivity of 10614 number of coconut per hectare in the country.

Coconut market was imperfect and monopolistic in nature. The prices in the market were determined mostly by the buyers. The price of mature coconut was higher than tender coconuts. The sale of tender and mature nuts in the villages was primarily controlled by the village aggregators, pre-harvest contractors and primary market wholesalers. Involvement of many middlemen increased the length of the channel and affected the marketing efficiency in terms of producers' share in consumers' rupee. Although effectiveness was high, farmers and consumers were not protected by the prevailing prices, Price spread was higher in those channels and was found to be exploitative in nature due to high profit margins earned by the middleman. Marketing cost was escalated mainly by the high cost of transportation. Contractual integration in coconut market was common in the study area.

Economic and financial analysis in value addition of coconut, in the selected processing unit indicated that capacity utilization increased from 70.63 to 72.81 per cent. It was also found that working ratio of the plant increased from 1.16 to 1.31, while fixed ratio was less than unity. Investment appraisal at 10 per cent discount rate the NPV of the plant was Rs. 29.19 lakhs, IRR was 23.35 per cent, BCR was 1.13 and PBP was 3.04 years. This indicated that investment in coir industry was highly profitable, economically feasible and financially viable. However, the processing industry faced constrains of shortage of raw material, erratic power supply and shortage of labour.

It can be concluded that the productivity of coconut needs to be increased through adoption of improved cultivation practices, extending credit facility to the growers and proper training programme to the farmers. The markets of coconut should be organized and more assembling centers be established in the rural areas so that the farmers can carry their produce to assembling center and distant traders can come and buy the produce to encourage higher price to the producers. Price incentive programme may be introduced for the horticultural crops. There should be adequate training and awareness programme on coconut for increasing production, productivity and marketing of the produce as well as on agripreneurship on coconut fibre among the youths.

An economic study on production and marketing of major rabi vegetables in the Thoubal district of Manipur

Zed Lairenjam

The present study was conducted in the Thoubal block under the Thoubal district of Manipur during the agricultural year 2015 – 16. It was designed to investigate the cost of production, income and employment generation along with their advantages over growing competing crops and also to identify the major problems confronted by the vegetable growers. Simple random sampling technique was used for the selection of 100 respondent farmers that comprise of 56 small (<2 Ha), 31 medium (2 – 4 Ha) and 13 large (>4 Ha). Both primary and secondary data were collected for the study.

The study revealed that the average land holdings of farmer varied from 1.41 hectare in small to 4.28 hectare in large farm. The cost of cultivation per hectare for the selected major *Rabi* vegetable was observed to be as high as [1] 1,64,047.86 in pea to as low as [1] 1,06,545.81 in brinjal. Relatively, it was also found that the gross and net return from the cultivation of pea was the highest with corresponding values of [1] 3,59,328.66 and [1] 1,95,280.81 respectively. The lowest gross return and net return was worked out in the case of potato with corresponding values of [1] 1,50,187.43 and [1] 33,398.05 respectively.

The study further reveals that the per hectare utilization of labour and generation of net income from the selected vegetables were much higher than those of competing crops. The utilization of labour was recorded maximum in the case of brinjal (113.56 MD) and minimum in mustard (40.67 MD). Regarding net income, pea still holds the most profitable crop and lowest in the case of mustard with [1] 27,685.51.

Among the production problems encountered by the farmers, high cost of inputs received maximum response from 83.35 per cent of the respondent farmers. And under the marketing front, the major problem encountered was found to be lack of cold storage with maximum response of 90.45 per cent while transportation problem was responded minimum of 45.18 per cent.

Consumer buying behavior of processed food products in Jorhat city

Ahmad Sear Bazgeh

A rapidly rising population and greater levels of urbanisation over the past few years, has significantly increased the demand for processed food products in India. Considering the importance of study on processed food products, the present study was attempted to examine the market arrivals of different processed food products in Jorhat city, customer's preference among various brands and satisfaction levels on processed food products.

The present study was conducted in Jorhat city on purposively selected six retail outlets and 20 randomly selected customers of processed food products from each retail outlets thus, comprising a total 120 nos. of respondents for the study. It was observed that the majority of the respondents (39.17%), customer of processed food products were found to be businessman followed by salaried job (29.17%). Out of the sample customers 85.83 per cent were found non-vegetarian and the remaining 14.17 per cent were vegetarian.

From the research study it was revealed that among all other brands of jam & jelly and sauces & ketchup, Kissan is the highest selling brand in Jorhat city with a share in total market arrival of these products of 43.84 per cent and 40.70 per cent for jam & jelly and sauces & ketchup, respectively. Similarly, with 59.18 per cent and 43.48 per cent, Nilons and Tropicana are the highest selling brands of pickles and fruit drinks respectively in Jorhat city. It was also found that 55 per cent of the sample customers get information about processed food products from TV advertisements followed by 21.67 per cent from display of retail outlets. Most of the customers prefer the brand Kissan with a mean score of 63.41 per cent and 66.32 per cent for both jam & jelly and sauces & ketchup, respectively. Similarly, the brand Nillon is mostly preferred (63.22%) for pickles and Tropicana is preferred with a mean score of 66.32 per cent for fruit drinks and squash. Among different factors influencing the brand preference of the customers, quality and availability of products were found most influential with a mean score of 64.32 per cent and 61.11 per cent, respectively. From the study of customers satisfaction level with the processed food products it was

found that 52.50 per cent customers were satisfied with price, 50.83 per cent highly satisfied with quality, 53.33 per cent satisfied with shelf life and 55 per cent of customers were highly satisfied with the availability of processed foods. The study also reveals that the majority of customers (36.67%) are mostly loyal to the specific brands followed by 26.67 per cent, 20 per cent and 16.67 per cent of respondents always, sometimes and rarely loyal to the brands of processed food products, respectively.

Effects of Television advertisement on children's consumption behaviour in Jorhat city

Antara Bhattasaly

The present study was conducted to examine the effects of Television advertisement on children's consumption behaviour in Jorhat city. Three schools namely K.V. RRL, Don Bosco and Carmel were purposively selected for data collection. A total of 180 children comprising 20 each from 8th, 9th and 10th standards of all the schools and 60 parents were personally interacted and necessary data were collected with the help of a semi-structured questionnaire. Stratified random sampling technique was used in the study.

The result shows that children's increasing interest on Television advertisement has been providing enormous scope for the companies to increase their overall sale. Ninety (90) per cent of the children were identified as the viewers of Television advertisements and number of boys viewing advertisements was slightly more than the girls (82 boys and 80 girls). One third (33.18 per cent) of the children spent a part of their valuable time in viewing Television daily. Almost half of the children (48.77 per cent) spent less than one hour time in Television viewing every day. 24.07 and 21.60 per cent girls and boys preferred to watch Television with their parents respectively. Advertisement influenced 17.90 per cent children to purchase such products which are actually not necessary to them. 33.33 per cent girls dependent on their parents while taking any purchase decisions. There are several factors which influence children's buying behaviour towards a product and 15.43 per cent girls took purchase decision based on its price followed by family member's opinion (14.81 per cent). In case of boys, quality packaging of the product (19.75 per cent) was the prime factor for purchase of a product followed by advertisement effect (11.11 per cent). Both girls (20.99 per cent) and boys (13.58 per cent) mostly preferred chocolates over other confectionary products. The insistence of boys (38.27 per cent) on parents was more than the girls (22.22 per cent) for purchase of products after watching the advertisement. Many tactics such as not taking food, showing anger, pretending illness, emotional blackmail etc. were normally used by the children to fulfill their demands. Boys (30.00 per cent) need more guidance from their parents as compared to the girls (28.33 per cent) while purchasing a product. As

per parent's opinion 18.33 per cent boys seldom insisted them for buying a product after viewing Television advertisement, whereas 15.00 per cent girls insisted their parents few times. As age increases, majority of the children's frequency of insistence for buying a product tend to decrease slightly. In case of girls 33.33 per cent parents mostly agreed the demands of their daughters, whereas only 23.33 per cent parents convinced with the demands of their sons. The major three problems of Television advertisement faced by the children were increased purchasing habit of the products (27.18 per cent), increasing demand for luxurious life (16.99 per cent) and conflicts arising between parents and children (15.05 per cent) respectively. Insistence for buying a product (17.35 per cent) was identified as the main problem based on the opinion given by the parents.

Effectiveness of social media as a marketing tool : A micro level study

Dhanjit Dutta

The present study titled "Effectiveness of Social Media as a Marketing Tool: A Micro Level Study" has been conducted for fulfillment of partial requirement for award of the degree of Master of Business Administration (Agri-Business). The recent proliferation and increasing usage of social media websites provides a platform for nurturing brands and influencing people's purchase decisions. Use of social media as a marketing tool has gained tremendous attention from business organization and entrepreneurs alike. Several attempts have been made worldwide to ascertain effectiveness of social media marketing and results of these studies often vindicated the notion that social media marketing is effective as a marketing tool. An attempt has been made to empirically test this perception and also to device strategies for increasing its effectiveness.

The study was conducted in the city of Guwahati, the capital of Assam. For primary data convenient samples were drawn from 150 nos of respondents residing in the city of Guwahati.

Major Findings:
- Social Media is helpful in increasing awareness for products / services.
- Social Media do influence buying decisions.
- Social Media are referred to by majority while making buying decisions.
- Having positive review in Social Media is very important.
- Significant amount of time is being devoted to Social Media.
- Social Media are gaining more prominence over TV and FM.
- Mobile device is the most widely used gadget for accessing Social Media.
- Facebook is the clear winner amongst various Social Media sites.

The following recommendation and suggestions can be derived from this study.
- Creating and maintaining a brand page invariably in Facebook.
- Maintaining mobile friendly websites and developing suitable applications for mobile devices.

- Having a proper Social Media strategy in place backed by ample resource allocation.
- Concerted efforts at organisational level to generate positive reviews.
- Avoiding temptation to put up direct advertisement.
- Using social media marketing in conjunction to the other marketing tool

Production and marketing of CC Tea by The SuiGeneris Inc. in Manipur

Haobam Dimashree Devi

Lemon grass *(Cymbopogan)* is an aromatic tall sedge which grows in many parts of tropical and sub-tropical South East Asia and Africa. In Manipur an organization called The SuiGeneris Inc. is currently having 200 acres of lemon grass plantation and produce a naturally caffeine free herbal tea, CC Tea that is rich in antioxidants.

The present study on the "Production and marketing of CC Tea by The SuiGeneris Inc. in Manipur" of Imphal-West district, broadly examined the organizational structure and job responsibilities vested on different managerial cadres, production and marketing of CC Tea from lemon grass, economics of CC Tea and constraints in production and marketing of CC Tea. The primary data were collected from the organization through personal interview with the help of a schedule and questionnaire.

The result revealed that the organization is headed by the Chief Managing Director, under whom there are three top managers namely, Chief Executive Officer, Chief Finance Officer, and Chief Operating Officer. In 2015, The SuiGeneris Inc. produced 12,00,435 kg of fresh leaves, 2,00,072 kg of dried leaves and 1,00,036 kg of final produce. From the final produce, three variants namely, CC Tea Classic (100gm), CC Tea Regular (200gm) and CC Tea bags (100gm) were produced. Three marketing channels were identified in the study area through which the organization marketed their products. In all the variants of CC Tea, the producer's share in consumer's rupee was highest in channel III. At the same time, this channel marked the lowest price spread for all the three variants. The cost of cultivation of 200 acres of lemon grass was worked out to be Rs.1,20,92,400. Thus the total cost of manufacturing of all the three variants of CC Tea was Rs.3,39,02,588 for 200 acres. The gross income for 200 acres was found to be Rs.12,42,94,730 and net return after deduction of 30% tax was worked out to be Rs.6,32,74,500. Therefore, cultivation of lemon grass is a profitable venture which is being utilize by The SuiGeneris Inc., a privately owned agri-enterprise operating in Manipur since 2010. Major problems faced by the organization were shortage of labour, high price of packaging materials, pests and diseases, inadequate training facility, lack of awareness, frequent bandhs and strikes, fund crisis, and spoilage.

Consumers' buying behaviour of organic inputs in Jorhat market

Jishnu Jyoti Saikia

With advent of organic agriculture, the demand for organic inputs like bio-fertiliser and bio-pesticide are continuously in rise. In the organic input market, several firms are engaged in production and marketing of different types of organic inputs. Hence, the consumers have more option to choose from. In this context, a study on organic input was designed to understand the brand awareness and preference of different consumers. Understanding the consumer behaviour would help the firms in formulating strategies to cater to the needs of the consumer and thereby increase their market share.

The present study was conducted in Jorhat market of Assam. A random sampling technique was used to draw a total of 40 sample respondents for the study. For convenience, organic inputs were classified as bio-fertilizer and bio-pesticide. A wide variety of bio-fertilizer and bio-pesticides were available in the market. Brand awareness and brand preference of bio-fertilizers revealed that consumers were more aware and preferred the bio-fertilizer products of M/S Rajpriyam. Similarly, consumers were more aware and preferred the bio-pesticide products produced by Orgaman R&D. Most preferred bio-fertilizer products were Essential, M.B. Buffer, Garden Samrat and Vermicompost. In case of bio-pesticide products, Econeem, K-Hume and Orgajin were preferred most by the respondents. Brand, price and quality were the major determining factors for preference of particular bio-fertilizer or bio-pesticide. Bio-fertilizer and bio-pesticides were purchased on monthly basis and on an average Rs 500 – 1000 was spent for purchase of these inputs. The buyers of bio-fertilizers were salaried person revealing the fact that very less per cent of farmers used to purchase organic inputs for commercial cultivation of crops. Organic inputs were mostly purchased for use in the flower garden and cultivation of horticultural crops.

Management of Broiler farming Enterprises in Jorhat sub-division of Assam

Lh. Changed Catherine

Poultry is one of the fastest growing segments of agriculture sector in India with around eight per cent growth per annum. India is the third largest egg producer after China and USA and fourth largest chicken producer after China, Brazil and USA (Kotaiah, 2016). The annual per capita availability also increased to 60 eggs and 2.5 Kg of meat, consistently with increase in productivity. However, it is far below the recommended level of consumption according to Indian Council Medical Research (ICMR) which is 180 eggs and 10.8 kg poultry meat per person per annum. In North Eastern Region, around 95 per cent of the population is non vegetarian (Sapcota and Sarma, 2002). In 19th livestock census, Govt. of India, total contribution of poultry population is the highest in Assam (1,53,21,082) and the lowest in Sikkim (2,06,811). Assam requires about 3.03 lakh tons of meat per annum as per the ICMR recommendation of 10.8 kg per person per annum with constituent of 90 per cent non vegetarian people. During 2015-16, the farm gate realization of live broiler chicken price ranged between Rs. 52.00 and 115.00. The present study was conducted in Jorhat sub-division of Jorhat district, Assam. Samples of 60 respondents were randomly selected from four blocks in Jorhat sub-divisions. The selected broiler farm samples were stratified into three groups on the basis of numbers of birds reared *viz.* group I (<500), group II (500-1000) and group III (>1000). The results reveal that most of the sample respondent relay on dealers for chicks and feed. The average feed consumption per bird per batch was 3.61 kg, 3.49 kg and 3.36 kg in group I, II and III. The return over cost was found to be highest in group II (1.23) followed by group III (1.22) and group I (1.15) as the total cost in group III was higher. Higher cost of feed, chicks, lack of availability of quality chicks, higher mortality rate, lack of organized market are found to be major problems faced by the broiler farmers belong to the sub-division during this period.

Production and marketing of specialty rice in Assam

Nibedita Taye

Assam is traditionally a rice growing area. Rice plays a pivotal role in the socio-cultural life of the people of the state. Most of these have been in use from time immemorial with traditional method of preparation. A few varieties of Oryza sativa produce rice of uncommon kind in terms of aroma, kernel colour and chemical composition, termed as 'specialty rice', (Chaudhary R, 2003). The specialty rice are those which are not common. Some of the special classes of rice in the state include Joha or aromatic rice, bora or waxy rice and chokuwa or soft rice, red rice and black rice (colour rice). These rice classes are grown from time immemorial to cater the household needs of the farmers. Cultivators resort to traditional varieties and cultivation practises. By and large there has been no effort to improve the production and productivity of these classes of rice. These orphan class of rice, however, can become item of commerce both in domestic and International markets. The unattended classes of rice are mostly grown organically by default. In this study an attempt was made to examine the status of Specialty rice in Assam. The study was started on 1st week of February, 2017 and completed by 2nd week of May, 2017. The study found that there is increase in the coverage of area under Black rice to the many district of the state. Out of the four districts (Goalpara, Majuli, Jorhat, Sivsagar) 44 producers were selected, 24 middlemen were selected, and 22 consumers were selected that resulted in a sample of 90 respondents. The marketing management of the specialty rice was also examined. An effort was made to identify the problems and prospects of the specialty rice in the state. Among different kinds of speciality rice, black rice was found to be grown to a considerable extent in Goalpara district. The return over cost (3.20) shows that the cultivation of black rice was profitable for the farmers. Black rice has got lots of market potential both inside and outside the state and even in the international market. Lots of value added products can be prepared from Specialty rice. High variation in market price of specialty rice, absence of market information inefficient market link communication etc are hampering the farmers to grow speciality rice extensively in the state. Lack of weighment capacity, absence of nearest

local market are also some of the problems encountered by the market intermediaries in marketing of specialty rice However, proper packaging and labelling is required to attract the consumers. Awareness drive and training to the rice growers about the profitability and other benefits of Black rice needs to be imparted to the farmers. All throughout these years, with the demand from the foreign countries and demand in the e-commerce market there is a great scope for these unattended class of rice to be well recognized.

Efficiency of small tea growers in Jorhat district of Assam

Oinam Dineswori Devi

The popularity of tea as beverage in the world is well known. The tea industry occupies an important place in the economy of the nation as a whole and in the state of Assam in particular. The present study was conducted in Jorhat district of Assam as there were more than 5000 Small Tea Growers (STGs) with a view to examine the socio economic background, resource use efficiency of STGs and constraints in management and marketing of tea. A multistage stratified random sampling technique was followed to select the sample for the study. Appropriate tools and techniques were used to analyze the data. It was found that the average family size of STGs was 5.28 in number. More than half of the population was in the age group of 15-59 years. The literacy rate of the sample was 86.76 percent. About 25 percent of the population was engaged in growing tea. In the STGs, 61.15 percent of total area was under tea plantation followed by paddy. In the family labour, male labour is higher than the female labour but in case of hired labour, female labour was higher than the male labour. The Cobb- Douglas production function was used to determine the major factors affecting the total amount of green leaf production. It was observed that the input variables area, family labour, permanent labour, fertilizer used had positive and significant influence on the production of green leaf. The estimated mean technical efficiency indicated that the sample farms were about 75 percent technically efficient. The study also revealed that management of pests and diseases, theft of green leaf, difficulty in managing the estates during festival, payment of wages to workers, cost of inputs and commission by the middlemen were the major constraints in the study area.

Application of Information and communication Technology (ICT) in farm management in Jorhat District of Assam

Raktim Ranjan Lahan

The study on the application of information and communication technology (ICT) in farm management decision in Jorhat district of Assam revealed that farmers in the study area received agricultural information from various sources and media. These included newspaper, radio, television, mobile phones, internet, KVK, other farmers etc. The television is the predominant source of information in the study area. The different sources of ICT were classified into four groups as face to face, other farmers, traditional media and modern ICT. Most of the farmers relied on more than one sources of information. Farmers access as per the needs and demands of their own. Farmers received different information like weather, soil, market price, irrigation, bank loan, modern tools, fertilizer and pesticide application. The frequency of accessing information from different sources was different. Different factors play an important role for awareness and use of ICT such as farmer's age, education, farm size etc. Most of the old age farmers were interested to get information from other farmers, relatives and traditional media. But the educated farmers were less interested to get information for other farmers. Large farmers were more interested to get information from traditional media and modern ICT. The mkisan web portal also plays an important for the farmers to get information in the study area. mkisan helps the farmers by giving different agriculture related information in the study area. The agricultural technology information centre (ATIC) which is under Assam Agricultural university, Jorhat play an important role to enrich the farmers knowledge on farm management by giving information. Different difficulties faced by farmers for accessing traditional and modern information such as low level of education, non awareness etc. Training and awareness programme, provision of stable power supply, more extension contacts, subsidized mobile service are expected to increase the awareness and use of ICT in farm management and thereby help the farmer to enhance their knowledge and skills on farm management.

Organization and Management of Youth Volunteer Union Milk Producer Company Limited (YMPC) in Manipur

Sarangthem Sarojranjan Singh

Billions of people around the world consume milk and dairy products every day. Not only are milk and dairy products a vital source of nutrition for these people, they also provide livelihoods opportunities for farmers, processors, shopkeepers and other stakeholders in the dairy value chain. Youth Volunteer Union Milk Producer Company Limited (YMPC) is a company incorporated on 11th December, 2013 and implemented by Youth Volunteer's Union (YVU) situated at Thoubal, Manipur. It was established as a part of the Integrated Diary Development Project and it is sponsored by TATA Trusts, Mumbai. It is the first milk producer company in Manipur. Apart from providing financial assistance to the members for establishment of home dairy units, the organization also provides other services like SHG formation, training and exposure facilities, procurement of raw milk, processing and marketing of milk, free vaccination to cattle (twice in a year), hands-on training etc. The present study was carried out in Imphal West and Thoubal districts of Manipur. A simple random sampling technique was followed to select the sample respondents. A sample of 50 member respondents and 30 non-member respondents were selected from villages viz. Thoubal Khunou, Tentha, Langmeidong under Thoubal tehsil and Tera Pisak under Kakching tehsil and Iram Siphai and Yumnam huidrom under Wangoi tehsil. The selected respondents were categorized based on number of cows they owned viz. small size (1 – 2 cows) and large size (> 2 cows). The results of the study revealed that due to the availability of sufficient staff in the organization, roles and responsibilities can be properly divided and it helps in efficient management of the organization in all directions. The net profit of YMPC was found to increase from Rs. 2,23,506 (2013-2014) to Rs. 12,54,599 in 2014-2015. It indicates that dairy business has a positive impact on income. The average net income per cow was higher (Rs. 45,388.37) in member respondents than that of non-member respondents (Rs. 39865.79). Average total man days for each respondent per annum were higher (301.12 man days) in members as against (292.76 man days) in non-members. Frequent *bandh* and strike, and regular power cut were identified as the major problems faced by the organization. Whereas, low price of milk and decreasing interest of youths in dairy farming were found to be the major problems in both member and non-member respondents.

A study on the *Ima* Market of Manipur

Sheetalmanjuri Ningthoujam

The *Ima* market also known as Khwairamband Bazaar is situated at the heart of the Imphal city, where there are 3,689 women vendors carrying out their entrepreneurial activities. The uniqueness of the *Ima* market is that all stalls are run by women alone. The Market is divided into three segments according to its location namely Purana bazaar, Laxmi bazaar and New market/Linthoingambi bazaar. One striking features is that goods and commodities sold are mostly local products. This sprawling commercial is a symbol of the economic status and liberty of the Meitei womenfolk. Majority of the women engaged in the market have poor educational background, having no other option for other engagement but for entrepreneurial or marketing activities. With no differentiation to one's caste, community and religion, women from far and remote areas of Manipur come to this market to sell their vegetables, fruits, fishes, local made products, clothes, ritual items etc to support the families. The present study is an attempt to analyse the organisational set up, market structure and the socio economic status of the women vendors with special reference to income and employment. The sampling design followed for the study was random sampling design. A total of 60 women vendors were simple randomly selected for the study. The study revealed that out of 60 women vendors, 41.66 per cent deal with the marketing of agricultural commodities and the remaining 58.34 per cent deal with the non agricultural commodities. Among the agricultural commodities maximum number of vendors deal with the marketing of fruits and for the non agricultural commodities they deal with the marketing of ritual items. Value wise marketing margin among the agricultural commodities is maximum in case of raw fish vendors i.e., Rs. 65,967 and for the non agricultural commodities it is maximum in silk clothes (*Wangkhei phi products*) vendors i.e., Rs. 51,750. About one third of the total population i.e., 28.33 per cent of the women vendors are widow. It shows the employment opportunities to a large extent by the market to the widow vendors. Every women vendor in the market works more than one woman day i.e. more than 8 hours in a day. The women of *Ima* market have faced challenges before and will continue to do so in future, but the market will survive though changes in its structure and dynamics are inevitable.

Management of ornamental fish marketing in Kamrup (Metro) district of Assam

Sujata Kaushik

Ornamental fish keeping and its propagation has been an interesting activity for many, which provide not only aesthetic pleasure but also financial openings. The present study was conducted in Kamrup (Metro) district of Assam to see the present status, management aspect of rearing, production and breeding, and problems associated with marketing of ornamental fish. For the study a sample of 30 ornamental shop owners was selected using simple proportionate random sampling technique. Selected shop owners were further categorized into three groups based on their shop rearing size *viz.*, Group I (<250 sq.ft.), Group II (250-500 sq.ft.) and Group III (>500 sq.ft.).

Regarding present status of ornamental fish business in Assam, it was found that about 80% of ornamental fishes from India to international market are exported via Kolkata airport, of which the lion's share (more than 80%) is contributed from North Eastern Region. Out of 250 potential ornamental fish species in North East, Assam recorded the highest number of species (187), followed by Arunachal Pradesh (165), Meghalaya (159), Manipur (139), Tripura (103), Nagaland (71), Mizoram (46), and Sikkim (29). There were only 20 aquarium shops in Guwahati up to 2004 (Bhattacharyya and Choudhury, 2004) which increased to 88 aquarium shops in 2016 (Department of Fisheries, GoA). Presently only 11 persons are associated with breeding of ornamental fishes in Guwahati.

With respect to management aspects of rearing and breeding, it was found that most of the recommended equipments and accessories were used by the shop owners except cement tank, quarantine tanks and heating apparatus, which were not used by them due to involvement of higher costs. Similarly, majority of the shop owners used recommended management practices. Marketing costs was found highest for crocodile fish (Rs. 1267.00), followed by parrot fish (Rs. 1175.00). Similarly, marketing margin was highest for discus (Rs. 35,913.00), followed by arawana (Rs. 28,364.00) and parrot fish (Rs. 14,288.00) respectively.

Manpower problem was emerged as the most severe problem in breeding of ornamental fishes. Breeding problem, high cost, electricity problem, non availability of good quality brood fish, mortality of new born babies etc. were some other problems identified during the present study. Mortality of reared fishes and higher transportation costs were identified as the major two problems faced by the firms in rearing of ornamental fishes. Fluctuations in demand was the major problem faced in marketing of ornamental fishes. Change of customer choice and manpower problem were the next two important marketing problems faced by the respondent firms.

Among the problem related to breeding the most encountered problems were manpower problem followed by complicacy of breeding process and high cost. Similarly mortality, higher transportation cost and financial problems were the major rearing problems. The major marketing problems were high cost of accessories, electricity problem and manpower problem.

Crop-weather relationship studies in *Sali* rice with special reference to development of predictive models under the prevailing climatic conditions at Jorhat

Pranjal Dutta

A field experiment was carried out during *kharif,* 2016 at the Instructional-Cum-Research (ICR) Farm of Assam Agricultural University, Jorhat to study crop-weather relationships of *Sali* rice grown under different micro-climatic environments: MR-I: 27th June, MR-II: 12th July and MR-III: 27th July with three varieties: Mahsuri, Swarna-Mahsuri and TTB-404 following a split plot (in number) design with four replications. Weekly mean maximum and minimum temperatures, morning and evening relative humidities, duration of bright sunshine hours and pan evaporation ranged from 26.5 to 34.7^{0}C, 9.7 to 26.8°C, 90 to 100%, 58 to 87%, 0.0 to 8.8 Hours and 1.4 to 4.7mm per day, respectively. Rainfall during the crop growth season was found to be nearly evenly distributed, barring few weeks when there was no rainfall. Biometric observations, *viz*. total biomass production, leaf area indices, plant height, no. of effective tillers, no. of grains per panicle, grain yield were recorded periodically. Twelve different phenophases were also identified. Meteorological variables showed a near normal distribution during the crop growth period. Most of the accumulated agro-climatic indices showed a gradual decrease in the three successive micro-climatic regimes irrespective of varieties. However, they showed a increasing trend during the Ripening Phase (RP) irrespective of varieties. Early-transplanted (MR-I) crop took more number of days from transplanting to maturity as compared to late transplanting (MR-II and MR-III). Total dry matter production (TDM) differed significantly in both varieties and growing environments irrespective of crop stages. Highest TDM was found in MR-I and the lowest in MR-III. While, leaf area index (LAI) differed significantly due to microclimatic regimes in all growth stages while non-significant for varieties in all the stages except in 60-DAT. Most of the agro-climatic indices and meteorological parameters yielded higher correlation coefficients with final yield irrespective of varieties and microclimatic regimes for all growth stages. Grain yield gave highest correlation coefficient of 0.960 against accumulated rainfall

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Department : Agrometeorology
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(ADRF) corresponding to Soft Dough (SD) stage and the lowest correlation coefficient of 0.860 against accumulated bright sunshine hours (ABSH) corresponding to ripening stage (RP). Most of the mean meteorological parameters yielded higher correlation coefficients (>0.900) corresponding to the Ripening stage (RP). While the lowest correlation coefficients were obtained for most of the parameters corresponding to the Panicle initiation (PI) stage. A few predictive models involving both accumulated indices and mean parameters were also developed combined over both varieties and microclimatic regimes corresponding to some selected crop growth stages. Most efficient predictive models were found for APTU and AMET corresponding to the Reproductive stage (RS). On the other hand, among the mean meteorological parameters, the best models were found for DTRF, PANE and MAXT corresponding to the Milk stage (MS). Lower per cent variations (PCV) were indicative of the fact that the predicted models are very effective under agro-climatic conditions of Jorhat.

Development of yield forecasting models for winter rice using meteorological parameters in the Brahmaputra valley of Assam

Sumpi Chutia

Crop yield forecasting is an art of predicting crop yields and production before the harvest actually takes place, typically a couple of months in advance. It is very much crucial for the sound planning and policy making in the agricultural sectors of the country. Different types of models viz, crop simulation models, crop weather analysis models and empirical statistical models are generally used to develop district, state and national level yield forecast. Keeping this in view, a study was carried out to develop yield forecast models of winter rice using modified Hendricks and Scholl technique in 14 districts of the Brahmaputra valley of Assam at vegetative (F1) and mid season (F2) stage of the crop. To develop the model, long-term yield data (kg/ha) and weather data on daily basis (maximum temperature, minimum temperature, rainfall, relative humidity morning and evening) were collected for the period 1990-2015. In addition, one extra parameter - BSSH from two locations (Jorhat and Tezpur) for the same period were also collected and utilized to develop forecast models for Golaghat, Jorhat and Sonitpur districts. The daily data were grouped into weekly basis as per requirement of the model. Weekly data were used to prepare simple and weighted weather indices for individual weather variables as well as for interaction of variables. Among the 25 years of yield and weather indices, 22 years data (1990-2012) were used to develop the forecast models and remaining three years data (2013, 2014 and 2015) were used for validation of the models developed. Stepwise regression analysis was executed by trial and error method to obtain the finest combination of predictors at 5% significant level. Result revealed that the model developed for Kamrup district showed good performance compared to other models with highest value of R^2 (0.88 & 0.92 in F1 & F2) and with acceptable limit of per cent error, RMSE, nRMSE, MAE and MBE during the process of validation. On the other hand, yield forecast model developed for Bongaigaon

district showed poor performance during validation and recorded the highest value of per cent error, RMSE, nRMSE, MAE and MBE compared to other districts during both the forecast (F1 & F2). Interaction of weather variables like Tmax & RH-II, Tmin & RF and Tmin & RH-1 were mainly found to influence the rice yield during F1 and F2 forecast in most of the districts. Forecast model developed after inclusion of BSSH has shown improvement in R^2 except Sonitpur district during F1 forecast compared to the model developed without BSSH. Better result was observed in Golaghat district with highest R^2 and lowest per cent error, RMSE, nRMSE MAE and MBE compared to Jorhat and Sonitpur. Yield forecast models developed in these three districts showed their dependency on the interaction of BSSH with rainfall as an important weather variable in influencing the winter rice yield. Thus, BSSH data may be included in developing the crop yield forecast models wherever available for better accuracy of forecast.

Analysis of the area, production and productivity of the selected spices of Kerala

Anshee Antony

Kerala is also known as land of spices. In India, Kerala is the major producer of many spices such as small cardamom, pepper, nutmeg, clove etc…Fluctuation in the spice production of Kerala may influence world production to a great extent. The present study analyse the area, production and productivity of the selected spices of Kerala. The objectives of the study were:-

1.Analyse the trend of area, production and productivity of selected spices in Kerala.
2.Estimate the variation in the production of the selected spices of Kerala.
3.Predict the future production of the selected spices of Kerala.

Time series data on area, production and productivity of the selected spices were collected for twenty-two years (1992-2014). Four functionsie., linear function, quadratic function, exponential function, and power function were used in order to study the trend. Best fitted trend equation had been selected based on the R^2 value.The direction and extent of growth had been estimated by using CAGR.Instability of production of selected spices had been studied by estimating coefficient of variation and Cuddy Della Valley Index. The production has been forecasted upto 2020 by using ARIMA methodology. The most suited model for the estimation of the production had been identified by calculating the RMSE value.

From the present study, it had been concluded that as per the value of coefficient of determination, quadratic function was found to be the best fitted trend function for the estimation of area, production and productivity of selected spices in Kerala. From trend analysis, CAGR and by observing the trend curves it had been understood that both area and production exhibited a declining trend for all spices except for nutmeg and small cardamom during the period of study. For all the spices except tamarind an increasing trend has been observed for productivity. Generally, production of selected spices was found to be stable except nutmeg in Kerala. For the purpose of forecasting proposed model

was ARIMA (0,1,0) for all spices except tamarind and turmeric. ARIMA (0,0,0) was found to be the best model for the forecasting of tamarind. ARIMA (0,0,1) was identified as the best suited model for forecasting the production of turmeric in Kerala. As per the values of RMSE trend curve is found to be the best model for estimation of production of all spices except for small cardamom and turmeric.

Forecasting models for characterizing production and productivity of coconut and rubber in Kerala

Arun Prasad

India is the third largest country in terms of global area and production of coconut after Philippines and Indonesia. Kerala was traditionally a coconut growing area along with the coastal states of Karnataka, Tamil Nadu and Andhra Pradesh. During 1974-75 Kerala had accounted for about 62 per cent of the coconut production in India and by 2003-04 Kerala's share had declined to about 49 per cent. Natural Rubber cultivation in India has been traditionally concentrated in Kerala and to some extent in the adjoining states of Karnataka and Tamil Nadu. The agro-climatic conditions in the state were very favourable for rubber cultivation. Kerala accounts for 83 per cent of the area under rubber in the country.

The present study has analyzed the production and productivity of coconut and rubber in India with special reference to Kerala. In the case of Kerala, all the fourteen districts have been selected for making a detailed study. The scope of the study is limited to only two places – Coconut Development Board, Kochi for coconut and Rubber Development Board, Kottayam for rubber. For forecasting the production and productivity of coconut and rubber, the study is restricted to fourteen districts in Kerala.

In the present investigation of production and productivity behavior for coconut and rubber was analyzed by different forecasting models and their statistical evaluation would provide insight into the reasons for variation with the following objectives:

1. To study the trend for production and productivity of coconut and rubber in Kerala and forecast using time series models.
2. To study the effect of error in forecasting models for coconut and rubber.
3. To validate accuracy of model and suggest suitable forecasting model using time series for production and productivity of coconut and rubber.

The major purpose of studies on forecast accuracy is to help the forecasters in selecting best forecasting method. In the present investigation different forecasting models

like Trend analysis, ANN model, ARIMA model and Exponential smoothing models are considered to produce forecast and to measure the forecast accuracy among selected different models. In the present study, forecasting excise was conducted to produce yearly production and productivity forecasts for future five years using selected methods for years 2012-2016 in case of rubber and 2015-2019 for coconut.

It is hoped that the identification of the best forecasting model would help the producers as well as consumers in taking appropriate decisions. The production and productivity obtained in coconut and rubber found to be increasing for various reasons, notably due to the fluctuations in climate, extent of area, prices etc. The change in life style has also resulted in the increased demand which yields its significant influence on production and productivity of coconut and rubber in Kerala.

Analysis of Growth on Area and Production of Pineapple and Orange in Manipur

Changamayum Girija Devi

Agriculture plays a vital role in India's economy. Agriculture is the main occupation and largest productive unit in Manipur economy. More than half of the total working populations of the state are directly dependent on Agriculture. Manipur is suitable for the development of horticulture. The major fruit grown in the state are pineapple, orange, banana, guava and peaches etc.

In this study, an attempt had been made to analyze the growth rate of area and production of pineapple and orange in Manipur. For this, compound growth rate was calculated. Along with this, factors effecting the production had also been studied using the multiple linear regression. Also prediction of the production, area and productivity of pineapple and orange had been done based on single exponential smoothing and ARIMA process.

The study reveals that production, area and productivity of pineapple and orange in Manipur mark significantly increasing trend during the study period (1997-2016). It was observed that the growth rate of production, area and productivity during period II (2006-2016) was found to be higher than period I (1997-2005). The study reveals that the intervention made by the scheme called Technology Mission and Horticulture Development in Manipur had positive impact on pineapple and orange.

The study also reveals that the weather parameters namely maximum temperature and maximum relative humidity were found to have significant effects on production of pineapple and orange. On the other hand minimum temperature, minimum relative humidity, rainfall and number of rainy days had been found non-significant. However the influence of climatic factors in production variation cannot be ignored completely because of the fact that the study uses the annual aggregate values of weather parameters.

The prediction of production, area and productivity of pineapple and orange was done for 2017 based on single exponential smoothing. Based on ARIMA process, prediction had been done for the years 2017, 2018, 2019, 2020 and 2021. The study also shows that there is a percentage increase in production, area and productivity of pineapple and orange in Manipur by 2021.

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Department : Agricultural Statistics
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Fluctuation of prices of important agricultural commodities in Nizamabad district of Telangana

Palthya. Sangram

Prices of agricultural commodities in a certain place mainly depend on its production and the prevailing supply and demand situation for the commodities on the place. Changes in prices are associated with the passage of time. Seasonal variations in supply and demand more particularly seasons coinciding with the people's festivals or with socio-cultural activities of the people influence the prices of some commodities. Changes in agricultural prices have serious effect on the entire economy.

The study was carried out in and around Nizamabad District of Telangana state. The period of reference for the present study was 18 years from 1997-98 to 2014-15. This study is entirely based on secondary data. Time series data on wholesale prices of three principal commodities *viz.,* rice, maize, turmeric are considered. In the present study, wholesale monthly price data from 1997-98 to 2014-15 for the Nizamabad District were considered. Data collected from the District Market yard and Department of Agricultural marketing in Nizamabad District.

The present study has been carried out with the objectives.
1. To construct the monthly and yearly price index of selected commodities.
2. To study the different trend equation in prices of the selected commodities and identify appropriate one.
3. To study the variation of prices of selected commodities within seasons and between periods.

To fulfil the objectives of study different statistical techniques such as index number, trend analysis and seasonal indices were adopted. Also to know the extent of fluctuation of prices coefficient of variation were calculated. To explain the results of the analysis different tables and graph were used.

From index number of commodity wise and year wise for the period 1997-98 to 2014-15, it was revealed that the index number always changes from year to year. In case

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of rice maximum price rise -56.12 per cent and declined 57.34 per cent over the previous year. Year to year change in price of maize varied from -37.06 per cent to 40.12 per cent and turmeric price varied from -289.57 per cent to 365 per cent.

Analysing the monthly average price index number for the study period taking April as base month. It was observed that prices were fluctuated over the months of a year for the selected commodities.

To examine the trend of prices over the years, the method of curve fitting was used. Fitting the curve in different functional form of equation, it was found that exponential form of equation was well fitted for computing trend values for the selected commodity.

Seasonal indices of different commodities were estimated by the ratio to trend method. The analysis of seasonal indices of prices of different commodities under consideration during the period 1997-98 to 2014-15, showed that for majority of commodities such as rice, maize and turmeric, harvesting season was the season of price rise. The range and coefficient of variation of seasonal indices in different period implies that seasonal price variation of maize and turmeric in Nizamabad District decreased in the two periods (1997-98 to 2005-06 and 2006-07 to 2014-15). In case of rice, it was found increasing in the two periods (1997-98 to 2005-06 and 2006-07 to 2014-15).

Integrated Nutrient Management and spacing in Tulsi

Bhaba Prashad Kalita

Tulsi is an important aromatic and medicinal plant, which gains commercial importance in recent years. The increasing demand for the essential oil both for the perfumery and pharmaceutical industry stressed the need for systematic investigation for increasing the herbage and oil yield. An experiment was therefore carried out at Instructional-cum-Research (ICR) farm, Assam Agricultural University, Jorhat during 2016, study the performance of tulsi under different spacing and to find out suitable integrated nutrient management in tulsi. The experiment was laid out in factorial randomized block design replicated thrice to assess the "Integrated nutrient management and spacing in Tulsi". The treatments consisted of two different species *Ocimum sanctum* (V_1), *Ocimum gratissimum* (V_2), along with two different plant densities *viz.,* 40×40cm (S_1), 50×50cm (S_2) and four doses of integrated nutrient management - 6ton/ha Vermicompost (F_1), 20-10-10 N-P_2O_5-K_2O kg/ha + 3t/ha VC (F_2), 40-15-15 N-P_2O_5-K_2Okg/ha + 3t/ha VC (F_3), 60-20-20 N-P_2O_5-K_2O kg/ha + 3t/ha VC (F_4),

Between the two species of tulsi significant influence on various growth parameters were found. *O. gratissimum* (V_2) was found statistically superior in regards to growth attributes in all the growth stages than that of V_1. This species also recorded significantly higher in almost all the yield attributing characters than that of¹ *Ocimum sanctum*. The highest leaves yield (4.46t/ha) and oil yield (29.60kg/ha) yield were obtained in *O. gratissimum* and was significantly superior over that of *O. sanctum*. Also, the uptake of nitrogen, phosphorous and potassium by tulsi were significantly higher in *O. gratissimum* (V_2).

Results revealed that between the two spacing, 40×40cm (S_1) showed statistically superior values in regards to almost all the growth and yield attributes. However, fresh leaves yield (3.78t/ha) as well as oil yield (21.84kg/ha) obtained in 40×40cm (S_1) were significantly higher than that of 60×60cm (S_2). Also, the uptake of nitrogen, phosphorous and potassium by tulsi were significantly higher in 40×40cm (S_1).

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Department : Agronomy
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Among the four different sources of INM significant influence on various growth parameters were found. (F_4) was found statistically superior in regards to growth attributes in all the growth stages and *at par* with (F_3). (F_4) also recorded significantly highest in almost all the yield attributing characters followed by (F_3). The highest fresh leaves (3.78t/ha) and oil yield (25.19t/ha) were obtained in (F_4) and was significantly superior to that of (F_3), (F_2) and (F_1). However leaves and oil yield of F_4 was significantly at per with that of F_3. Also, the uptake of nitrogen, phosphorous and potassium by tulsi were significantly highest in (F_4) and F_4 and F_3 were significantly *at par*.

An economic analysis showed that out of these two species, higher gross return (₹.207200.00/ ha), net return (. 161737.00/ha) and B:C ratio (4.56) could be obtained in case of *Ocimum gratissimum* (V_2). In between the spacing higher gross return (. 152880.00/ha), net return (. 107237.00/ha) and B:C ratio (3.35) were obtained in closer spacing (S_1) than that of wider spacing (S_2). Among the four INM the highest gross return (. 176330.00/ha), net return (. 132939.00/ha) and B:C ratio (4.06) could be obtained with F_4 followed by F_3, F_2 and F_1.

Nutrient management in scented rice- lathyrus relay cropping under organic system

Chayanika Borah

A field experiment entitled "Nutrient management in scented rice-lathyrus relay cropping under organic system" was conducted at Instructional-cum-Research Farm, Assam Agricultural University, Jorhat during *kharif* and *rabi* season, 2016-17 to evaluate the effect of different scented rice varieties and organic sources of nutrients in rice-lathyrus relay cropping. The experiment consisted of three varieties *viz*. *badshahbhog* (V1), CR Dhan-909 (V2) and *kola joha* (V3) and six organic sources *viz*., control (I1), enriched compost (I2), vermicompost (I3), green leaf manuring (I4), azolla compost (I5) and microbial consortium (I6). The experiment was laid out in factorial RBD with three replications. The soil of the experimental site was sandy loam in texture with pH 5.1, medium in available N (287.39kg/ha), P_2O_5 (26.58kg/ha), K_2O (149.56kg/ha) and organic carbon (0.77%). Total rainfall received during whole crop growing season was 1275.4mm. The mean maximum and minimum temperature during the whole crop growing period ranged from 24 to 34.7°C and 8 to 26.8°C, respectively.

Different growth and yield attributes were influenced significantly due to different rice varieties and organic sources of nutrients. Almost all the growth and yield attributing characters were observed significantly higher in enriched compost (I2) and rice variety CR Dhan-909 (V2). In case of grain and straw yield highest value of 2.99 and 5.92t/ha respectively, were recorded when enriched compost (I2) was applied. Significantly higher N, P_2O_5 and K_2O uptake was recorded in enriched compost (I2). Similarly, among the varieties CR Dhan-909 (V2) recorded significantly higher yield attributing characters contributing grain and straw yield 5.63 and 3.64 t/ha, respectively. The per cent content of N, P and K of grain and straw including uptake as well as total uptake was significantly influenced by rice varieties and organic sources of nutrients. Available soil N, P and K were significantly influenced by both the treatments.

No significant residual effect was observed due to varieties on second crop lathyrus. But, most of the growth and yield attributing characters of lathyrus crop were significantly

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 Major Advisor : Dr. J. Goswami

influenced due to different organic sources. However, significantly higher seed (490.46kg/ha) and stover (660.21kg/ha) yield was observed under residual effect of enriched compost (I2). Highest uptake of N, P_2O_5 and K_2O by lathyrus crop was observed in plots previously treated with enriched compost (I_2).

In terms of economics, the highest gross income, total rice equivalent yield of the system and comparatively higher net return were recorded with the application of enriched compost as 100% RDN to the first crop rice. Highest B:C ratio(1.93 and 2.73) of the system was observed in microbial consortium (I_6) and CR Dhan-909 (V_2) respectively. Most of the growth and yield attributing characters including gross income and total rice equivalent yield and residual effect in succeeding lathyrus was found higher with application of enriched compost when applied in high yielding rice variety CR Dhan-909. Hence, considering the positive effect on growth, yield, quality and soil health, enriched compost can be considered best for adopting at the field level to reap good economic yield with better quality, sustained soil health and high net return.

Agronomic management of maize for food-fodder production

Gauri Mohan

A field experiment entitled "Agronomic management of maize for food-fodder production." was carried out at Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during the *rabi* season of the year 2016-17 to find out the potentiality of maize for dual purpose to enhance the food–fodder production under different plant population and to find out the requirement of nitrogen for maize grown as food cum fodder purpose. The experiment was laid out in factorial RBD and replicated thrice. The treatment consisted of eight crop management practices *viz.,* Grain crop at 60 cm x 30cm (T_1), Fodder crop at 30 cm x 15 cm (T_2), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at knee-high stage for fodder (T_3), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at tasseling stage for fodder (T_4), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at milking stage for fodder (T_5), Fodder cum grain crop at 30 cm x 15 cm with removal of alternate rows at knee-high stage for fodder (T_6), Fodder cum grain crop (30 cm x 15 cm) removal of alternate row at tasseling stage for fodder [T_7], Fodder cum grain crop at 30 cm x 15 cm with removal of alternate rows at milking stage for fodder (T_8) and two levels of fertilizer *viz.*, F_1: 100% of RDF and F_2: 150% of RDF. The soil of the experimental site was sandy loam in texture, acidic in reaction (5.15), medium in organic carbon (0.62%), low in available N (210.65 kg ha^{-1}) and medium in available P_2O_5 (38.64 kg ha^{-1}) and K_2O (295.55 kg ha^{-1}). N was applied in 2 split doses one at knee high stage and second was at tasseling stage. Maize variety "PAC 751" was sown on 5th October (2016) and harvested by three picking on 22th February, 24th February, 27th February.

Experimental findings revealed that the crop management practices differed significantly. Crop management practice T_1 recorded the highest values for all growth parameter, crop physiological parameters (LAI, LAD and chlorophyll content), cob parameters, yield (grain and stover yield), and nutrient (NPK) uptake of maize. The highest grain and stover yield being 34.21 q ha^{-1} and 105.52 q ha^{-1}, respectively was produced from T_1 which was *at par* with crop management practice T_6, T_7 and T_8. However, green fodder

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Department : Agronomy
 Major Advisor : Dr. K. Kurmi

yield (164.04 q ha^{-1}) and dry matter yield (35.31 q ha^{-1}) was found to be highest in crop management practice T$_2$. Grain equivalent yield were found to be highest in crop management practice T$_7$ which recorded 39.49q ha^{-1}. Among the fertilizer levels F$_2$: 150% of RDF recorded the highest growth parameters, crop physiological parameters, cob parameters, yield (grain and stover yield), green fodder yield and nutrient (NPK) uptake of maize.

In terms of economics, crop management practice T$_7$ recorded the highest gross return (Rs 1, 20,951.67 ha^{-1}) and crop management practice T$_1$ recorded the highest net return (Rs 90,631.40 ha^{-1}) followed by crop management practice T$_7$ (Rs 83,333.24 ha^{-1}). The highest B: C ratio (4.46) was recorded from crop management practice T$_1$ due to low cost of cultivation which was followed by T$_5$ (3.52). Among the fertilizer level F$_2$: 150% of RDF recorded highest gross return (Rs 1,05,543.92 ha^{-1}) net return (Rs 70,650.40 ha^{-1}).

Phosphorus management in aerobic rice

Kajod Mal Ghasal

A field experiment entitled 'Phosphorus management in aerobic rice' was carried out in the Instructional-cum-Research (ICR) Farm, Assam Agricultural University, and Jorhat during autumn season of 2016. The treatment of the experiment consisted of three phosphorus sources *viz*., S_1 single super phosphate, S_2: diammonium phosphate and S_3: rock phosphate, three doses of phosphorus viz., D_1 10kg P_2O_5 ha^{-1}, D_2:20kg P_2O_5 ha^{-1} and D_3:30kg P_2O_5 ha^{-1} and two biofertilizer treatments i.e. B_1 without biofertilizer and B2: Azospirillum $_+$ PSB. One absolute control was included for comparison. The experiment was laid out in factorial randomized block design (RBD) replicated thrice with the objectives to *study* the performance of aerobic rice under different sources and levels of phosphorus and to evaluate the phosphorus use efficiency of aerobic rice.

The soil of the experimental site was sandy loam in texture, medium in available N (285.36kg ha^{-1}), P_2O_5 (22.85kg ha^{-1}) and K_2O (138.04kg ha^{-1}) and organic carbon (0.62%) with pH value of 5.2. The rice variety "Inglongkiri" was sown on 11th March, 2016 and harvested on 08th July. 2016. The rainfall received during the crop season was only 1350 mm. The weekly average maximum temperature ranged from 24.9 to 33.5°C and minimum temperature 15.9 to 26.1°C, respectively. Out of the three phosphorus sources, rock phosphate recorded the highest grain (26.19q ha^{-1}) and straw (47.05q ha^{-1}) yield followed by single super phosphate. Among the doses, highest grain (27.43q ha^{-1}) and straw (49.39q ha^{-1}) yield were recorded in 30kg P_2O_5ha^{-1} and the lowest grain (22.37q ha^{-1}) and straw (37.70q ha^{-1}) yield were found in 10 kg P_2O_5ha^{-1}. In case of bio-fertilizer, Azospirillum $_+$ PSB recorded higher grain yield (26.17q ha$^{-1)}$ than that of without bio-fertilizer (22.87q ha^{-1}). Significantly higher N, P and K uptake were recorded with phosphorus application through rock phosphate which was statically at par with single super phosphate. Rock phosphate recorded higher values of agronomic (39.76kg kg^{-1}) and physiological use efficiency (207.02kg kg^{-1}) of phosphorus which was followed by the source single super phosphate. Application of 30kg P_2O_5 ha^{-1} recorded higher values N, P and K uptake by grain, straw and total and significantly higher available P_2O_5 (31.2 kg ha^{-1})in soil after harvest. Out of the

three doses of phosphorus, application of 10kg P_2O_5 ha^{-1} registered highest agronomic use efficiency (36.16kg kg-^{1}) and the highest physiological use efficiency of phosphorus (234.18kg kg^{-1}) was recorded with 30kg P_2O_5 ha^{-1}. Azospirillum $_+$ PSB exhibited significantly higher N, P, K uptake, agronomic use efficiency (39.43kg kg-^{1}) and physiological use efficiency of phosphorus (223.48kg kg^{-1}) than without biofertilizer treatment. So far the economics is concerned, the treatment combination that included application of rock phosphate at the rate of 30kg P_2O_5 ha^{-1} inoculated with Azospirillum + PSB recorded the highest net return of ₹.56,717.00 ha^{-1} and with highest benefit-cost ratio (B:C) of 2.63.

Integrated nutrient management in maize (*Zea mays*)

Krishnakhi Borah

A field experiment entitled "Integrated Nutrient Management in maize (*Zea mays*)" was carried out at Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during the summer season of the year 2016 to find out the varietal response to Integrated Nutrient Management (INM) and to study the growth, development and yield of the crop under different INM practices. The experiment was laid out in split plot design (SPD) and replicated thrice. The treatments consisted of two varieties *viz.*, RCM-76 (V_1) and DA-61-A (V_2) and seven INM practices *viz.,* 0 NPK kg/ha (I_1), RDF (I_2), RDF+ *Azospirillum* + PSB (I_3), 50% RD of N through fertilizer+50% N replaced by vermicompost (I_4), 75% RD of N through fertilizer + 25% N replaced by vermicompost (I_5), 50% RD of N through fertilizer+50% N replaced by enriched compost (I_6), 75% RD of N through fertilizer+25% N replaced by enriched compost (I_7).

The soil of the experimental site was sandy loam in texture, acidic in reaction, medium in organic carbon (0.72%), low in available N (159 kg/ha) and medium in available P_2O_5 (23.78 kg/ha) and K_2O (160.5 kg/ha). N was applied in 2 split doses one at knee high stage and second was before tasseling. Two maize variety "RCM-76" and "DA-61-A" was sown on 15th march (2016) and harvested by two picking on 24th June and 4th July.

Experimental findings revealed that the two varieties did not differ significantly, however DA-61-A variety showed better response to different INM treatments. INM practices influenced the growth characters of maize in terms of number of leaves per plant and all yield attributing character of maize. 50% RD of N through fertilizer+50% N replaced by enriched compost (I_6) recorded the highest values for all crop physiological parameters (LAI, LAD and chlorophyll content). Similarly, the yield attributing characters *viz.*, weight of cob with and without husk, length of cob, average diameter of cob, number of rows/cob, grain/row, grain/cob, 1000 grain weight, weight of grain per cob, yield (grain and stover yield) and nutrient (NPK) uptake of maize was observed to be highest under 50% RD of N

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through fertilizer + 50% N replaced by EC (I$_6$). The highest grain and stover yield being 39.8 q/ha and 78.4 q/ha respectively was produced from I$_6$ (50% RD of N through fertilizer + 50% N replaced by EC) treatment. Likewise, 50% RD of N through fertilizer + 50% N replaced by EC (I$_6$) recorded the highest grain protein content. However, nutrient content in soil after harvest of the crop was found to be non-significant. In terms of economics, 50% RD of N through fertilizer + 50% N replaced by EC (I$_6$) recorded the highest gross return (₹ 101666) with DA-61-A (V$_2$) variety and 75% RD of N through fertilizer + 25% N replaced by EC (I$_7$) recorded the highest net return (67533) with DA-61-A variety which was closely followed by 75% RD of N through fertilizer + 25% N replaced by EC (I$_5$) treatment (66250) and 50% RD of N through fertilizer + 50% N replaced by EC (I$_6$) treatment (65472). The highest B:C ratio (3.63) was recorded from RDF+*Azospirillum*+PSB (I$_3$) treatment due to low cost of cultivation which was followed by RDF (I$_2$) treatment (3.52) and 75% RD of N through fertilizer + 25% N replaced by VC (I$_5$) (3.44) treatment.

Performance of direct seeded *sali* rice as influenced by sowing dates, INM and their residual effect on succeeding rapeseed crop

Milon Jyoti Konwar

A field experiment was carried out at Instructional-cum-Research (ICR) farm, Assam Agricultural University, Jorhat during 2015-2016. The experiment was laid out in split-plot design replicated thrice to assess the "Performance of direct seeded *sali* rice as influenced by sowing dates, INM and their residual effect on succeeding rapeseed crop". The treatments consisted of four different sowing dates in main plot *viz.*, 1st May (D_1), 11th May (D_2), 21st May (D_3) and 31st May (D_4) along with methods of sowing *viz.,* direct seeding (M_1), transplanting (M_2) and nutrient management- recommended doses of fertilizer (F_1) 60:20:40 N:P_2O_5:K_2O kg/ha and INM package (F_2) (Organic manure @ 1 t/ha + mixed innocula of *Azospirillum* sp. and *Bacillus megaterium* P-5 @ 4 kg/ha, Rock Phosphate @ 10 kg P_2O_5/ha, MOP @ 40 kg K_2O/ha) in sub-plots.

Among the four different sowing dates of rice significant influence on various growth parameters were found. May 11th (D_2) was found statistically superior in regards to growth attributes in all the growth stages and at par with May 1st (D_1) sown crop. May 11th (D_2) also recorded significantly higher in almost all the yield attributing characters followed by May 1st (D_1). The highest grain (40.24 q/ha) and straw (68.07 q/ha) yield were obtained in May 11th (D_2) sown crop and was significantly superior to that of May 21st (D_3) and May 31st (D_4). Also, the uptake of nitrogen, phosphorous and potassium in grain, straw and total uptake by *sali* rice were significantly higher in May 11th (D_2) sown crop.

Results revealed that between the two methods of sowing, transplanting (M_2) resulted statistically superior in regards to almost all the growth and yield attributes. However, the grain yield (40.26 q/ha) as well as straw yield (68.12 q/ha) obtained in transplanting (M_2) were significantly higher than that of direct seeding (M_1). Also, the uptake of nitrogen, phosphorous and potassium by grain, straw and total uptake by *sali* rice were significantly higher in transplanting (M_2).

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In nutrient management practices, INM (F_2) practice had significant effect on various growth and yield attributing characters. Also the grain yield (39.75 q/ha) as well as straw yield (67.52 q/ha) obtained in INM (F_2) were significantly higher than that in RDF (F_1). The nitrogen, phosphorous and potassium uptake by grain, straw and total uptake by the plant were also higher in INM (F_2).

An economic analysis showed that May 11th (D_2) sown crop recorded the highest B:C ratio of 1.57 with a net return of ₹. 57625.00/ha followed by 1st May (1.48 and . 54280.00, respectively), May 21st (D_3) and May 31st (D_4). In methods of crop establishment, direct seeding resulted in higher B: C ratio of 1.55 and net return of . 52355.00 as compared to transplanting (M_2). However, in nutrient management treatments, INM (F_2) recorded the highest B:C ratio of 1.58 and net return of . 56675.00/ha than RDF (F_1).

In the succeeding crop, no significant effect was found among the treatments so far growth and yield attributes character, seed and stover yield as well as in uptake of nutrients due to different treatment effects of the preceding crop were concerned.

Tillage and INM in direct seeded *Sali* rice and their effect on fodder lathyrus

Nilotpal Hazarika

A field experiment entitled "Tillage and INM in direct seeded *Sali* rice and their effect on fodder lathyrus" was conducted at Instructional-cum-Research (ICR) farm, Assam Agricultural University, Jorhat during 2016-2017. The experiment was laid out in split-plot design with three replications. The treatments consisted of three different tillage in main plot *viz.*, minimum tillage (T1), zero tillage with non-selective herbicide (Glyphosate) (T2) and conventional tillage (T3) along with sources of nutrients - recommended doses of fertilizer (F1) 60:20:40 N:P2O5:K2O kg/ha, 50% N replacement through Vermicompost + 50% RDF of N and full RDF of P2O5 and K2O (F2) and 50% N replacement through Enriched compost + 50% RDF of N and full RDF of P2O5 and K2O(F3) in sub plots.

The result of the experiment revealed that the growth characters of rice were significantly influenced by different tillage treatments. Conventional tillage (T3) was found statistically superior in regards to growth attributes in all the growth stages. Conventional tillage (T3) also recorded significantly higher yield attributing characters. Significantly higher grain (42.81 q/ha) and straw (71.83 q/ha) yield were obtained in conventional tillage (T3) followed by minimum tillage (T1) and zero tillage (T2).The uptake of nitrogen, phosphorus and potassium in grain, straw and total uptake by *Sali* rice were significantly higher in conventional tillage(T3) treatment.

The INM treatment receiving 50% N replacement through Enriched compost +50% RDF of N and full RDF of P2O5 and K2O (F3) had significant effect on various growth and yield attributing characters. The grain yield (38.26q/ha) as well as straw yield (66.66q/ha) obtained in (F3) were significantly higher than (F2) and (F1). Also the uptake of nitrogen, phosphorus and potassium by grain, straw and total uptake by the *sali* rice were significantly higher in (F3) treatment.

An economic analysis showed that Conventional tillage (T3) recorded the highest B:C ratio of 1.49 with a net return of 56708.00/ha as compared to other tillage practices. In sources of nutrient F1 resulted in higher B:C ratio of 1.45 and net return of 44812.00/ha as compared to F3 and F1 treatment.

In the succeeding crop, no significant effect was found among the treatment so far growth characters, green fodder yield and dry matter yield as well as in uptake of nutrients to different treatment effects of the preceding crop.

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Irrigation scheduling in transplanted autumn rice on the basis of alternate wetting and drying technology

Prakshipta Boruah

A field experiment entitled "Irrigation scheduling in transplanted autumn rice on the basis of alternate wetting and drying technology" was carried out at Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during the *ahu* season of the year 2016 to work out the irrigation scheduling for transplanted autumn rice and to study the growth, development and yield of the crop under alternate wetting and drying technology. The experiment was laid out in randomized block design (RBD) and replicated thrice. The treatments consisted of eight irrigation regimes *viz.*, irrigation at 5 cm depletion of water from soil surface (T_1), irrigation at 10 cm depletion of water from soil surface (T_2), irrigation at 15 cm depletion of water from soil surface (T_3), irrigation at 20 cm depletion of water from soil surface (T_4), irrigation at 25 cm depletion of water from soil surface (T_5), irrigation at 30 cm depletion of water from soil surface (T_6), irrigation at 3 days after disappearance of ponded water (T_7) and continuous flooding (T_8).

The soil of the experimental site was silty loam in texture, acidic in reaction, medium in organic carbon (0.63%), low in available N (171.30 kg/ha) and medium in available P_2O_5 (22.70 kg/ha) and K_2O (254.50 kg/ha). All plots received N-P_2O_5-K_2O at recommended dose of 40-20-20 kg/ha in the form of Urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP), respectively, where N was applied in 2 split doses. The rice variety "Dishang" was sown on 23rd February (2016), transplanted on 15th March (2016) and harvested on 18th June (2016). The total amount of rainfall received during the crop growth period was 1106.10 mm and total evaporation during the period (8th SMW to 25th SMW) was 54.4 mm.

Experimental findings revealed that irrigation schedules influenced the growth characters of rice in terms of plant height, number of tillers/hill and dry matter accumulation. Irrigation at 15 cm depletion of water from soil surface (T_3) recorded the highest values for all growth characters and crop physiological parameters (LAI, CGR and RGR). Similarly, the yield attributing characters (effective tillers/hill, length of panicle and number of grains/panicle), yield (grain and straw yield) and nutrient (NPK) uptake of rice was observed to be

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highest under irrigation at 15 cm depletion of water from soil surface (T_3). On the other hand, the test weight and harvest index (HI) was found to be non-significant under different irrigation regimes. The highest grain and straw yield being 4.28 t/ha and 6.32 t/ha respectively was produced from irrigation at 15 cm depletion of water from soil surface (T_3) which was found to be statistically *at par* with the yield obtained from irrigation at 3 days after disappearance of ponded water (T_7) [4.02 t/ha and 6.11 t/ha respectively]. Likewise, irrigation at 15 cm depletion of water from soil surface (T_3) also recorded the highest crop water use efficiency (Crop WUE) and field water use efficiency (Field WUE). However, organic carbon and nutrient content in soil after harvest of the crop was found to be non-significant. In terms of economics, irrigation at 15 cm depletion of water from soil surface (T_3) recorded the highest gross return (₹ 67360.00), net return (40465.60) and benefit-cost ratio (2.50).

Crop establishment methods and nitrogen management in organically grown scented rice (*Oryza sativa*) and their residual effects on vegetable pea (*Pisum sativum*)

Pranjit Bharali

A field experiment on scented rice var. 'kola joha' was carried out in the organic block located at Instructional-cum Research Farm of Assam Agricultural University, Jorhat during *kharif* and *rabi s*easons of 2016-17 to evaluate the effects of crop establishment methods and nitrogen management practices in scented rice-pea relay cropping system under rainfed condition. The treatments consisted of five crop establishment methods *viz*., M_1- Dibbling sprouted seeds in puddled field, M_2–Transplanting 30 DNS, M_3- Transplanting 60 DNS, M_4 – Transplanting 60 (30+30) days DPS and M_5 – Transplanting 30 DNS and one third tillers/hill removed at 30 DAT along with four nitrogen management treatments *viz*., N_0- Control, N_1- 100% RDN (FYM), N_2- 100% RDN (VC) and N_3- 50% RDN + 50% RDN (VC) were tested in a randomized block design with 3 replications. The soil of the experimental site was sandy loam in texture with pH 5.9, medium in organic carbon (0.58%), low in available N (267.80kg/ha) but medium in available P (23.4kg/ha) and available K (172.27kg/ha). Total rainfall received during the whple crop growing period was 1629.30mm distributed in 88 rainy days.

Different growth and yield attributing characters of rice were influenced significantly due to crop establishment methods. Almost all the growth and yield attributing characters were observed significantly higher in transplanting 60 (30+30) days DPS over the other methods of crop establishment.. In case of grain and straw yield the highest value of 2.68 and 5.51t/ha, respectively was recorded when transplanting of 60 (30+30) days DPS was done. The per cent content of N, P and K in grain and straw of rice was not affected significantly but their uptake by grain and straw as well as total uptake were affected significantly due to different crop establishment methods. Residual soil pH, available N, P, and K were not affected significantly due to different crop establishment methods except the organic carbon content in soil.

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Most of the growth and yield attributes of pea crop were not influenced significantly due to different crop establishment methods. However, the highest green pod yield of 146.02 kg/ha was recorded with transplanting 30 DNS and the stover yield of 185.65kg/ha with transplanting 60 (30+30) days DPS treatment. The per cent contents of N, P and K in seed and stover and their uptake by seed and stover as well as total uptake were not significantly affected due to different crop establishment methods. Residual soil pH, organic carbon, available N, P and K were also not affected significantly due to different crop establishment methods followed in rice crop. In system basis, the gross return, net return and benefit-cost ratio were recorded the highest in transplanting 60 (30+30) days DPS method followed by transplanting 30 DNS and one third tillers/hill removed at 30 DAT.

The highest rice grain equivalent yield of 3.70 (t/ha) in scented rice-pea relay crop sequence was recorded in the method when transplanting of 60 (30+30) days DPS was followed.

Different growth and yield attributes of rice crop were not influenced significantly due to different nitrogen management practices. Among all the nitrogen management treatments, application of 100% RDN (FYM) equivalent to 20kgN/ha produced the highest grain and straw yield of 2.28 and 4.99t/ha, respectively. The N, P and K contents in grain and straw were not affected significantly due to nitrogen management practices. Residual soil organic carbon and available N, P and K contents were influenced significantly due to nitrogen management practices.

The pea crop was not influenced significantly due to nitrogen management practices followed in rice crop in respect of all the growth and yield attributing characters. The highest green pod yield of 148.27kg/ha and stover yield of 168.10kg/ha were recorded with the application of 100% RDN (FYM). The N, P and K contents in seed and stover and their uptake were not affected significantly due to nitrogen management practices.

The highest rice grain equivalent yield of 3.17(t/ha) was recorded with the application of 100% RDN (FYM). The highest value in terms of gross return, net return and benefit-cost ratio were recorded with the application of 100% RDN (FYM).

A slight gain in residual soil N and K_2O, but loss in P_2O_5 were observed in all the crop establishment methods and nitrogen management practices at the end of experimentatio

Physiological performance of some green gram (*Vigna radiata* L. Wilczek) genotypes under varying levels of applied aluminium

Apang Sitang

A pot experiment was carried out during the summer season of 2015 with five genotypes of green gram (SGC-20, Pusa-0672, Pant Moong-5, Pratap and Pusa-9531) and four different levels of applied aluminum [(50 µM Al (T_2), 100 µM Al (T_3), 200 µM Al (T_4), and 300 µM Al (T_5)] along with a control (T_1) to assess the physiological performance of some green gram genotypes under varying levels of applied aluminum. The crop was shown on 22nd February and harvesting started from 28th of April onwards. The mean weekly temperature during the crop growing season ranged from 17.9°C to 28.8°C and the rainfall was 29.4 mm respectively and the relative humidity ranged between 65.2 – 91.8 per cent. The soil was acidic with low organic carbon, low available N, K and medium P content. The recommended packages of practices were followed for raising the crop. Increase in soil applied aluminium levels caused progressively lower values of leaf area, LAI, LAD, membrane stability index, root surface area, root length, number of root nodules, leaf chlorophyll content, in-vivo leaf nitrate reductase activity, number of pods per plant, number of seeds per pod, seed yield per plant, test weight of seed and harvest index in green gram genotypes. Pusa-9531 and Pant Moong-5 were found to be the higher seed yielders followed by the genotype Pratap whereas the genotype SGC-20 was found to be the lowest performer in this regard. GenotypesPusa-9531 and Pant Moong-5 recorded higher values for various physiological, biochemical and yield characters namely chlorophyll content, superoxide dismutase (SOD) activity, *in-vivo* leaf nitrate reductase activity, leaf area, leaf area index, leaf area duration, membrane stability index, root surface area, root length and number of root nodules per plant, pods per plant, seeds per pod and seed yield per. On an average application of 300 µM aluminium induced highest activities of superoxide dismutase (SOD) in leaves, highest lipid peroxidation and the content of proline. Dry matter yield of green gram shoot and root decreased progressively with increase in levels of applied Al. Genotype Pusa-9531 showed lowest per cent reduction in harvest index over control (6.64%, 7.26%,

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10.12% and 28.2% under 50, 100, 200 and 300 μM Al respectively; The corresponding reduction in seed yield per plant were 6.36%, 16.6%, 22.7% and 48.12%, respectively. On the other hand SGC-20 had recorded the highest reduction in these two traits with various levels of applied aluminium compare to control. With applied aluminium the traits namely total chlorophyll content and nitrate reductase activity were found to have positive correlation with biomass yield (R^2 =0.929 and R^2 =0.922, respectively) and grain yield (R^2 =0.915 and R^2 =0.881, respectively). In case of the genotype Pusa-9531 the reduction in biomass yield and grain yield were only 39.58% and 47.54% respectively when the plants of this genotype were grown with highest levels of applied aluminium (when soil aluminium concentration was increased by around 48%) as compared to control. The corresponding reduction percentages in case of the most susceptible genotype were found to be 49.95% and 52.91%, respectively.

Evaluation of physiological performance of lentil genotypes in organic situation under deferred dates of sowing in rice fallow land

Bhargob Sarmah

An investigation was carried out during November, 2016 to March, 2017 in the Instructional-cum-Research (ICR) farm and Department of Crop Physiology, Assam Agricultural University, Jorhat-13, to evaluate the physiological performance of lentil genotypes in organic situation under deferred dates of sowing in rice fallow land. Five lentil genotypes namely HUL-57, SLC-102, PL-406, KLS-218 and SLC-101were used for the study. There were three dates of sowing viz. 15th November, 30th November and 15th December. The land used for raising the crop has been maintained for last ten years as organic plot and has been used for raising winter rice crop. The lentil crops raised were supplied with nutrients through organic inputs (well rotten cow dung and enriched compost) and the chemicals used for plant protection were also organic. Significant variations were recorded among the genotypes in terms of various parameters namely total leaf chlorophyll content, relative leaf water content, *in- vivo* leaf nitrate reductase activity, root: shoot ratio, dry matter partitioning, number of pod per plant, number of seeds per pod, grain yield and harvest index .These parameters exhibited a decreasing trend with delay in the date of sowing from the recommended one. However lipid peroxidase activity was found to increase due to delay in sowing of lentil genotypes. Among the genotypes the HUL-57 performed the best compared to the other genotypes under both the situations when sowing was done at recommended date of sowing and when the sowing was delayed. On the other hand the genotype SLC-101 registered the lowest performance. The genotype HUL-57 exhibited the lowest percent reduction in terms of total leaf chlorophyll content, relative leaf water content, *in- vivo* leaf nitrate reductase activity, root: shoot ratio, dry matter partitioning, number of pod per plant, number of seeds per pod, grain yield etc. followed by the genotype KLS-218. When the sowing was delayed by 15 days (30th November) on an average biomass and grain yield were decreased by 12.29% and 3.30% respectively, whereas the corresponding decreases were 35.49% and 13.53% when biomass and grain yield from

15th December sowing were compared with that of 15th November sowing. In case of HUL-57 the decrease in biomass and grain yield were only 33.97% and 12.11% respectively when performance under 15th December sowing were compared with that of 15th November sowing.

The better performance of HUL-57 could be attributed to better performance of this genotype in terms of the parameters namely total chlorophyll content, relative leaf water content, *in- vivo* leaf nitrate reductase activity, root: shoot ratio, dry matter partitioning, number of pod per plant, number of seeds per pod etc. As with the delay in sowing resulted in the exposure of the lentil plants to moisture shortage coinciding with the vegetative and early reproductive stages, the genotype HUL-57 can be labeled as moisture shortage tolerant genotype; more over this genotype can be said to have adjusted efficiently under the decreasing length of photo period as encountered when sowing was delayed.

Nitrogen use efficiency in some upland rice (*Oryza sativa* L.) genotypes under moisture stress condition

Bikha Timung

Rice (*Oryza sativa* L.) is the staple food for more than 70 per cent of Indian, which is grown in 44 million hectares with a production of about 90 million tons annually. It is estimated that rice demand in 2025 will be 140 million tons in India. In Northeast India, the total areas under upland rain fed rice in the country are about 6.0 million hectares. There is scarcity of standing water in the upland field even after few hours of cessation of rain. The productivity of upland rice is very poor (about 0.90 tons/ha) as compared to the national average (1.9 tons/ha). In upland rice, water stress causes serious yield loss of upland rice due to reduction in various physiological parameters, more particularly nitrogen use efficiency (NUE). Therefore, a pot experiment was carried out during February 2014 to June 2014 using the Polyhouse to maintain physiological drought, and thereafter the nearby experimental field of the Department of Crop Physiology, AAU, Jorhat. The main objective of the work was to study the effects of water regimes (Full irrigation & No water + 5000 ppm of 6000 PEG spray at tillering and heading stages) on physiological variability, particularly NUE in five upland rice genotypes *viz.*, Mipholong, Balam, Sok Langlu, Sovak and Inglongkiri collected from North Hill zones (i.e. Karbi Anglong) of Assam. Fixed Time Nutrient Management (FTNM) approach was used to determine the optimum rate of nitrogen for maximum yield and higher NUE under physiological drought condition. As such, amount of nitrogen fertilizer received by each of the varieties during growing period was 140 kg N/ha (1400 ppm = 1.4%) irrespective of water regimes. A zero N level was also run for all the genotypes as a component of the FTNM to examine the yield variation among the varieties under moisture stress condition.

In the investigation, plant height (1.22 to 2.5%), leaf area (0 to 10.7%), RLWC (2.32 to 8.94%), chlorophyll (1.24 to 6.86%), nitrate reductase activity (1.4 to 5.09%), total N- content in leaf (6.77 to 91.51%), carbohydrate content (11.27 to 22.23%), panicle length (2.34 to 9.53%), panicle weight (9.07 to 11.87%), no. of seeds per panicle (3.8 to 11.9%), thousand grain weight (3.75 to 7.15%), economic yield (8.23 to 14.72%), biological yield

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(2.18 to 9.05%), N uptake (3.66 to 6.11%) and harvest index (0.66 to 9.55%) were reduced significantly in the varieties under physiological drought condition as compared to irrigated one. There were also significant reductions in NUE (1.0 to 9.82%) by drought condition. The varieties Inglongkiri, Sok langlu and Sovak performed well under moisture stress condition. Moreover, the varieties Balam (46.65%), Mipholong (45.14%) and Inglongkiri (42.84%) had the higher per cent increase in proline content under drought. The variety Inglongkiri with the highest total N-uptake (102 kg/ha), NUE (23.08%), HI (49.833%), and the lowest reduction in grain yield (8.23%) has emerged as suitable genotype under water stress condition as compared to the irrigated one.

Physiological performance of some lentil genotypes in rice fallow as influenced by foliar application of potassium

Birkhang Brahma Patgiri

Lentil (locally called masur) is grown as a post-rainy season crop in the rainfed areas. India is producing 14.76 million ton of pulses from an area of 23.63 million hectare and is one of the largest pulse producing countries in the world. The area covered under lentil in India is 1.450 million hectare and its productivity is 759 kg/ha. In Assam, lentil is cultivated in an area of 0.23 lakh ha with a production of 0.12 lakh MT registering a productivity of 522 kg /ha. To meet the domestic demand for lentil, Assam has to gear up the production of lentil by increasing area under this crop and /or increasing the productivity. Assam has an area of 0.54 million hectares as rice fallow which may be profitably utilized for growing pulse crops in *rabi* season provided there is availability of genotypes and package to suit the low available soil moisture conditions prevalent during *rabi* season in rice fallow land. Foliar application is regarded as a preferred solution when the quick supply of nutrients is hindered or the soil conditions are not conducive for the absorption of nutrients. Considering the above points a field experiment was conducted to evaluate the physiological performance of seven genotypes of lentil as influenced by foliar application of potassium during *rabi* season of 2014-15at ICR farm of AAU, Jorhat-13. A pot experiment was also conducted during *rabi* season of 2015-16 to evaluate the root parameters including the same treatments as in the case of the field experiment at the premises of the Stress Physiology Laboratory, Department of Crop Physiology, AAU, Jorhat. Three treatments comprised of T_0 = water spray, T_1 = Foliar application of potassium @1% at first flowering stage and T_2 = Foliar application of potassium @ 1% at first flowering as well as at 15 days there after. The seven lentil genotypes included in the study were HUL-57, IPL-121, KLS-218, PL-406, Chirang local, PL-135 and VL-4 which were collected from RARS Shillongani, Nagaon.

From the study wide variabilities were observed in terms of different parameters in the lentil genotypes as influenced by foliar applications of potassium. Compared to the single foliar application (T_1), foliar application of potassium done twice (i.e. T_2) resulted in

higher increase in the various parameters over T_0. The genotype HUL-57 was found to be the best in terms of parameters namely specific leaf weight (42.33g DW m^{-2}leaf),leaf area (397.12cm^2/plant), root volume(0.322cm^2/ plant), root biomass (0.166g/plant), root surface area (33.42cm^2/plant), relative leaf water content (38.59%), total dry matter production (18.57g/plant), number of pods per plant (119.57), weight of thousand seeds (21.40g) and harvest index (31.66%) which might have contributed positively towards the highest grain yield in this genotype (1039.85kg/ha with T_2. From the correlation study also it was found that plant dry matter at active pod filling stage exhibited significantly positive correlation with the morpho-physiological parameters namely leaf area ($r = 0.74$) per plant, nodule number per plant ($r = 0.78$) and relative leaf water content ($r = 0.72$). Grain yield exhibited significant positive correlation with leaf area ($r=0.85$), nodule number per plants ($r = 0.88$), root volume ($r = 0.70$) and relative leaf water content ($r = 0.82$).

Effect of entomopathogenic fungi, *Metarhizium anisopliae* on growth and yield of french bean

Himanshu Kurmi

Experiments were carried out during September, 2016 to March, 2017 in the Department of Crop Physiology, Assam Agricultural University, Jorhat-13, to evaluate the effects of different concentrations of fungal isolate of *Metarhizium anisopliae* on french bean. In one experiment, fungal isolates of *M. anisopliae* at 10^5cfu/ml, 10^6cfu/ml, 10^7cfu/ml and 10^8cfu/ml concentrations were tested to determine their effects on germination and subsequent seedling growth of french bean under laboratory condition. It was observed that germination percentage, germination index, vigour index, shoot and root length, fresh and dry weight of shoot and root were affected by *M. anisopliae* isolates in a concentration dependent manner. Among the applied concentrations, 10^6cfu/ml and 10^7cfu/ml concentrations were found to be more stimulatory compared to control. Another experiment was conducted in field condition with these two concentrations (10^6cfu/ml and 10^7cfu/ml concentrations) to evaluate their effects on growth and yield of french bean. Three different modes of application, *viz.* seed treatment (before sowing), foliar application (15 DAS, 30 DAS and 45 DAS) and combination of seed treatment and foliar application were employed. Recorded data revealed that plant growth of french bean in terms of plant height, leaf number, leaf area, root volume, shoot and root dry weights were increased by *M. anisopliae*. Physiological parameters such as relative leaf water content, total chlorophyll content and leaf N P K content of french bean were also positively influenced by the fungal isolate. However, no significant alteration was recorded in leaf proline content irrespective to mode of application and concentration of fungal isolate. Among the different treatments, 10^7cfu/ml concentration was found to be more stimulatory when applied as combination of seed treatment and foliar spray. At this treatment combination, pronounced stimulatory effects were recorded on yield and different yield attributing parameters of french bean. From the results of this investigation, it can be concluded that in addition to its well established protective role against insect pest, *M. anisopliae* also exhibits stimulatory effects on growth, development and yield of the crop.

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Physiological basis of submergence tolerance in lowland rice

Krishna Talukdar

The experiment was conducted for two years during Kharif season 2016 and 2017. About 200 genotypes from different adaptations were collected and screened for submergence tolerance by SES scoring developed IRRI, Philippines. After screening, five genotypes *viz*. Tejai longpi, Marjina, Badam bao, Sok langlu and OM5451 were selected based on survival, recovery characteristics and comparing with submergence susceptible line IR-64. Significant variation was observed amongst the genotypes for all the parameters *viz*. lipid peroxidation, leaf soluble protein content, leaf temperature and Membrane Stability Index, Chlorophyll Stability Index, Nitrate Reductase Activity. However, a significant increase in MDA content, root volume, root: shoot ratio was observed under stress condition. Stress induced reduction in stem elongation and plant height was found highest in Badam bao which could be correlated to an increase in total carbohydrate content in the genotype. Badam bao also recorded the lowest reduction in total chlorophyll content and tiller number under submerged condition. It can be assumed that Badam bao being a tall variety has got an inherent capability to cope submergence stress by reducing stem elongation and increasing tiller number thereby increasing yield. In the present study, under submerged condition, Badam bao could maintain its yield and yield attributes in terms of 1000 grain weight and no. of grain /panicle. This could be correlated with a significant increase in flag leaf area in the genotype.

Modern high-yielding rice varieties are highly susceptible to flooding whereas traditional cultivars have acquired moderate tolerance to flooding but they carry the penalty being of inherently lower grain yields. Therefore, in the present investigation, it was found that two traditional genotypes *viz*. Badam bao and Marjina could be grown successfully under submerged condition with moderately higher yield.

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Approaches for Enhancing Nitrogen use efficiency in some upland rice (*Oryza sativa* L.) genotypes under water stress condition

Ms. Larbeen Teronpi

Rice (*Oryza sativa* L.) is the principal food crop for North Eastern region of India, and it is extensively cultivated (72% of the total cultivated area) in upland, lowland and deep water conditions. The total areas under upland rain fed rice in the country are about 6.0 million hectares, which accounts 13.5 per cent of the total area under rice crop in the country. In the rain fed upland rice, there is no standing water in the field even after few hours of cessation of rain. The productivity of upland rice is very poor (about 0.90 tons/ha) as compared to the national average (1.9 tons/ha). Water stress causes serious yield loss of upland rice under water stress condition due to reduction in various physiological parameters, more particularly nitrogen use efficiency (NUE). Therefore, a pot experiment was conducted to evaluate six indigenous upland rice genotypes (*viz.,* Mairen Ake-er, Soksu Ajoha, Soksu Abara, Chubok Abara, Bijor Soksu, and Inglongkiri) from North Hill zones (i.e. Karbi Anglong) for higher NUE and yield potential under different water regimes (Full irrigation & No water+ 5000ppm of 6000PEG spray at tillering and heading stages). Real Time Nutrient Management (RTNM) approaches were used to determine the optimum rate of nitrogen for maximum yield and higher NUE under physiological drought condition. As such, amount of nitrogen fertilizer received by each of the varieties during growing period was 130 kgN/ha (1300ppm=1.3%) irrespective of water regimes.

In the study, plant height (upto 18%), leaf area (2 to 13%), RLWC (1 to 10%), chlorophyll (0 to 40 %), nitrate reductase activity (12 to 40%), Nitrogen – content (0.04 to 0.43%), carbohydrate content (upto 1.03%), panicle length (1 to 17%), panicle weight (13 to 34%), no. of seeds per panicle (1 to 8%), thousand grain weight (1%), grain yield (2 to 21%), biological yield (2 to 30%) and harvest index (upto 15%) were reduced significantly in all the varieties under moisture stress condition as compared to normal irrigation. There were also significant reductions in Grain N- content (2 to 31%), Straw N- content (14 to

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48%), total N –uptake (9 to 33%) and NUE (1 to 8%) by drought condition. The varieties Inglongkiri, Mairen ake-er and Bijor soksu performed well under moisture stress conditions. Moreover, physiological drought increased Proline accumulation in leaves of all the varieties. Bijor soksu (17.38%), Mairen ake-er (17.04%) and Soksu ajoha (16.32%) had the higher per cent increase in proline content under drought as compared to irrigated at heading stage. The variety Inglongkiri with the highest score corresponding to total N-uptake (88.85%), NUE (25.78%) and HI (43.51%), and the lowest reduction in grain yield (1.6%) has emerged as suitable genotype under water stress condition as compared to the irrigated one. To achieve an optimum yield, the cumulative dose of nitrogen as envisaged in the RTNM approaches, may be applied in splits up to 130 kg/ha based on the SPAD values of upland Ahu rice crop under physiological drought condition.

Thus from the above it could be concluded that Inglongkiri, a developed variety of Assam (RARS, Diphu), was found physiologically efficient among the varieties tested. This variety possesses the adaptive traits, especially higher N use efficiency, higher yield and attributes under physiological drought condition. Therefore, Inglongkiri may be taken as a donor in breeding programme for direct seeded upland limited moisture condition, and can be grown suitably under agro climatic conditions of elsewhere in Assam during Ahu season. Furthermore, to achieve an optimum yield, the cumulative dose of nitrogen as envisaged in the RTNM approaches, may be applied in splits up to 130 kg/ha based on the SPAD values of upland Ahu rice crop under physiological drought condition.

Physiological responses of some rice (*oryza sativa* l.) varieties to salinity stress condition

Nguyen Viet Thanh

Salinity is a major abiotic stress limiting growth and productivity of plants in many areas of the world due to increasing use of poor quality of water for irrigation and soil salinisation (Guptaand Bingru, 2014). Salinization affects many irrigated areas mainly due to the use of brackish water. Worldwide, more than 45 million hectares of irrigated land have been damaged by salt, and 1.5 million hectares are taken out of production each year as a result of high salinity levels in the soil (Munns& Tester, 2008). High salinity affects plants in several ways: water stress, ion toxicity, nutritional disorders, oxidative stress, alteration of metabolic processes, membrane disorganization, reduction of cell division and expansion, genotoxicity (Hasegawa*et al.*, 2000; Munns, 2002; Zhu, 2007). Therefore,laboratory and pot experiments were conducted to evaluate ten upland rice genotypes (*viz.,*Bahadur,Joymati,Ashoni Bara, Moleegacbhuru, Gitesh, Monoharsali and Moniram from Assam, and OM 5451, OM 6976, OM 4900 from Vietnam) for adaption to salinity condition.

In the study, seed germination (by 56.87%, 60.91%, 64.95%, 82.07%.) and shoot vigour index (by 49.08%, 58.47%, 64.19, 82.97%) were reduced commensuration with the increase in salt (NaCl) concentration from 10,20,30 and 40mM respectively as compared to control. All ofMoP, $CaCl_2$, Kinetin, Thiourea, Gibberellic acid, and Glucose used for pretreatments of seeds separately, improved seed germination (by 7.30%, , 7.85% 2.0 %, 4.28% 8.74%, and 0%), and shoot VI (by 28.4%, 33.08%, 28.66%, 32.68%, 53.99%, and 7.84%) many fold under saline (30mM NaCl) condition as compared to control (without salt & stimulator). The seeds without any chemical treatment reduced germination by 17.07% & VI by 11.92%in the study.Reductions in Plant height (0-5%), leaf area index (upto 16%), RLWC (1 to 16%), photosynthesis (25 to 46 %), chlorophyll (5 to 85 %),nitrate reductase activity (2 to 30%),carbohydrate content (19 to 50%),panicle length (0 to 10 %), panicle weight (0 to 14%), test weight (5%), economic yield (0 to 30%), biological yield (1 to 15%) and harvest index (1-8%), and HD grains (32.08-120.55%) were reduced in all the varieties

under salinity condition as compared to normal condition. In contrast, salinity increased in sterility by 3.39-69.93% in the varieties as compared to normal.

Based on the overall scores, the tolerance ranges of the rice varieties to salt stress condition as compared to control areJoymati (**Score** 15.0)>Bahadur(13.0)>Gitesh (14.0)>Monoharsali&Moniram(11.0)>OM6976(7.0)>Aghonibora=Mulagabhoru(6.0)>OM5451=OM4900 (5) perform well under salinity condition. Thus, it could be concluded that**Joymati**, the cultivar from India and **OM 6976**, the cultivar from Vietnam were found physiologically efficient among the varieties tested against salt stress condition.These two varieties possess the adaptive traits, higher yield and attributes under physiological salinity condition. Therefore, these varieties could be used as donors in breeding program for developing other salt tolerant plant populations in future.

Physiological characteristics of some rice (Oryza sativa L.) genotypes for higher nitrogen use efficiency under low light condition

Pranjal Das

Rice (*Oryza sativa* L.) is the world's single most important food crop, being the primary food source for more than one-third of the world's population. Kharif rice is characterised by its tropical agroclimatic environment of low sunshine hours, high temperature and high humidity (Sengupta and Dasgupta, 1978). Rice plant requires about 1500 bright sunshine (BSS) hours for the period from transplanting to maturity. Prevalence of only about 800-900 BSS hours during August to December in Northeastern region of India, not only hampers the physiological efficiencies but also renders nutritional imbalance by retarding Nitrogen uptake and ultimately the productivity of winter rice crop (Bharali *et al.,* 1994). Therefore a pot experiment was conducted to evaluate eight rice genotypes for higher NUE and yield potential under low light condition (H"35% shade). Nitrogen @ 0, 50, 100kg ha^{-1} were applied to the crop in splits as basal and at maximum tillering stages so that the optimum rate of nitrogen for maximum yield and higher NUE of the crop can be worked out under low light condition.

In the study, Leaf number (7.81-35.29%), Tiller number (2.31-26.60%), Specific leaf weight (0.36-3.93%), Net assimilation rate (0.64-66.38%), Root biomass (5.88-11.90%), Nitrate reductase (0-9.45%), N-content in leaf (0.1-0.39%), Starch content (1.61-18.23%),Reducing sugar (17.45-60.96%), No.of grains per panicle (4.02- 7.07%), No. of panicle per hill (2.31-18.76%), Panicle weight (14.02-51.53%), Panicle length (0.86-22.84%), Economic yield (4.84-23.35%), Biological yield (0.11-26.34%), HI (0.41-3.5%), HD grain (0.47-14.11%) were reduced significantly in almost all the varieties under low light condition as compared to normal light. There were also significant reductions in grain N-content (0.01-0.08%), grain starch (0.16-5.23%), grain sugar (12.60-36.86%) and NUE (1.12-7.86%), under low light condition. The varieties Senduri Sali, Kati Sali and Swarna prabha performed well under low light condition. Moreover, low light increased the leaf area (4.78-11.43%), plant height (0.52-3.17%), Chlorophyll a (3.49-66.80%), Chlorophyll b (34.36-

73.98%), Total Chlorophyll (19.28-73.71%), grain sterility (2.81-12.31%) in the varieties as compared to normal light condition. Based on the overall scores for physiological indices, the tolerance ranges of the rice varieties to low light condition are Senduri Sali (27) > Kati Sali (11) > Swarna prabha (9)> Aki Sali and Bodumoni Sali (7) > Rong salpona and Bordubi Sali (3) >IR-8(1) perform well under low light condition. The variety Senduri Sali with the highest score corresponding to Grain N- content (4.36%), NUE (60.26%) has emerged a suitable genotypes under low light as compared to normal one. Based on the overall scores, to achieve the maximum yield, the optimum rate of nitrogen under low light is 50kg ha^{-1} (44) followed by 0kg N ha^{-1} (16)>100kg N ha^{-1} (8). Thus, it could be concluded that Senduri Sali, a traditional variety of Assam was found to be physiologically efficient. The variety is charcterised especially for yield and yield attributes e.g. lower yield reduction (4.84%), lower sterility (2.81%), higher HD grains (69.17%), higher panicle weight (3.79%), higher HI (39.21%), higher LEU (1.21%), higher NUE (67.10%) and higher economic yield (14.31%) at 50kg N ha^{-1} under low light condition. Therefore, Senduri Sali may be taken as a donor in breeding programme for low light condition, and can be grown suitably under agro- climatic condition elsewhere in Assam during Kharif season. Because, under low light condition, leaf nitrogen at flowering stage had positive and significant correlation with number of panicle hill^{-1} (0.472*). At harvest, grain nitrogen exhibited positive and significant correlation with economic yield (0.412*), Harvest index (0.451*), number of grains panicle^{-1} (0.610**) and panicle weight (0.522**) under low light condition.

Evaluation of some upland rice genotypes for tolerance to moisture shortage

Rashmi K. V.

Rice is the staple food for more than 70% of Indian population, which is grown in 44 million hectares with a production of about 104.80 million tonnes, Out of 45 million hectares, upland rice occupies about 7 million hectare. It is often found that upland rain fed crops suffered due to soil moisture stress at critical crop growth stage including drought. Considering the importance of this point, a study was considered worthy to evaluate the effects of the water deficit with the following objectives: 1.Evaluation of physiological performance of selected rice genotypes under different moisture regimes and 2.To understand the physiological basis of tolerance of rice genotypes towards moisture shortage under Assam situation. The experiment were conducted in two years during Ahu season 2016 and 2017 using plastic pots with 3 moisture regimes namely (T_0) Maintain the soil moisture at field capacity, (T_1) Withholding the irrigation for 15 days at Maximum tillering stage (T_2) withholding the irrigation for 15 days after panicle emergence using ten genotypes of rice namely V_1 (Tamdao), V2 (Inglongkiri) V_3 (Koimurali), V4 (Meghi), V5 (Guni), V6 (Kasalath), V7 (Luit), V8 (IR 36), V9 (Nagina), V10 (Shahabhagi Dhan).

Significant variation was observed among the genotypes at max.tillering and panicle emergence stage for all the parameters. The moisture deficit created at max.tillering and panicle initiation stage also could bring about significant difference in these parameters. Excepting the parameters Viz.Lipid peroxidase activity and proline content, leaf temperature and root surface area all the parameters recorded reduction in their values under moisture deficit condition. In terms of grain yield the genotype Luit (9.88g) occupied the first position under non stress situation, stress imposed at max.tillering stage(7.876g) and stress imposed at panicle initiation stage (6.023g).Next to Luit the genotype Kasalath, Shahabhagi dhan,Inglonggkiri were show to be better performance in terms of grain yield. From the correlation study grain yield was found to be significantly and positively correlated with total chlorophyll under stress at max.tillering stage, RLWC at both stages of observation under both stress and non stress situation and root surface area at both stages of observation only

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under non stress condition, No.of effective tillers and grains per panicle, thousand grain weight at both stages of observation under non stress and stress situation. In terms of biomass production the genotype Inglongkiri, Kasalath, Shahabhagi dhan, Luit were the better ones. By virtue of its better performance in terms HI, 1000 grain weight the genotype Luit was able to become the highest grain yielder although its biomass production capacity was next to Inglongkiri, Kasalath, Shahabhagi dhan from the present study the moisture deficit stress imposed at panicle initiation stage was found to have more adverse effect on majority of the physiological parameters and grain yield more adversely. On an average a reduction of 17.27% and 21.01% in biomass yield were recorded under moisture deficit situation when the deficit was imposed at maximum tillering and panicle emergence stage respectively as compared to that of non stress situation. The corresponding reductions in grain yield were 28.90% and 42%.

Morphplogical characterization of rice genotypes for aerobic condition

Sewali Pegu

An experiment was conducted during Rabi season in the year 2016. About 169 lines from different adaptation were collect and screened for low moisture stress response by SES scoring method developed IRRI, Philippines. After screening, five lines *viz*. Banglami, Inglongkiri, Boga ahu, Ronga ahu and Bengungutia ahu were selected for the present investigation to evaluate the effect of low moisture stress on rice. The results obtained during the investigation revealed that moisture stress significantly influenced various morpho-physiological, biochemical and yield parameters. It was found that stress induced reduction in root shoot ratio, root volume, number of tillers per plant, leaf area index, specific leaf area, relative growth rate and photosynthetic parameters were lower in Ronga ahu, followed by Banglami and Inglongkiri. A reduction in values of relative leaf water content, membrane stability index and an increase in lipid peroxidation, proline content were recorded under aerobic condition. Under aerobic condition, a comparatively better performance was recorded in Ronga ahu, Banglami and Inglongkiri in regards to yield related parameters. Maximum reduction in area of leaf stomata (abaxial stomatal area, adaxial stomatal area) and stomatal frequency was observed in Bengungutia ahu followed by Boga ahu under aerobic condition. The tolerance indices parameter *viz*. Drought Resistance Index, Dry Matter Stress Index, Drought Tolerant Efficiency, and Plant Height Stress Index recorded in the study and revealed that cultivar Ronga ahu and Banglami showed maximum DTE and DRI under aerobic condition. From the results of the experiment it may be concluded that, Ronga ahu, was more suitable under aerobic condition and this could be attributed to higher accumulation of proline, adjustment of anatomical feature like stomatal modification, etc. Some genotypes like Banglami and Inglongkiri showed certain degrees of tolerance under moisture stress which could also be considered suitable, whereas Boga ahu was susceptible variety. The susceptible variety invariably reflected less favourable plant water status, more metabolic de-arrangements in terms of photosynthesis rate, nitrate reductase activity, chlorophyll loss and depression level of membrane stability.

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Physiological performance of some green gram (*Vigna radiata* L.) genotypes under varying soil moisture regime in acidic soil

Thingbaijam Ahilia Devi

Green gram (*Vigna radiata* (L.) R. Wilczek) belonging to the family leguminosae, is one of the important grain legumes of arid and semiarid tropics. Summer green gram covers an area of 13.41 thousand hectares in Assam with an average productivity of 520 kg/ha (Anonymous, 1992). Soils of Assam are generally acidic which affect the plant growth by inhibiting microbial growth, colonization in host rhizosphere and the activity of nodules besides affecting other major physiological processes in green gram plant. Water deficit stress is one of the most important abiotic stresses which affect the physiological, biochemical processes and crop yield parameters that lead to decreased performance of this crop. The crop of green gram during summer in Assam situation faces moisture deficit at various stages of crop growth. Existences of variation in the tolerance level towards moisture deficit and soil acidity among the varieties of different pulse crops have been reported. The present study was carried out to evaluate the physiological performance of some green gram genotypes under four different soil moisture regimes. The study was carried out in soil taken in pots under rain out shelter in the stress physiology premises as well as in the laboratory of the Department of Crop Physiology, Assam Agricultural University, Jorhat during the summer season of 2015 with five genotypes of green gram namely Pratap, Pusa-9531, Pant Moong- 5, Pusa-9072 and Pant Moong-4 under four different soil moisture regimes *viz*., soil moisture at field capacity, 15% less than field capacity, 30% less than field capacity and 45% less than field capacity with three replications. The soil moisture regimes were maintained throughout the growing season till the physiological maturity stage of the crop. The crop was sown on 15th February and picking was started from 30th May onwards. The study showed that with decrease in the soil moisture level the various morpho-physiological and biochemical parameters such as leaf area, leaf area index, leaf area duration, relative leaf water content, plant biomass, number of nodules , membrane stability

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index, leaf chlorophyll content and leaf nitrate reductase activity showed a declining trend in all the five genotypes ; however the values of lipid peroxidation, superoxide dismutase activity and leaf proline content registered an increasing trend with decreasing soil moisture level. In the case of yield parameters it was found that, with decrease in soil moisture level there was progressive decline in the values of various yield parameters *viz.,* number of pods per plant, number of seed per pod, thousand seed weight, seed yield per plant and harvest index in all the genotypes tested. The genotypes Pant Moong-5 was found to be the best genotype in terms of various physiological, biochemical and yield parameters like leaf area, leaf area index, leaf area duration, relative leaf water content, plant biomass, root surface area, number of nodules per plant, membrane stability index, chlorophyll content, in-vivo leaf nitrate reductase activity, superoxide dismutase activity, number of pods per plant, number of seed per pod, seed yield, and harvest index. With the lowest level of soil moisture i.e. 45% less than field capacity the genotypes Pant Moong-5 recorded the lowest per cent reduction in various parameters *viz.*, leaf area, leaf area duration, chlorophyll content, nitrate reductase activity, number of pods per plant and number of seeds per pod, thousand seed weight, seed yield and harvest index, as compared to that with soil moisture at field capacity. The better performing genotype Pant Moong-5 also accumulated higher levels of proline and showed higher superoxide dismutase activity under moisture deficit condition compared to at a soil moisture content of field capacity. The genotype pant Moong-5 registered a per cent reduction of only 25.85% in seed yield at a soil moisture content of 45% less than the field capacity compared to that with soil moisture content at field capacity which was considerably lower as compared to the rest of the genotypes.

Interaction of *Beauveria bassiana* (Bals.) Vuill. on haemocytes of *Periplaneta americana* (L.)

Abhilisa Mudoi

Pathogenicity test of three strains of *Beauveria bassiana* (Bals.) Vuill. on instars and adults of *Periplaneta americana* (L.) (Blattodea: Blattidae) were carried out in the Physiology Laboratory, Department of Entomology, Assam Agricultural University, Jorhat during 2014-2016. There were five instars; the mean body length and width of ootheca, 1st, 2nd, 3rd, 4th, 5th instars and adults were found to be 7.98×3.95 mm, 4.14×1.89 mm, 9.77×2.67 mm, 15.60×4.44 mm, 23.43×6.67 mm, 30.79×8.78 mm and 34.48×14.05 mm respectively. The developmental period of instars and adult longevity were found to be 170.16 and 94.09 days respectively. Among the three strains, KR855715 showed the promising result at 1×10^7 conidia/ml in terms of its biological parameters and mortality against *P. americana*. Mortality revealed that the 1st and 2nd instars were more susceptible to *B. bassiana* (KR855715) and showed 100 per cent mortality on 2nd and 3rd days after treatment (DAT) respectively. The histopathology of *B. bassiana* infecting *P. americana* suggested that the surface of the insect was totally distorted and mycelial network of the fungus was clearly visible under SEM. The Total Haemocyte Count (THC) of 1st, 2nd, 3rd, 4th, 5th instars and adults of *P. americana* varied between 3495 to 3535, 4185 to 4210, 6005 to 6120, 7405 to 7580, 9075 to 9285 and 12535 to 12725/mm^3 respectively. In 1st instars, THC decreased significantly after 6 hours of treatment. Whereas THC of 2nd, 3rd, 4th, 5th instars adults decreased significantly after 24 hours of treatment. The population and morphology of Prohaemocytes (PRs), Plasmatocytes (PLs), Granulocytes (GRs) and Spherulocytes (SPs) were also affected. Molecular characterization of gut bacteria of *P. americana* was also carried out with Ultra Clean Microbial DNA Isolation Kit (Mo Bio Laboratories) and four bacterias *viz.*, *Acinetobacter junii* from hindgut, *Pseudomonas mosselli* from gastric caeca, *Aeromonas hydrophila* from malpighian tubules and *Paenibacillus lautus* from midgut were identified. Inhibitory effects of *B. bassiana* against the gut bacteria were also observed. The study revealed that *B. bassiana* is highly pathogenic to *P. americana* which could overcome the defense responses resulting in death of the insect.

Pollinator diversity and effect of Apis cerana F. pollination on yield of mango, *Mangifera indica* L.

Anuradha Deuri

Investigations on the diversity of insect foragers and the effect of *Apis cerana* F. pollination on mango was carried out at the Experimental Farm, Department of Horticulture of Assam Agricultural University, Jorhat during summer season of 2015 and 2016. The treatments consisted of pollinator exclusion (PE), open pollination (OP), bee pollination 1 (BP_1) @ 3 hives/ha, bee pollination 2 (BP_2) @ 5 hives/ha and bee pollination 3 (BP_3) @ 7 hives/ha. Among the different insect foragers of mango, *Apis cerana* was the most dominant forager comprising 46.66 % followed by *Apis mellifera* (8.00%), *Apis florea* (7.00%), *Vespa magnifica* (8.00%), *Musca domestica* (6.00%), *Episyrphous balteatus* (8.00%) and *Chrysomya megacephala* (6.66%). Besides these, other insect foragers which were found in less numbers were *Coccinella septumpunctata (5.00%), Oecophylla smargdina (3.33%), Pieris rapae* (2.66%) and *Papilio demoleus* (1.33%). The study on foraging behavior of *Apis cerana* revealed that 0900-1000 hours was the peak period of visit by *A. cerana* on mango flower. The number of *Apis cerana* visit per square meter per minute was recorded to be maximum (09.75±0.25) during 0900-1000 hours and minimum (01.90±0.16) during 1300-1400 hours. The number of flower visit per minute was found to be maximum (11.64±0.23) in between 0900-1000 hours and minimum was (03.49±0.06) per minute at 1300-1400 hours of the day. The maximum time spent per flower was recorded to be (06.81±0.07) seconds during 0900-1000 hours while the minimum was found to be (04.13±0.08) seconds during 1300-1400 hours of the day.

The fruit setting and yield of mango crop was found to be higher in *Apis cerana* pollinated treatments over OP and PE. The highest per cent of fruit set was recorded in BP_3 (42.29%) and the lowest was in PE (31.03%). Significant differences were found in all the bee pollinated treatments. The maximum yield was recorded in BP_3 treatment (84.75q/ha) followed by BP_2 (78.37q/ha), BP_1 (75.34q/ha) and lowest in PE (58.18q/ha) treatments respectively.

The various meteorological factors *viz.* bright sunshine hours, temperature, rainfall and relative humidity influenced the foraging activities of *Apis cerana*. Bright sunshine hours and temperature showed positive correlation with foraging behavior of *Apis cerana*. On the other hand, rainfall and relative humidity showed negative correlation with foraging behavior of *Apis cerana*.

Development of bio-intensive IPM module against insect pests of rice

Binita Borah

Field experiment were carried out carried out in ICR (Instructional cum Research) Farm during *Sali* and *Ahu* season 2016-2017.

Incidence of major pest stem borer, leaf folder, caseworm, whorl maggot and gundhi bug and their natural enemies *viz.,* coccinellid, spiders, and dragonfly/damselfly were recorded throughout the crop growth period. However, the stem borer, leaf folder, caseworm, whorl maggot and gundhi bug were more prominent during *Sali* season, 2016 and stem borer, leaf folder, caseworm, whorl maggot and gundhi bug were prominent during *Ahu* season, 2017. Among all the pests, the stem borer was most dominant (6.16% DH) and leaf folder was least dominant (3.93%) at early stage of crop during *Sali* season, 2016 whereas, during Ahu season, 2017 the whorl maggot was most dominant (9.76%).The correlation study revealed that the infestation of different pests and their natural enemies was influenced by the weather parameters in both the years. Correlation studies during *Sali*, 2016 revealed that infestation of stem borer had significant negative relation with Tmax (r= -742) and significant positive relation with RH (mor) (r =0.795). The infestation of leaf folder had significant negative relation with Tmin (r =-0.804), RD (r =-0.499), RH (mor) (r =-0.760); and the infestation of caseworm had significant negative relation with Tmin (r =-0.848), RD (r=-0.535); whereas it showed significant positive correlation with RH (mor) (r =+0.709). Gundhi bug had significant negative relation with Tmax (r =-0.775), with Tmin (r=-0.930). Correlation studies during the *Ahu* season, 2017 showed that the infestation of whorl maggots had significant positive relation with Tmax (r =+0.741) and Tmin (r =+0.972) and the infestation of stem borer had significant positive relation with Tmax (r =0.726) and Tmin(r =0.942) and no significant relation was found between gundhi bug and meteorological parameters during *Ahu*, 2017.

Out of the eight treatment tested, the treatment combinaton of *Beauveria bassiana* WP @ 10gm/lit along with sub-lethal dose of chlorpyriphos 20EC @ 1ml/lit was found to be most effective in reducing the infestation of stem borer, leaf folder,case worm and whorl maggot during during *Sali* and *Ahu* 2016-2017.

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Bioassay of some plant oils against white grub, *Lepidiota mansueta* (Coleoptera: Scarabaeidae) and Termite, *Odontotermes obesus* (Isoptera: Termitidae)

Diksha Dutta

A laboratory experiment was carried out in the Department of Entomology, Assam Agricultural University, Jorhat during 2015-16, to determine LC_{50} and relative toxicity against white grub *Lepidiota mansueta* and termite *Odontotermes obesus*. Observation made during the present investigations revealed that among the plant oils neem oil was found to be most effective with highest mortality of 62.88, 71.90 and 80.35% after 24, 48 and 72 hours at 10.00%, respectively. Followed by *karanj* oil (50.03%) at 24 hours, (65.26%)at 48 hours and at 72 hours (76.70%) at 10.00%. For jatropha oil, highest mortality was recorded as 56.10, 67.65 and 77.50% after 24, 48 and 72 hours at 12.00%, respectively. The results also revealed that per cent mortality of white grubs increased gradually with increase in concentration as well as exposure period. The order of toxicity to *L. mansueta* with respect to LC_{50} values chlorpyriphos (0.608) > neem oil (6.911) > *karanj* oil (9.108) > jatropha oil (11.621) after 24 hours, chlorpyriphos (0.368) > neem oil (4.524) > *karanj* oil (5.995) > jatropha oil (8.300) after 48 hours and chlorpyriphos (0.257) > neem oil (2.484) > *karanj* oil (4.426) > jatropha oil (5.000). A unit value (1.00) was assigned to chlorpyriphos to evaluate the relative toxicity. The comparison of relative toxicity revealed that neem, *karanj* and jatropha oil were 0.088, 0.066 and 0.052 times less toxic than chlorpyriphos when exposed for a period of 24 hours, for 48 hours it was 0.081, 0.061, 0.044 times less toxic and 0.103,0.058, 0.051 times less toxic for period of 72 hours. The order of relative toxicity was chlorpyriphos > neem oil > *karanj* oil > jatropha oil for the exposure period of 24, 48 and 72 hours.

Similarly, the data on mortality of *Odontotermes obesus* revealed that among the plant oils neem oil was found to be most effective with highest mortality of 61.02, 72.55 and 83.35% after 24, 48 and 72 hour at 2.00% respectively followed by *karanj* oil with highest mortality (58.35%) at 24 hours, (62.87%) at 48 hours and at 72 hours (70.05%) at 2.50%. For jatropha oil, highest mortality was recorded as 50.03, 67.66 and 71.92% after 24, 48 and

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72 hours at 4.00%, respectively. The results also revealed that per cent mortality of termites was increased gradually with increase in concentrations as well as exposure period. The order of toxicity of plant oils against *O. obesus* with respect to LC_{50} values chlorpyriphos (0.031) > neem oil (1.296) > *karanj* oil (1.933) > jatropha oil (4.054) after 24 hours, chlorpyriphos (0.020) > neem oil (0.627) > *karanj* oil (1.426) > jatropha oil (2.986) after 48 hours and chlorpyriphos (0.016) > neem oil (0.241) > *karanj* oil (0.636) > jatropha oil (2.130) after 72 hours. A unit value (1.00) was assigned to chlorpyriphos to evaluate the relative toxicity. The comparison of relative toxicity revealed that neem, *karanj* and jatropha oil were 0.016, 0.023 and 0.007 times less toxic than chlorpyriphos when exposed for a period of 24 hours, for 48 hours 0.032, 0.014, 0.006 times less toxic and 0.066, 0.025, 0.007 times less toxic for period of 72 hours. The order of relative toxicity was chlorpyriphos > neem oil > *karanj* oil > jatropha oil for the exposure period of 24, 48 and 72 hours.

Population dynamics of aphids and their role in incidence on viral diseases of potato, *Solanum tuberosum* L.

Dipendu Debbarma

Field and laboratory investigations were carried out to know the population dynamics of potato aphids and their role in disseminating viral diseases at Assam Agricultural University, Jorhat during 2016-17. Experimental results delineates the presence of only one species of aphid (*Myzus persicae* Sulzer) and found active from 2nd week of December, 2016 to 1st fortnight of February, 2017. The lowest (0.19 / leaf) and highest (2.56 / leaf) population of *M. persicae* was recorded on 15th December, 2016 and on 26th January, 2017, respectively. Correlation studies between weekly mean population of aphids / leaf and different meteorological parameters registered significant negative correlation with the morning (r=-0.843) and evening (r=-0.673) relative humidity. However, other meteorological parameters *viz.,* maximum and minimum temperature, total rainfall and BSSH were found to be non significant.

Altogether eight different species of coccinellids *viz.*, *Mecraspis discolor* (Fab.), *Cheilomenes sexmaculata* (Fab.)*, Coccinella transversalis* (Fab.)*, Coccinella septempunctata* L.*, Brumoides suturalis* (Fab.)*, Propylea* sp.*, Harmonia dimidiata* (Fab.) and *Coelophora saucia* (Mulsant) and one species of spider (*Neoscona* sp.) were recorded during the course of the study. The maximum population of coccinellids (0.32/plant) coincided with the peak aphid population (2.56/leaf). Correlation studies of *M. persicae* with their aforementioned natural enemies revealed a highly significant positive relationship. Significant negative correlation with morning relative humidity was registered for both cocinellids (r=-0.734) and spider (r=-0.809) population. However, other meteorological parameters *viz.,* maximum and minimum temperature, total rainfall and BSSH were found to be non significant.

The first incidence of viral disease was observed after 42 days of sowing of potato and the maximum disease incidence (28.39%) was recorded on 2nd week of February,

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2017. Altogether ten alternate hosts of *M. persicae viz., Melastoma melabathricum* L., *Mikania micrantha* Kunth*, Chromolaena odorata* L., *Ageratum houstonianum* Mill., *Solanum nigrum* L., *Hibiscus rosa-sinensis* L., *Lycopersicon esculentum* Mill., *Capsicum annum* L., *Solanum melongena* L. and *Spilanthes calva* DC. were recorded from the vicinity of the experimental plots. Out of these, potato leaf roll virus was detected only in *Melastoma melabathricum* L. besides potato leaves and *M. persicae.*

Population dynamics and management of insect pest of tomato, *Solanum lycopersicum* L

Harshita A. P.

Field experiments on pest and natural enemy complex and management of insect pest of tomato, *Solanum lycopersicum* L. were carried out at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat, during 2015-16 and 2016-17, respectively.

A total number of three species under two orders and three families were recorded as pests and three species of predator under order coleoptera were recorded as natural enemies during the period of investigation. *Helicoverpa armigera*, *Aphis gossypii* and *Bemisia tabaci* were found as major pests of tomato and among them *A. gossypii* was found to be the most dominant sucking pest. It reached its peak (9.4 and 9.1/leaf) during March and first fort night of February during 2015-16 and 2016 -17, respectively. The maximum population of whitefly (6.30/leaf) was observed during March, 2016 and (6.20/leaf) was observed during last week of February, 2017. The peak infestation by of *H. armigera* (6.06 and 6.30/plant) was recorded during March in 2015-16 and 2016-17, respectively. *Coccinella transversalis* F. and *Micraspis discolor* (F.) were the most dominant species observed throughout the cropping season. The maximum number of coccinellid (2.7 and 2.7/plant) was observed during March, 2016 and February, 2017, respectively.

All the insect population showed a significant negative correlation with average relative humidity and positive correlation with maximum temperature, total rainfall during both the seasons and as regards to coccinellid predators, it showed a significant negative correlation with average relative humidity and a non-significant positive correlation with maximum temperature and also showed a positive significant correlation with aphid population during 2015-16 and 2016-17, respectively. All the treatments tested against pests of tomato gave effective control and increased yield over untreated control. Spinosad @ 0.3 ml/litre was graded as most effective treatment in reducing *H. armigera* and *B. tabaci* population but it was second best treatment, next to Azadirachtin @ 5 ml/litre in case of *A. gossypii*. However, in case of white fly, next to spinosad @ 0.3ml per litre, Azadirachtin @ 5 ml/litre found to be the promising one followed by *Beauveria bassiana* @ 5 ml/lit in reducing whitely population. The treatment Spinosad gave highest cost benefit ratio (1:1.46) followed by Azadirachtin (1:1.39), *B. bassiana* (1:1.35), respectively.

Effect of different artificial food on the growth and development of honeybee, Apis cerana (Hymenoptera : Apidae)

Hemi Borah

Experiment was conducted during 2016 in the Apiary and Apiculture Laboratory, Department of Entomology, AAU, Jorhat to see the "Effect of different artificial food on the growth and development of honeybee, *Apis cerana* (Hymenoptera: Apidae)". It was found that the colony strength was found to be maximum (6.50±0.36) and (7.25±0.26) in the treatment 5 (Soybean flour + Sugar solution + Yeast + Vitamins) and lowest was found to be (5.57±0.58) and (6.30±0.82) at treatment 7 that is sugar solution (Control) after 7 and 15 days respectively. The highest egg area (20.22±1.79cm²) and (24.54±1.43cm²) was observed in the treatment 5 and lowest was found to be (16.26±1.97cm²) and (20.32±1.16cm²) at treatment 7 after 7 and 15 days respectively. Likewise, the maximum larval area (17.19±1.68cm²) and (20.35±0.85cm²) was observed in the treatment 5 and minimum was found to be (11.45±0.42cm²) and (13.39±1.51cm²) at treatment 7 after 7 and 15 days respectively. And the highest pupal area (17.62±1.10cm²) and (24.34±0.58cm²) was observed in the treatment 5 and lowest was found to be (11.24±0.57cm²) and (18.22±1.13cm²) at treatment 7 after 7 and 15 days respectively.

The maximum pollen area was observed after 7 days (9.32±2.09 cm²) and 15 days (14.49±1.12cm²) in treatment 5 and lowest was found to be (5.48±1.43cm²) after 7 and (8.23±0.99cm²) after 15 days at treatment 7. The highest honey hoarding was observed after 7 days and 15 days of treatment in treatment 5 are (15.10±0.57cm²) and (22.97±1.09cm²) and lowest was found to be (10.96±0.04cm²) and (15.40±0.24cm²) at treatment 7 respectively.

The highest length of larvae was observed (0.67±0.02cm) after 5 days of treatment in treatment 5 and lowest was found to be (0.50±0.10cm) at treatment 7. The maximum breadth of larvae was observed (0.35±0.04cm) after 5 days of treatment in treatment 5 and lowest was found to be (0.28±0.10cm) at treatment 7. The highest weight of larvae (0.33±0.02gm) was also observed in treatment 5 after 5 days of treatment and lowest was

found to be (0.27±0.02gm) at treatment 7. The maximum length of pupae (1.00±0.06cm) was observed after 12 days of treatment in treatment 5 and minimum was found to be (0.88±0.06cm) at treatment 7. The highest breadth of pupae (0.46±0.06cm) was observed after 12 days of treatment in treatment 5 and lowest was found to be (0.39±0.06cm) at treatment 7. Likewise, the highest weight of pupae (0.36±0.03gm) was observed after 12 days of treatment in treatment 5 and lowest was found to be (0.30±0.02gm) at treatment 7.

The enemies occurred in the colonies during the year were wasps, waxmoth, ants, lizard and cockroach. The diseases found in the colonies during observation were Thaisac brood and Nosema. The lowest larval mortality was observed (0.10±1.00%) after 5 days of treatment in treatment 5 and 3 and highest (0.67±0.58%) was found at treatment 7. The minimum pupal mortality (1.26±1.15%) and (0.23±1.00%) was observed in treatment 5 and maximum was found to be (1.67±1.00%) and (0.59±1.15%) at treatment 7 after 7 and 12 days of treatment respectively. However lowest adult mortality was observed (1.33±0.58%) and (0.56±0.58%) after 7 and 15 days of treatment in treatment 5 and highest was found to be (1.67±1.15%) and (0.67±0.58%) at treatment 7 respectively.

The various meteorological factors *viz.* temperature, relative humidity and rainfall influenced the brood area, weight of larvae and pupae. Maximum temperature and maximum relative humidity showed positive correlation with brood area, weight of larvae and pupae. On the other hand, minimum temperature, minimum relative humidity and rainfall showed negative correlation with brood area, weight of larvae and pupae.

Intraguild predation and interaction between *Coccinella transversalis* and *Coccinella septempunctata* on Eggplant

Mohsin Musaddik Rohman

The experiment on Intraguild predation and interaction between *Coccinellatransversalis*and *Coccinellaseptempunctata* were carried out during 2015-2017 at Experimental Farm, Deptt. ofHorticulture and the laboratory, Deptt. ofEntomology, Assam Agricultural University, Jorhat.

Two species of aphid *viz.*, *Aphis gossypii* and *Myzuspersicae*andsix species of coccinelliid predators *viz.*, *C.transversalis, C.septempunctata,Cheilomonassexmaculata, Harmoniadimidiata, Brumoidessuturalis*and*Micraspis discolor* were collected and identified from eggplant. The *A.gossypii*(36.04%) was comparatively more abundant on eggplant than *M.persicae* (17.04%) at field and*A.gossypii* was found throughout the cropping season. Among the coccinellid predators, *C.transversalis* and *C.septempunctata*were most dominant with their relaive abundance 1.12% and 0.99%, respectively. Besides aphids, five other insect pests *viz.,Bemisiatabaci, Leucinodesorbonalis, Amrascabiguttulabiguttula, Henosepilachnavigintioctopunctata* and *Monoleptasignata*were found to infest egg plant during 2015-2017. The coccinellid predators plays important role in control of aphids population. When observed the intraguild predation between dominant predator *C.transversalis* and *C.septempunctata* in presence of extra guild prey *A.gossypii*, it was found that the mean consumption of *A. gossypii* by a single *C. transversalis*3rd instar and 4th instar grub were 48.10±1.83 and 77.75±2.43, respectively. While, the mean consumption of *A. gossypii* by a single *C. septempunctata*, 3rd instar and 4th instar grub were 47.80±1.60 and 69.95±1.63, respectively. When both the predator were released together in different combinations like *C.transversalis*(4th)×*C. septempunctata*(4th), *C. transversalis*(4th)× *C. septempunctata*(3rd), *C.transversalis*(3rd)×*C. septempunctata*(4th) and*C. transversalis*(3rd)×*C.septempunctata*(3rd) and their consumption were 91.55±0.81, 84.73±0.83, 83.88±0.72 and 72.006±0.81, respectively. The combined effect of these two predators was assessed by Multiplicative Risk Model and it was found that in all combinations,

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the observed consumption was significantly lower than the expected consumption, except in case of of*C. transversalis*(3rd)×*C. transversalis*(3rd) instar.This indicated that in lower instars for food competition was less in comparison to higher instars. When different instars of *C. septempunctata*were combined together in all cases the expected consumption was always significantly higher than the observed consumption. This indicated that there was some harmful or intraspecific effect among the different instars of C.*septempunctata*, when consumed prey. When both the predators released together in different combinations, the expected consumption of combination of both the predators was significantly higher than the observed consumption and it indicated the antagonistic effect of both the predators in presence of sufficient*A. gossypii*population.When observedintra and interspecific interaction between both the predators in presence of sufficient *A. gossypii*, there was no cannibalism in both the species.But in absence of*A. gossypii,C.septempunctata*, showed highest intraspecific cannibalism(53.30%) among 3rd and 4thinstar and lowest (13.33%) was observed in between *C. transversalis*(4th)×*C. transversalis*(4th). The interspecific interaction in absence of aphids, *C. septempunctata*(4thinstar)cannibalised maximum(35%) on *C. transversalis* (3rd) and lowest(10%) was registered by *C. transversalis*(3rd) on *C. septempunctata*(3rd) instar. Adults of both the species cannibalised 100% of conspecific and heterospecific grub in absence of aphid.As the experiment was done on petri dish and both the predators showed antagonistic effect, thus it is recommended not to release these two coccinellid predators together in protected cultivations and the experiment should be repeated in potted plants and open field conditions.

Prey searching behaviour of Aphidophagous predator, *Macrolophus pygmaeus* Rambur (Miridae: Hemiptera) on tomato plant

Nomi Sarmah

The laboratory experiment on 'Prey searching behaviour of aphidophagous predator , *Macrolophus pygmaeus* Rambur (Miridae: Hemiptera) on tomato plant' was carried out at the laboratory of Agricultural Zoology and Entomology division, Agricultural University of Athens, Athens, Greece during 2015-16,to study the prey searching behaviour *M. pygmaeus* by using *Ephestia kuehniella* eggs and *Myzus persicae* as prey and placing preys on different leaflets and leaflet combinations. This behaviour was also observed by placing predators on different release points, which was further correlated with leaf surface area and trichome density

When *E. kuehniella* eggs were offered on the different leaflet of tomato and 5th instar *M. pygmaeus* were allowed to feed on it, the highest consumption was recorded on the leaflet A (8.55 no./predator), which was closer to the release point of the predator. Out of the three consumption categories, sucked, half sucked, and ruined, the sucked numbers of eggs were highest on the leaflet A (6.10 no./predator). When 2nd instar nymph of *M. persicae* was placed on the leaflet combination *viz.,* AB, AC, BC, DC, it was found that the number of prey consumption was highest on AB (10.60 no./predator) followed by AC (9.40 no./predator) and BC (9.20 no./predator) without differing to each other. In DC combination the consumption was significantly low (7.10) in comparison to the AB combination. The factor "leaf position" was found to have a significant effect in the prey consumption of the predator. The prey consumption was highest on the lower leaves followed by the middle and the top leaves i.e. 10.85, 10.20, 8.9 numbers respectively and among them there was no significant differences. However, significantly lower prey consumption (7.10) was recorded on the apex leaves. The leaf surface area was significantly higher (104.48 cm^2) on the lower leaves as compared to the middle, top and apex leaves. There was no significant difference between the leaf surface area of top and the apex leaves but consumption was significantly lower in apex leaves. The trichome density had significant effect on prey

searching behaviour of *M. Pygmaeus*. The number of trichomes was significantly higher on the under and upper surface of apex leaves i.e. 783.75 and 409.50 from 0.5 cm² area, respectively, in comparison to other leaves and the consumption of *M. Persicae* was also significantly low (7.00 no./predator) on apex leaf. But, in without leaf experiment, it was found that the highest consumption (13.00 no./predator)was on the apex leaves position. The predator released point had significant effect on the prey searching of *M. pygmaeus*. When the distance of released point from prey patch was less (2.80cm), the consumption was highest (9.80). The interplay position of the prey and predator had no significant effect in the consumption of *M. persicae* by *M. pygmaeus* and the predator did not prefer any particular direction and hence the predator *M. pygmaeus* can be released in any part of the plant.

Carabid complex of horticultural orchards

Phunu Mili

The work on 'Carabid complex of horticultural orchards' was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat-13, during the year 2014-2015 and 2015-16 to give a comprehensive information of carabids found in horticultural crops. Carabids were collected by pitfall trap, light trap, sweep net and hand picking from okra, brinjal, cabbage, cucumber, bean, gladiolus, gerbera, banana and citrus. Total 23 species of carabids belonging to 12 genera *viz., Clivina, Scarites, Harpalus, Cicindela, Tanystoma, Calosoma, Drypta, Panagaeus, Pherosophus, Pterostichus, Chlaenius,* and *Sparostes* under 11 tribes- Clivinini, Scaritini, Harpalini, Cicindelini, Platynini, Carabini, Dryptini, Panagaeini, Brachinini, Pterostichini and Chlaeniini and 9 subfamily (Scaritinae, Harpalinae, Cicindelidae, Platyninae, Carabinae, Dryptinae, Brachininae, Pterostichinae and Licininae) were identified by following published Keys and literature and described on the basis of observed morphological characters. Among these species, 6 under genus *Chlaenius viz., C. bimaculatus, C. sericeus, C. tricolor, C. vestitus, C. aestivus* and *C. hamifer,* 3 under *Clivina viz., C. assamensis, C. memnonia, C. lobata* and 2 under *Scarites, Harpalus, Cicindela* and *Pherosophus* each *viz., S. indus, S. inconspicuous, H. rufipes, H. calceatus, C. sexpunctata, C. assamensis, P. occipitalis* and *Pherosophus* sp. From *Tanystoma, Calosoma, Drypta, Pterostichus, Sparostes* and *Panagaeus,* there was one species of each genus *viz., Tanystoma* sp., *Calosoma orientale, Drypta lineola, Pterostichus madidus, Sparostes striatulus* and *Panagaeus cruxmajor.* Highest collection of carabids were obtained from pitfall trap (46%) followed by light trap (42%). Total 420 numbers of carabids were collected from Jan-Dec, 2015. The species richness, species diversity and species evenness were highest in okra (2.918, 2.782 and 1.054, respectively). Among all the species, *S. indus, C. assamensis* and *S. inconspicuous* were relatively more abundant species. The present study may help in proper identification of different carabid species of Assam for future studies and the dominant species can be incorporated in future Integrated Pest Management programme as natural pest control agent.

Effect of botanicals on the growth and development of *Callosobruchus chinensis* (L) (Coleoptera: Bruchidae) and its damage

Ramya HR

Pulse beetle, *Callosobruchus chinensis* (L) is one of the most important destructive coleopteran storage insect-pests. Management of theses insects are very important for reducing the post harvest losses of Pulses. The present investigation was carried out to study the effect of botanical oils on the growth and development of *Callosobruchus chinensis* (L.) and its damage. Commercially available oils of Neem, Karanj, Castor, Mustard and Sunflower were collected from the local market. Three dosages viz., 3.0m1/kg of five botanical oils were taken in order to test efficacy of oils on growth and development and the infestation caused by *C. chinensis*. Observation were taken on the oviposition, developmental period, adult emergence, per cent adult emergence, growth index, adult weight of male and femal, per cent weight loss, per cent damage and per cent germination of treated seeds. The results revealed that among the different treatments the lowest fecundity were observed in the Sunflower oil (45.33, 37.00, 29.33) at all three dosagaes. The parameters like developmental period, adult emergence, growth index, weight of male and female adults were also effected in neem oil treated seeds and these were followed by Karanj, Castor, Mustard and Sunflower oil. The result revealed that there was a significant difference among the treatment. The lowest per cent weight loss was recorded in Neem oil treatment at all three dosages i.e., 2.36, 0.41 and 0.16 followed by karanj oil (2.73, 0.91 and 0.58), Castor oil (3.33, 1.83 and 1.33), Mustrad oil (4.56, 2.66 and 1.53) and Sunflower oil (4.90, 2.93 and 2.36). Neem oil at all three dosages was also found to be effective with lowest per cent damage (10.66, 2.33 and 1.00) on green gram seeds followed by Karanj oil (13.00, 4.33 and 2.00), Castor oil (14.66 5.66 and 3.50) Mustard oil (17.33, 12.00 and 6.00) and Sunflower oil (89.99), Karanj oil and Sunflower oil with 88.88 followed by Castor and Mustrad oil with 83.33 the present study revealed that Neem, Karanj, Castor, Mustard and Sunflower oils had various degree of efficacy on the growth and development of *Callosobruchus chinensis* and its damage.

Responses of Tribolium castaneum (Herbst) and Callosobruch chinesis (L.) to color cues

Shelja Pegu

It has been estimated that between one quarter and one third of the world grain crop is lost each year during storage. Much of this is due to insect attack. Red flour beetle, *Tribolium castaneum* (Herbst) and Pulse beetle, *Callosobruchus chinensis* (L.) are two of the most destructive coleopteran storage insect-pests. Management of these insects are very important for reducing the post harvest loss of cereals and pulses.

The present study was carried out to study the colour preference of *T. castaneum* and *C. chinensis* in store. The colour cues used were Red, Green, Yellow, Indigo, Orange, Blue, Violet and Transparent as control. The result showed that in multi-choice colour cue preference test of *T. castaneum* at 24, 48 and 72 hours after release preferences were highest in Violet (13.07 to 13.80%), while preferences were lowest in Green (1.80 to 2.13%). In multi-choice test of *T. castaneum* male preference was highest in Indigo (5.40 and 5.60%) at 24 and 48 hours after release and Violet (6.47%) at 72 hours after release. Similarly female was highest in Violet (7.33 to 8.20%) across different time intervals. Green (1.13 to 1.27% and 0.60 to 1.00%) was the least preferred for both male and female across different time intervals. The sex ratio (male: female) of *T. castaneum* migrated to different colour cues showed that migration of female was highest towards Violet (1:1.45 and 1:1.54) and was lowest towards Green (1:0.50 and 1:0.63) at 24 and 48 hours after release, while at 72 hours after release migration was highest towards Red (1:1.50) and was lowest towards Control (Transparent) (1:0.52). In single-choice colour cue preference test of *T. castaneum* Violet (24.07%) was found to be the highest preferred colour cue at 24 hours after release, while at 48 and 72 hours after release Indigo (25.20% and 25.80%) was found to be highest. Green (14.53 to 15.87%) was the least preferred colour cue across different time intervals. In single-choice test of *T. castaneum* male preference was highest in Indigo (12.00 and 15.47%) at 24 and 72 hours after release and Violet (14.87%) at 48 hours after release. Similarly female was highest in Violet (12.80%) at 24 hours after release and Blue (12.47 and 12.87%) at 48 and 72 hours after release. Green (7.73 to

9.27% and 6.27 to 7.13%) was the least preferred for both male and female across different time intervals. The sex ratio (male: female) of *T. castaneum* migrated to different colour cues showed that migration of female was highest towards Blue (1:1.28 to 1:1.50) across different time intervals and at 24 hours after release migration was lowest towards Yellow (1:0.87) and Indigo (1:0.87), while at 48 and 72 hours after release migration was lowest towards Violet (1:0.66) and Indigo (1:0.66).

In multi-choice colour cue preference test of *C. chinensis* across different time intervals preferences were highest in Indigo (14.47 to 16.47%), while preferences were lowest in Red (4.00 to 4.93%). In multi-choice test of *C. chinensis* male preference was highest in Indigo (6.67 to 7.73%) across different time intervals. Similarly female was highest in Violet (8.67 to 9.73%), while Red (1.93 to 2.07% and 2.07 to 2.87%) was the least preferred for both male and female across different time intervals. The sex ratio (male: female) of *C. chinensis* migrated to different colour cues showed that migration of female was highest towards Violet (1:2.03 to 1:2.05), while migration was lowest towards Orange (1:0.38 to 1:0.51) across different time intervals. In single-choice test of *C. chinensis* across different time intervals preferences were highest in Indigo (25.73 to 27.67%), while preferences were lowest in Red (12.80 to 14.33%). In single-choice test of *C. chinensis* male preference was highest in Violet (13.07 to 13.93%) across different time intervals. Similarly female was highest in Indigo (13.67 to 14.80%), while Red (5.93 to 6.73% and 6.87 to 7.60%) was the least preferred for both male and female across different time intervals. The sex ratio (male: female) of *C. chinensis* migrated to different colour cues showed that migration of female was highest towards Blue (1:1.49 to 1:1.50), while migration was lowest towards Orange (1:0.87 to 1:0.88) across different time intervals.

The present study revealed that *T. castaneum* and *C. chinensis* reacted differently to different colour cues during the storage of wheat and greengr.

A study on the training needs of village level extension functionaries of land based govt. departments in UBVZ of Assam

Ahmad Shah Qaderi

Training is an important process of capacity building of individuals as to improve the performance. Hence, training needs assessment is vital to the training process. It helps to identify present problems and future challenges to be met through training and development. Training need identification is a tool utilized to identify what educational courses or activities should be provided to employees to improve their work productivity.

The present study was conducted in Jorhat, Golaghat and Sivsagar district of Assam. 120 respondents as Village Level Extension Functionaries (VLEFs) were randomly selected which were 40 from each district.

It was observed that majority of the respondent Village Level Extension Functionaries (54.16%) were from Upper middle age group (48 years and above), with majority (55.83%) of respondents falling in Intermediate class of education level and a majority (70%) of respondents having high level of total service experience. In case of job satisfaction, information sources and decision making pattern a majority of the respondents were found to be satisfied with their job which is a great strength for the extension machinery in the respective organizations.

From the research study it was also revealed that a majority of the respondents were devoid of adequate training exposure and subsequently it was found that a large number of sampled Village Level Extension Functionaries were having medium level of training needs.

Age, education, total service experience, job satisfaction, attitude toward extension and sources of information were observed to have significant correlation with the extent of training needs. Further, length of service in present place posting, decision making pattern and training exposure have no significant correlation with the extent of training needs.

Lack of trainings, lack of transportation, lack of proper and timely guidance from higher authorities and lack of travelling allowance were found to be the major constraints among the VLEFs. Adequate and timely arrangement of training programs led by the higher officials along with travelling allowances are suggested for mitigation of the major constraints and for improvement of the job performances.

A study on the information seeking behaviours of commercial winter vegetable growers in Assam

Atrika Mudoi

In agricultural environment, relevant and timely information helps farmers to take right decision to sustain growth of agriculture activity. Information may come to farmers from various sources. The appropriateness of these sources varies from enterprise to enterprise, situation to situation and from time to time. Hence, it becomes quite important to channelize the right information at the right time through the right channel, for which knowledge of different information sources consulted and used by farmers under different situations and at different times is important to know in developing effective extension systems.

The present study was conducted in Barpeta, Darrang and Jorhat district of Assam with a view to find out the information seeking behaviour of commercial winter vegetable growers in Assam. A multistage sampling technique was followed to select 180 respondents. Total 180 respondents were selected for the study. Data was collected by administering structured schedule. Statistical tools employed to analyze the data included frequency distribution, percentage, mean, standard deviation, Karl Pearson's co-efficient of correlation, 't' test, multiple regression analysis and Henry Garrett ranking method.

The study revealed that mean age of the respondents was 42.41 years and 22.22 per cent of the respondents had education up to middle level. Mean land holding of the respondents was 1.34 ha. and 68.33 per cent of the respondents utilised less than 1 ha. of land for the cultivation of winter vegetables. Majority of the respondents (62.78 %) had 10 – 20 years of experience as winter vegetable cultivators. Majority of the respondents (76.67 %) had medium level of innovativeness characteristic. Majority of the respondents (65.00 %) of the respondents had medium level of economic motivation, medium level of market orientation (66.11%). Majority of the respondents (73.33 %) had medium level of risk orientation capabilities, medium level of mass media exposure (76.11%). Most of the respondents (52.78 %) did not have any membership with any organisation.

The study further revealed that 78.33 per cent of the respondents had medium level of information seeking behaviour. The study also revealed that among various information

sources, agricultural inputs' dealers were consulted more than any other information sources. Satisfaction level on consultation with the inputs dealers was also ranked first. Significant, negative relationship were found between age and experience on winter vegetable cultivation with information seeking behaviour of the respondents. Positive and significant relationship were found with education, experience on winter vegetable cultivation, mass media exposure, change agent contact and organisational participation with information seeking behaviour of the respondents.

Regarding information needs of commercial winter vegetable growers, 61.11 per cent of the respondents highly desired information on ongoing government schemes on vegetable production. About 62.78 per cent of the respondents moderately needed information about customer demand in the vegetable market. Respondents also desired information about irrigation source, methods and government assistance on irrigation, bank schemes on agricultural loans, credit facilities, cold storage facility, ongoing government schemes on vegetable cultivation etc.

Major problems faced by the respondents while seeking information included financial problems to gather information, Non availability of sufficient information sources in close proximity, Unavailability of inputs information, Lack of market related information, Language barrier on information sources, Lack of opportunities to attend agricultural trainings, Psychological hindrances, Lack of leaflets / bulletins on vegetables, Poor communication and transport facilities, etc.

Coping mechanism of small and marginal farmers affected by flood induced sand and silt deposition-a study in Dhemaji district of Assam

Debajani Deori

The present study was conducted in Dhemaji district of Assam to determine the impact of flood induced sand and silt deposition on livelihood of tribal and non tribal small and marginal farmers. The present study also compared the coping mechanisms that tribal and non tribal groups adapted with. Multistage sampling technique with proportional allocation was used for selecting 75 tribal and 75 non tribal respondents. The total size of respondents was 150. Data were collected adopting the personal interview technique administering a structured schedule with open ended questions. Relevant statistical tools were employed to analyze the data.

The study revealed that mean age of tribal respondents was 42.96 years and tribal respondents were 43.09 years. In case of education, majority of non tribal (20.00%) and tribal (21.33%) respondents were illiterate. The study also revealed that mean of non tribal family size was 7.23 and mean of tribal family size was 7.89.In case of annual income, the mean value of non tribal respondents was Rs.63.066.67 and mean value of tribal respondents was Rs.62, 826.67. Moreover the mean area of affected land by sand and silt deposition of non tribal respondents was 0.30 ha and tribal respondents was 0.42 ha.

It was observed that majority of the non tribal (77.33%) and tribal (77.33%) respondents had medium level of impact on agriculture. In case of impact on livestock it was found that majority of the non tribal (58.67%) and tribal (62.67%) respondents had medium level of impact. The majority (68.00%) of the non tribal and tribal respondents had same medium level of impact on housing and household materials. The level of impact on health (76.00%) of tribal respondents was more than non tribal (58.67 %) respondents. The majority of the non tribal (60.00%) and tribal (66.67%) respondents had medium level of psychological impact.

In this present study, several traditional and externally induced coping activities were indentified from both tribal and non tribal groups. It was found that most of the cases coping

activities were different between tribal and non-tribal respondents. However, some traditional systems of tribal farmers were adopted by few non-tribal farmers also. There were some socio-religious changes also taken place in the study area in case of a few numbers of tribal respondents because of the impact of sand and silt deposition on livelihood. It was found that there was a significant positive relationship between gross income and migration level of tribal respondents whereas no significant relation was found between gross income and migration level of non-tribal respondents. The KVK personnel take more initiative to create awareness among the farmers about their successful intervention. The government should take action to provide opportunities to earn more by different activities like weaving, livestock, mixed cropping, etc. for improving the livelihood of affected farmers.

A study on Farmers' adoption of High Yielding Aromatic Rice Varieties developed at RARS, Titabar and their associated practices in Jorhat district of Assam

Dipanjali Saikia

The study entitled "A Study on Farmers' adoption of High Yielding Aromatic Rice varieties developed at RARS, Titabar and their associated practices by the farmers in Jorhat district of Assam was carried out in Jorhat district of Assam, following Ex-Post-Facto research design with a view to examining the extent of adoption of high yielding aromatic rice varieties and their associated practices. The study covered the location specific high yielding aromatic rice varieties developed by Regional Agricultural Research Station, Titabar.

A total of 120 respondents were selected by using multistage purposive cum random sampling technique for the study. Age, education, family type, annual income, operational land holding, extension contact, mass media exposure, social participation, risk preference and economic motivation were the selected independent variables and the dependent variable was extent of adoption for the study. The data were collected by means of personal interview schedule during 25th Jan, 2017- 3rd March, 2017. Frequency, percentage, mean, Standard deviation, chi-square, Karl Pearson's product moment coefficient of correlation, Multiple Regression and 't'-test were the statistical techniques used for the analysis of data.

The findings of the study revealed that the majority (42.5%) of the respondents belonged to the age category of 35-50 years and educated up to middle school level (30.83%) with nuclear type of family (68.33%) and most of them (52.5%) had marginal operational land holding and 85.83 per cent had medium level of annual income ranging between Rs. 47080.62-113818.5, respectively. Majority of the respondents (69.17%) had medium level of extension contact. Majority of the respondents (64.17%) and (71.67 %) had medium level of mass media exposure and social participation respectively. Regarding risk preference and economic motivation, majority of the respondents (68.34%) and (80%) had medium level of risk preference ability and economic motivation respectively.

The findings of the study revealed that the overall adoption of high yielding aromatic rice varieties and their associated practices was of medium level. The majority (68.33%) of the respondents had medium level of extent of adoption followed by 16.67 per cent of the respondents having high level of extent of adoption of high yielding varieties of aromatic rice and their associated practices. Moreover, 15 per cent of the respondents had low level of extent of adoption of high yielding varieties of aromatic rice and their associated practices. In case of recommended practice wise adoption level, the study revealed that all the respondents (100.00%) fully adopted the recommended varieties, practice of seed selection and sowing time of seed. Majority of the respondents (93.33%) and (73.33%) partially adopted the practices of nursery bed size and quantity of seed respectively. It was observed that, majority of the respondents (86.66%) did not adopted the practice of plant protection measures in seed bed. It was found that majority of the respondents (46.67%) fully adopted the practice of gap filling. Majority of the respondents (72.5%) and (69.17%) fully adopted the practice of number of seedlings per hill and transplanting time respectively. Majority of the respondents (73.33%) and (54.17%) partially adopted the practice of row to row and plant to plant spacing respectively. It was found that majority of the respondents (55.83%) and (50%) fully adopted urea and SSP respectively. Regarding the application of recommended dose of MOP, majority of the respondents (461.67%) partially adopted the practice. It was found that majority of the respondents (82.5%) fully adopted the practice of number of split application of urea. Again, Majority of the respondents (60%) and (66.67%) partially adopted the practices timing and split application of urea respectively. The majority of the respondents (91%) did not adopt the recommended plant protection measure in case of pest control followed by 17.5 per cent of the total respondents partially adopted the plant protection measure and 6.67 per cent of the total respondents fully adopted the plant protection measure. A positive and significant relationship was found between extent of adoption and education, operational land holding, annual income, mass media exposure, extension contact and economic motivation.. The independent variables age, education, family type, annual income, operational land holding, extension contact, mass media exposure, social participation, risk preference and economic motivation fitted into the regression equation could explain together 57.2per cent to the total variation on the extent of adoption of high yielding aromatic rice varieties developed by RARS Titabar. Poor sale price of the product, poor market facility, aroma of the variety lost after 1-2 years, distant market, lack of proper marketing channel, high cost of labour, inadequate irrigation facility, high cost of fertilizer and pesticide, lack of courage in taking risk, threshing problem due to stickiness of the grain, lack of proper storage facility, milling problem due small sized grain were found to be major problems faced by the farmers.

The regulation of remunerative price for the produce, proper marking facilities/ channel and timely availability of good quality inputs would help out to set up the adoption level of high yielding aromatic rice.

A study on learning style of the under-graduate students of Assam Agricultural University, Jorhat

Gitauditya Laishram

The study was conducted at the College of Agriculture (Jorhat) and the College of Home-science (Jorhat) under Assam Agricultural University, Jorhat with a view to study the 'learning style' of the under-graduate students of Assam Agricultural University. Additional studies have also been conducted to know the 'learning skill' and 'critical thinking ability' of the students. Problems faced by the students during the learning process have also been covered. Students of both the colleges were taken as respondents and selected by using a proportionate random sampling design. A total of 226 students were selected for the study. The data were collected by administering structured questionnaires. Relevant statistical tools were employed for analyzing the data collected.

The study revealed that majority (74.34%) of the students was female and 25.66 per cent were male. In academic achievement, 69.91 per cent of the students belonged to the category having CGPA between 7.5 - 8.5. Majority (63.72 %) of the students came from an urban background and 94.69 per cent of the students went to English medium school during their 10+2 level. The study also revealed the proficiency of the students in the medium of instruction where 42.48 per cent were termed as good and 6.19 per cent as poor in it. 37.17 per cent of the students had a second preference for Agriculture as a study area at their higher secondary level with 15.04 per cent having first preference for Agriculture.

The study revealed that the students of Agriculture and Home-science possessed almost the same learning skill. The students of both the colleges 'always' possessed the skill of 'co-operating with others' and 'class-participation', while they 'often' possessed the skill of 'independent work', 'initiative', 'home-work completion in time and effectively', 'problem solving' and 'goal setting to improve work'. The learning style was also found to be similar in both the colleges where 34.07 per cent of the students belonged to 'Reflector' category and 'Activist' (10.19 %) the least. In College of Agriculture, 33.33 per cent of the students belonged to 'Reflector' category, while in case of College of Home-science, 37.50 per cent of the students belonged to 'Reflector' category. In case of critical thinking ability

of the total respondent, more than 2/5th of the students (44.25%) belonged to the phase of being 'competent' in 'analyzing' the information and data. Similarly in 'employing' the formulas and procedure, more than 2/5th of the students (42.04%) belonged to the competent phase. However, in 'integrating' the information from different point of view, 39.82 per cent of the students belonged to 'developing' phase. In 'drawing a conclusion', 33.19 per cent of the students belonged to the 'accomplished' phase. On the other hand, in 'revising the conclusion', 40.71 per cent of the students belonged to the 'developing' phase.

Large syllabus, irregular power supply, more of theoretical oriented curriculum, difficulty in simultaneous use of LCD and blackboard, limited teacher- student interaction, less attention span and least interest of students in study, non audible of some teachers' voice till last bench, lack of frequent field demonstration, less applicability of subject matter to real life were found to be the major problems as perceived by the students.

Pesticides application practices followed by farmers in vegetables- A study in Darrang district of Assam

Goutam Das

Pesticides are widely usedby farmers in crop protection for more production.Different studies reported on theindiscriminate use of pesticides and health hazards faced by the farmers. The present study was carried out to know the pesticides application pattern of farmers and related health risks in vegetable cultivation. The study was conducted in Darrangwhich is one of the major vegetable growing district of Assam.Multistage samplingtechniquewas followedfor the selection of 150 respondents. Data were collected for five selected vegetables such as cabbage, cauliflower, tomato,brinjal and chilli. Data were collectedwith the help of interviewschedule. Relevant statistical tools were employed to analysesthe data.

The study revealed that the mean age of the farmers is 36.89 years.Themajorityof the respondents wereilliterate (44.67 %). The average operational land holding of the intervieweeswas1.32 ha.Theaverage for family size was found as 6.80 nos. The study revealed thatrespondentsused17 different types of insecticides in the selected vegetables.However,those insecticides were not recommended by AAU for that particular vegetable.Among all insecticides,Profenofos 40%+Cypermethrin4%E.C was the most usedinsecticide in vegetables.The study found that respondents usedseven different kinds of fungicides in vegetable crops, Out of whichMancozeb 75% WP was only AAU recommended fungicide applied in tomato. Among allthe fungicides,Mancozeb 75% WP was the most used fungicide in vegetables. Farmers used the pesticides based on their decision or following the advice of the input dealers.A portion of the respondents reported about health hazard due to pesticides application.Few precautionary measures were also adopted by the respondent while handling of pesticides. From the study, it is revealed that in farmers' field a different set of pesticides dominated over Assam Agricultural University recommended insecticide. The study suggests that efficacy of all the pesticides should be tested based on a sample collected from the field. Farmers should be trained to use right types of pesticides in the vegetable.

A study on extent of adoption of high yielding varieties of glutinous rice developed at RARS, AAU, Titabar in Jorhat district of Assam

Hejbina Mehjabin Hussain

The study entitled "A study on extent of adoption of high yielding varieties of glutinous rice developed at RARS, AAU, Titabar in Jorhat district of Assam"was undertaken to examine the extent of adoption of high yielding glutinous rice varieties and the recommended package of practices by the farmers in Jorhat district. For the present study those high yielding glutinous rice varieties which were developed by Regional Agricultural Research Station, Titabar and had got recommendation were considered. It was found that all the farmers were not putting their cultivable land under these varieties, though the Scientist claim that these varieties have great potential for production. There may be a lot of factors and constraints which might have hindered the process of adoption of these high yielding varieties of glutinous rice.Therefore to draw an appropriate picture about the prevailing situation and to formulate future strategy for improvement, the present study was undertaken.

An Ex-Post-Facto research design was followed to carry out the study. A multistage purposive cum random sampling design was followed for selection of respondents. A total of 120 respondents constituted the sample of the study. Data collection was done by adopting the personal interview technique administering a structured schedule. Frequency, percentage, mean, Standard deviation, co-efficient of variation, Karl Pearson's product moment coefficient of correlation, Multiple Regression and 't'-test were the statistical techniques used for the analysis of data.

The findings of this study revealed that that majority of the respondents (60.00%) belonged to middle age group, majority of the respondents (57.50 %) were middle school level, majority (50.00%) of the respondents belonged to medium size of family, majority of the respondents (51.66%) had cultivation+Business type of occupation. It was found that 60 per cent of the respondents were small farmers with operational land holdings 1.0 ha to 2 ha.It was found that majority (75%) of the respondents had an income ranging from Rs

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66706.70 to Rs.110318; majority of the respondents (53.33%) had medium level of extension contact and majority of the respondents (71.66%) had medium level of mass media exposure. The findings also revealed that majority of the respondents (70.00%) had medium level of economic motivation, majority of the respondents (72.50%) had medium level of risk preference ability and majority of the respondents (80.83 %) had medium level of social participation

A positive and significant relationship was found between extent of adoption and size of operational land holding, annual income, occupational status, mass media exposure, extension contact, social participation, risk preference and economic motivation. The independent variables age, education, family size, size of the operational land holding, annual income, occupational status, extension contact, mass media exposure economic motivation, risk preference and social participation fitted into the regression equation could explain together 58.60 per cent to the total variation on the extent of adoption of high yielding varieties of glutinous rice and its recommended package of practices.

The first three ranked socio-economic problems were non-availability of credit facilities (Rank I), high cost of labour (Rank II) and high cost of inputs (Rank III). The first three ranked technological problems were lack of irrigation (Rank I), non-availability of desired technology (Rank II), and Lack of convinction in the new technology (Rank III). The first three ranked institutional problems were lack of regulated market(Rank I), Poor market linkage (Rank II),and weak extension activities at village level (Rank III). The first three ranked bio-physical problems were high cost of seeds of high yielding varieties (Rank I), occurrence of heavy weed growth (Rank II) and heavy pest and disease incidence (Rank III). The most important measure suggested by majority (85.00%) of the respondents was making timely availability of quality seeds in local markets and gram Panchayat level.

Assessment of training needs of Agriculture Extension Assistants in recent advances of extension education : A study in Dibrugarh and Tinsukia districts of Assam

Jahnabi Senchowa

The economy of the state of Assam is basically based on Agriculture as the dependence of rural labour on Agriculture and allied activities was nearly 53 percent. Majority of the Assamese community survives on Agriculture and its allied aspects as their livelihood. Improvements in the field of Agriculture is solely dependent upon the improvement of the personnel of the State Departments associated with this discipline.

The Agriculture Extension Assistants has to play a vital role in effective transfer of agricultural technology. The Agriculture Extension Assistants has to motivate, educate and guide farmers to adopt new ideas and practices. Keeping this in view, the present study entitled , "Assessment of training needs of Agriculture Extension Assistants in recent advances of Extension Education – a study in Dibrugarh and Tinsukia districts of Assam" was undertaken with the major objective of Assessing training needs of Agriculture Extension Assistants in recent advances of Extension Education.

The Findings of this study revealed that majority (65.00 %) of the Agriculture Extension Assistants were middle aged .Majority (47.50 %) of the respondents had educational qualification up to HSLC. Majority (62.50 %) of the respondents had Total Service Experience of 13-24 years. Majority (65.00 %) of the respondents had Training Exposure between 3- 14 in their service tenure.

It is evident from the study that 100 per cent of the respondents had attended training on Subject Matter, 93.33 percent of them had attended training on Extension Methodology and 61.66 percent on other categories apart from Subject Matter and Extension Methodology. A very high majority (71.67 %) of the Respondents had moderately favourable Attitude towards Extension work. Maximum (74.16 %) Respondents are Moderately Satisfied

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in their Job. The study revealed that most important Sources of Information of the respondents is the "Progressive farmer", and the Least Important Source is "Agents of Input Organizations". The Motivational Profile of the study reveals that "Better Relationship with Superiors of the Department" is the most important Motivational Factor and "Better Relation with Co-Workers" is the least important motivational factor for the Respondents. Majority (67.50 %) of the Respondents had shown medium Role Conflict. Majority (70.83 %) of the Agriculture Extension Assistants had shown medium level of Role Awareness in their Designation.

The Training need areas for AEAs were categorized into ten aspects- Application of ICT Based Extension, Prospects of Market led Extension, Prospects of Group led Extension, Approach to Participatory planning, Perspectives of Human Resource Management, Approach to Liberalization of Economy, Preparation of module for skill development of farmers, Knowledge on Private Extension and Privatization, Perspectives of Farm Journalism and Agri-preneurship Development.

The most needed training need areas of Agricultural Extension Assistants identified were – "Fundamentals of Internet Browsing" (WMS= 2.94), "Concept of Market led Extension" (WMS= 2.95), "Promotion and practices of Group farming" (WMS=2.99), "Knowledge on PRA tools" (WMS=2.95), "Mainstreaming gender in Agriculture" (WMS=2.94), "Knowledge on Globalization of Economy" (WMS=2.91), "Formulation of Training design" (WMS=2.95), "Public Private Partnership in Agriculture" (WMS=2.96), "Knowledge and role of Mass Communication" (WMS=2.90), and "Concept of Agripreneurship" (WMS=2.96).

The Study revealed that majority (69.16%) of Agriculture Extension Assistants have Medium level of training needs , followed by high level of training needs (20.00%), and low level (10.84%) of Training needs.

The findings of Co-relation analysis of the various selected Socio-personal characteristics of Agriculture Extension Assistants and their training needs revealed that Age (r=0.04); Service Experience (r=0.02), Attitude towards Extension Work (r=0.02), Job Satisfaction (r=0.01), Motivational profile (r=0.12), Role Conflict (r=-0.04) was found to be Non significant with Training needs, whereas Role Awareness (r=-0.15) was found to be negatively significant with Training needs.

A study on entrepreneurial behaviour of rural youth in relation to selected agro-based enterprises in Lakhimpur district of Assam

Mouchumi Dutta

Youth are the backbone of a nation and are the most potential segment of a society. Youth are like clay which can be moulded in desired shape. Hence there is an immense necessity to utilise our youth in a right direction for the uplift of the society. Entrepreneurship development as a phenomenon generating jobs, plays a vital role in particular to alleviate high unemployment level. Agriculture is one of the promising areas for entrepreneurial activity with a high potential for employment generation. To carry out income generating activities, rural youth need to possess good entrepreneurial behaviour. The study was conducted in Lakhimpur district of Assam in the year 2017 with a view to find out the entrepreneurial behaviour of rural youth in relation to selected agro-based enterprises. Purposive and random sampling techniques were used for the selection of respondents. Total 120 respondents were selected for the study. Data was collected by administering a structured schedule. Statistical tools employed to analyze the data included frequency distribution, percentage, mean, standard deviation, weighted mean score, Karl Pearson's co-efficient correlation, 't' test and multiple regression analysis.

The study revealed that 73.33% of the rural youth were engaged in vegetable cultivation belonged to the age group between 25-29 years. Majority (70.00 %) of the respondents had middle school to higher secondary level of education. Majority (55.00%) of the respondents belonged to a medium sized family, possessed small sized operational land holdings (48.33%). The study also revealed that majority (78.33%) of the respondents had income ranging between Rs.84,716 .63 to Rs.1,66,283.63 and medium level of extension contact (63.33%).Majority (91.67%) of the respondents had no training and medium level of marketing orientation(70.00%).

On the other hand, majority (65.00%) of the rural youth engaged in muga cultivation belonged to the age group between 25-29 years.The study revealed that 85.00% of the

rural youth engaged in muga cultivation had middle school to higher secondary level of education. Majority (51.67%) of the respondents belonged to a medium sized family, possessed small sized operational land holdings (35.00%). The study also revealed that majority (65.00%) of the respondents had income ranging between Rs.84,873.11 to Rs.1,55,126.88 and medium level of extension contact (60.00%). Majority (71.66%) of the respondents had no training and medium level of marketing orientation (85.00%).

Results further revealed that more than half of the rural youth engaged vegetable cultivation (61.66%) had medium level of entrepreneurial behaviour and more than half (63.34%) of rural youth engaged in muga cultivation had also medium level of entrepreneurial behaviour. A positive and significant relationship was found between entrepreneurial behaviour and age, education level, size of the family, size of operational land holding and annual family income, marketing orientation of the respondents engaged in vegetable cultivation and muga cultivation in the district.

The three components *viz.,* education, family size and marketing orientation were found to be the most contributing factors for entrepreneurial behaviour of rural youth engaged in vegetable cultivation. The multiple regression model with all predictors produced R^2=0.521, which means the variables jointly contributed 52.10 per cent in variation towards entrepreneurial behaviour of rural youth engaged in vegetable cultivation.

In case of muga rearer, age, family size and marketing orientation were found to be the most contributing factors for entrepreneurial behaviour. The multiple regression model with all predictors produced R^2=0.594, which means the variables jointly contributed 59.40 per cent in variation towards entrepreneurial behaviour of rural youth engaged in muga cultivation.

Problems encountered by the respondents in carrying out the agro-based enterprises included lack of capital, lack of marketing facilities, lack of need-based training, non availability of tank and canal for irrigation facilities, non-availability of raw material, lack of adequate knowledge on organic farming, high cost of hiring vehicle etc.

An Evaluative Study of Training Programmes on Panchayati Raj Institute conducted by Extension Training Centre, Jorhat

Mridupaban Mudoi

India is a vast country with many states that have a population of more than 1.3 billion. Democratically governing a country of this size necessitates several tiers of government. Keeping this in view Panchayati Raj Institutions have been introduced under the 73rd Amendment Act of the Constitution of India. Accordingly in view of the historic Constitution (73rd Amendment) Act, 1992, the Assam Panchayati Raj Act, 1994 was enacted and came to effect from 5th May, 1994. Preparing the Panchayat members for their new roles as local decision-makers, calls for education and training on a massive scale, for which appropriate tailor made training content, methods and tools are needed.

The study was conducted with a view to measure the effectiveness of training programmes conducted by Extension Training Centre, Jorhat and to delineate the factors affecting training transfer by PRI members and the resultant transfer outcome. A purposive cum random sampling technique was followed for selection of total 120 nos. of respondents. Only 2 districts namely Jorhat and Golaghat were selected for the present study.

In this study, first a database of the training programmes conducted by ETC, Jorhat for 3 years (2013-14 to 2015-16) was developed. The database of the training programme revealed that maximum numbers of training programmes were conducted during the period 2013-14 (140 nos.), followed by 2015-16 (77 nos.) of which majority (51.77%) of the trainees were female and belonged to OBC category (44.26%). Maximum (72.22%) numbers of training programmes were conducted for the trainees of Jorhat district and also majority (51.04%) of the training programmes were conducted on campus.

The findings of this study revealed that majority (72.50%) of PRI members were in between 31 to 50 years and 11.67 per cent of PRI members were graduate followed by 40.83 per cent of PRI members belonged to OBC caste. Majority (56.67%) of the trainees were female with the experience of working in PRI ranging from 4 to 8 years (73.33%).

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Department : Extension Education
Major Advisor : Dr. P. Mishra

Majority (84.17%) of the trainees were belonged to nuclear family. A healthy percentage (74.17%) of the PRI members possessed moderate level leadership behaviour. The study also showed that majority (78.33%) of the respondents possessed moderate level cosmopoliteness and have moderate level decision making ability.

Regarding the effectiveness of training programmes in terms of perceived usefulness, knowledge gained and skill developed as a result of training programme, majority (75.83%) of the trainees opined that the training was moderately useful. On the other hand, 75.00 per cent trainees perceived that there was moderate gain in knowledge as result of the training programme and there were 77.50 per cent of the trainees perceived that the skill was moderately developed. Moreover, in terms of its perceived usefulness, the topic on "Community participation in Swachh Bharat Mission" (WMS= 2.79) was ranked "first".In terms of perceived knowledge gained, the topic on "Pradhan Mantri Gram SadakYojana" (WMS= 2.71) was ranked "first". Besides, effectiveness of training programme regarding its perceived skill developed, the topic, "Panchayati raj institution accountant software" (WMS= 2.90) was given "first" rank by the respondents.

Moreover, "peer support" (WMS= 4.67) and "Strategic link" (WMS= 4.67), followed by "Supervisor support" (WMS= 4.64) and "General work environment" (WMS= 4.64) were considered to be major factors of training transfer and "Community participation under Swachh Bharat Mission reduces open defecation" (WMS= 4.68) followed by "MIS under MGNREGS improves decision making ability and communication" (WMS=4.68), "RKVY increases total production and reduces yield gap of important crops" (WMS= 4.68), "role played by GP in increasing livestock production and management increases nutritional status of the villagers" (WMS= 4.63), were considered to be the major training outcome of the training programmes.

Findings of correlation analysis showed that age (r = 0.15*), work experience (r = 0.21**) and decision making ability (r = 0.19**) had positive and significant relationship with effectiveness of training programmes. However, It can be further seen from the analysis that the relationship between leadership behaviour (r= -0.15*) and effectiveness of the training programme were negatively significant.

A study on the adoption of low-cost polyhouse for Off-season cultivation of selected vegetable crops in Assam

Musliha Nasrin

Low cost polyhouse technology enables farmers to cultivate vegetables during Off-season and fetch higher price to the farmers. Marginal and small farmers face several challenges such as small land holding, poor yield due to reliance on natural phenomenon such as hailstorm, heavy rainfall and lack of knowledge of scientific methods of agriculture. For such reasons, farmers do not get the maximum productivity from the crops and face difficult to get year round production, which results in low profitability. In Assam, a huge quantity of Off-season vegetables are procured from other states of India almost round the year. Hence, growing of Off-season vegetables inside polyhouse can prove to be an economic boon for the state and increasing profit maximization of the farmers. Therefore, the study was conducted to find out the extent of adoption of low cost polyhouse for Off-season cultivation of selected vegetable crops in Assam.

In order to carry out the study, 4 districts of Assam were selected purposively where maximum beneficiaries of RKVY existed. A total 80 respondents consisted the samples of the study. Data collection was made by administering a structured schedule. Statistical tools employed to analyze the data included frequency distribution, percentage, mean, standard deviation, weighted mean score, Karl Pearson's co-efficient correlation, and 't' test .

The study revealed that majority of the respondents (56.25%) belonged to middle age group, majority of the respondents (75.00%) were middle school level. It was found that majority (45.00%) were marginal farmers with operation land holding below 1 ha, majority of the respondents (65.00%) had medium level of extension contact and majority of the respondents (78.75%) had medium level of annual family income. The findings also revealed that majority of respondents (67.50%) had medium level of scientific orientation, majority of respondents (65.00%) had medium level of risk orientation, majority of the

respondents (85.00%) had medium level of decision making ability, majority (67.00%) of respondents had medium level of source of finance. Majority (62.50%) had medium level of knowledge level which was measured by utilizing a Knowledge Test prepared for the study. The study also revealed that majority (57.50%) of the farmers possessed medium level of extent of adoption, followed by (23.75%) who had low level of extent of adoption, while (18.75%) of the farmers exhibited high level as regards to extent of adoption the low cost polyhouse technology respectively.

A positive and significant relationship was found between extent of adoption and annual family income, scientific orientation and marketing orientation.

Problems encountered by the respondents in carrying out low cost poly house technology included-lack of capital, not getting required returns, lack of adequate marketing facilities, lack of need-based training and follow up, non-availability of irrigation facilities and natural calamities.

Some of the suggestions given by the respondents included-proper irrigation facilities should be made available, frequent visit of the experts needed, financial support should be more, permanent structure may be provided that are more durable, etc.

A study on motivation of Agri-preneurs towards Agro-based enterprise in Upper Brahmaputra Valley Zone of Assam

Pareenita Baruati

The study was conducted in three districts of Assam namely Jorhat, Golaghat and Dibrugarh with a view to find out the entrepreneurial motivation of Agri-preneurs. Purposive and random sampling techniques were used for the selection of respondents. Total 186 respondents were selected for the study. Data was collected by administering a structured schedule. Statistical tools employed to analyze the data included frequency distribution, percentage, mean, standard deviation (wherever applicable) and weighted mean score.

The study revealed that 46.78 per cent of the agri-preneurs belong to age group between 36-50 years; majority (77.97%) of the respondents belong to the general caste; had Hindu as their religious preference (94.08%). It was observed that majority of the respondents (87.63%) were male and majority (93.02%) were married. It was seen that 40.32 per cent respondents were class IX passed; majority (57.53%) had nuclear family and majority (80.64%) of the respondents were first generation entrepreneurs. In terms of experience of the respondents in the enterprise (in years) majority (54.83%) had an experience in the enterprise of 7-20 years. The study also revealed that majority (90.86%) of the respondents received support from their respective families; 48.40 per cent respondents received advice as form of help and majority (60.22%) of the respondents had 51-75 per cent contribution of the family in their enterprise. Majority (55.92%) of the respondents spent up to 5-8 hours of time in their enterprise, majority (86.03%) of the respondents had their enterprise located rurally and majority (76.88%) had their enterprise as part of their house. 69.36 per cent respondents utilized "cash" as the mode of sales. It was seen that majority (80.64%) respondents had both own and burrowed funds as their sources of finance; majority (65.34%) had their sources of borrowings as co-operative banks. The study further revealed that majority (78.49%) of the respondents had annual income ranging between ` 166882 to ` 329665. In terms of type of agri-business undertaken

by the respondents 38.17 per cent had opted for food processing. Majority (64.52 %) had individual ownership of agri-business. Majority (89.78%) did not participate in any entrepreneurship development programme. Majority (63.97%) had medium level of marketing orientation and majority (83.87%) of the respondents had low level of management orientation and majority (94.08%) had medium level of entrepreneurial motivation.

In terms of entrepreneurial motivation, 26 factors of motivation were selected by going through various research papers and judges rating. It was measured on the basis of weighted mean score; the study revealed that out of all the 26 factors, "a sense of determination and hard work" (3.82) ranked first. Two factors *viz.,* "urge to earn extra income" and "become self sufficient" (3.81) ranked second. "Regard or fondness towards business" (3.41) was ranked third. "Responsibility towards family" (3.24) ranked fourth and the factor "attain a certain status in the society" (3.07) ranked fifth.

The advantages received from government and other institutions by entrepreneurs were analyzed by using cumulative frequency and percentage. It was seen that "attending training under various institutions"; "credit facilities provided by cooperatives", "Public Private Partnership", "supply of animal feed at subsidized rate", "exposure visits", "awareness campaign", "provision of farm machineries at subsidized rate" and "market assurance to entrepreneurs through regulated markets" were some of the advantages received as outlined by the respondents.

As shown by the rank found through frequency and percentage; constraints reported by the respondents included, "lack of capital", "lack of marketing facilities", "lack of government government assistance in terms of need based trainings", "lack of knowledge about proper techniques of marketing", "lack of adequate knowledge on use of inputs such as seed material, fertilizer doses, etc.", "non availability of water filtration", "lack of equipments such as pumps sets and other equipments required for irrigation", "lack of access to raw materials and labour at proper time", "interruption of power supply" and "lack of awareness of different schemes availed for entrepreneurs".

Attitude of farmers towards Field Management Committee in Assam: A study in Jorhat district

Prabir Datta

A large share of the world's poor live in rural areas and is small-scale farmers. It is therefore important to increase the income of small-scale farmers to reduce poverty.

To reach the goal one policy is to promote Producer Organization (POs) in developing countries. Producers Organization (PO) is considered as one of the platform for development of farmers all over the world. In Assam the concept of Producers' Organization is not new. During the early sixties, Department of Agriculture, Government of Assam organized farmers under Field Management Committee (FMC). Agriculture of Assam is characterized by a large number of marginal and small farmers, fragmented land holdings, low level of adoption of technologies, low productivity, dependency on monsoon rainfall, etc. These hinder the improvement of agriculture. To address these issues, the Government of Assam decided to mobilize farmers in the form of Field Management Committee. Field Management Committee is a producer organization meant for effective management of agriculture in a specific crop field. The history of FMCs indicates that after performing successfully for a period of time it almost defunct. This problem of sustainability is a point of concern. For sustainability of FMCs, attitude of farmers towards FMC and factors influencing its membership pattern need to be studied. Therefore, this study was conducted in Jorhat District of Assam to address these two issues. Total 240 respondents were selected (120 members and 120 non-members of FMCs) by using multistage sampling technique. An attitude scale was constructed for the study. The appropriate statistical tests were used for analysis of data. From the study, attitude of nonmembers of FMCs was found significantly favorable than members of FMCs ($t=1.133**$). The mean age of members and nonmembers were 43.75 years and 42.00 years respectively. Mean education in terms of years were 8.63 years and 8.93 years for members and non-member respectively. The majority of the respondents of FMC members and non-members belonged to the General category (58.33% and 61.66%respectively). Organizational participation (excluding FMC) was significantly more in case of members as compared to nonmembers. A majority of members (61.67%) had a

medium level of government extension contact and majority of non-members (84.17%) had low levels of government extension contact. For majority of the respondents, both members and nonmember's primary source of income belonged to on farm (81.67 % and 52.50 % respectively). In case of members, average annual income was Rs. 172566.7 and in case of nonmembers, it was Rs. 211458.33. In case of members, the mean land holding was 1.44 ha and in case of nonmembers, it was 0.80 ha. The t test indicated that there were significant difference between age, operational land holding, the extent of government extension contact, the primary source of income and annual family income of members' and non-members' means in these characteristics, both the groups were heterogeneous. In case of group members, extent of extension contact (r = 0.238), and size of operational land holding (r = 0.182) had positive and significant correlation with attitude towards FMCs. From forward stepwise regression analysis, it was found that extension contact, operational land holding, annual family income and caste influences the membership pattern of Field Management Committee. These variables together explained 67.50 per cent (Adjusted R2 =0.675) of the variance of effective factors on farmer's membership pattern toward FMC. The study recommended that special drive should be made to encourage the non-members to become members of the FMC.

Study on Adoption of Indigenous and High Yielding Varieties (HYVs) of rice by Tribal and Non-tribal farmers in Baksa district of Assam

Ranjita Goswami

Assam occupies a special place in the rice production area. Farmers of the state cultivate paddy in three seasons i.e. winter (*sali*), autumn (*ahu*) and summer (*boro*) rice. Assam is also home to many indigenous varieties of rice. The production and productivity of the Indigenous varieties are much less compared to the recommended HYVs but still some farmers in certain areas (mostly Tribal dominated areas of Bodoland) prefer growing indigenous variety of rice along with HYVs. Therefore, it was found necessary to know the differences in adoption and preferences of Indigenous and HYVs between the two groups of tribal and non-tribal farmers though living in the same district and in proximity. In light of the above reasons, the present study entitled "Study on Adoption of Indigenous and High Yielding Varieties (HYVs) of rice by Tribal and Non-tribal farmers in Baksa district of Assam" was undertaken.

Considering both the tribal and non-tribal farmers, a purposive cum random sampled investigation was conducted using a pre-tested schedule by personal interview during the month of July, 2016. A total of 160 numbers (104 Non-Tribal and 56 Tribal farmers) of respondents were selected as the final sample by proportionate random sampling method (on the basis of total tribal and non-tribal population in the village). For analyzing the data various statistical tools like Frequency Distribution, Percentage, Mean, Standard Deviation, Chi-Square, Tobit Analysis and "t" test were used.

The study reveals that majority (60.57%) non-tribal and tribal (62.50%) and total farmers (61.25%) belonged to age group of 36- 60 years. Majority of the non-tribal respondents (25.96%) attended up to middle school level but 33.92 per cent tribal farmers were illiterate and 31.25 per cent of total farmers attended up to middle school level. Both tribal (48.21%) and non-tribal (52.88%) farmers were in joint families and majority of the non-tribal respondents (68.27%) and tribal respondents (64.28%) belonged to medium size

of family. Majority (45.19%) non-tribal, tribal (48.22%) and 46.25 per cent total farmers were small farmers with operational land holdings 1.0 ha to 2 ha. The income status reveals that non-tribal (51.92%) farmers were below poverty line and 58.93 per cent tribal were above poverty line. The majority of total farmers (40.00%), non-tribal (41.38%) and tribal (39.29%) were basically engaged in agricultural activities. Majority non-tribal (72.12%) and tribal farmers (66.07%) had never attended any training regarding rice cultivation. About 79.80 per cent of the non-tribal and 71.93 per cent of tribal farmers had medium level of mass media exposure. Similarly, majority (66.35%) non-tribal and 80.36 per cent tribal farmers had medium level of extension contact. About 57.70 per cent non-tribal and 51.78 per cent tribal farmers had no membership in social organization. About 67.31 per cent non-tribal, tribal (55.36%) and 63.12 per cent of the total respondents were with medium level of economic motivation. Majority (63.12%) of total respondents, 63.46 per cent non-tribal and 62.50 per cent tribal farmers had medium level of scientific orientation.

The study revealed that non-tribal farmers cultivated HYVs in 68.13 per cent area and tribal farmers cultivated in 31.87 per cent area. But in case of Indigenous varieties non-tribal farmers cultivated in 44.93 per cent and tribal farmers cultivated in 55.07 per cent area. The major HYV varieties grown by the non-tribal farmers were Masuri, Ranjit, Moniram and varieties grown by tribal are Ranjit, Bahadur and Masuri. The indigenous varieties grown by the non-tribal farmers mostly Nolbonni, Ballam Joha, Moinagiri and varieties grown by tribal are Phulpakhri, Tanagaguri, Parochokua bonni.

The findings show that majority (73.07%) non-tribal and 51.78 per cent tribal farmers had medium level extent of adoption in both HYVs and Indigenous Varieties. "t value" is significant in case of extent of adoption of Indigenous Varieties. Overall age, family size, training exposure, social participation, economic motivation and scientific orientation of the farmers had a positive and significant association with the extent of adoption in case of HYVs. In case of indigenous rice, annual income had a positive and significant association with extent of adoption. Further, these significant and nearly significant variables were taken for Tobit analysis to see the influence of these factors on extent of adoption of HYVs, where only training exposure showed a positive and significant contribution towards adoption of HYVs.

Further, it was observed that tribal farmers preferred indigenous rice varieties because of their taste, cooking quality, local brew making, low operational cost etc and preferred HYVs because of yield, market demand, cooking quality etc. But non-tribal farmers preferred indigenous varieties because of their traditional delicacies, taste, less farm care etc and showed preference to HYVs because of yield, market demand, cooking quality etc.

A study on adoption of crop diversification by small and marginal farmers for their food security

Sanseeta Gogoi

Food is the basic necessity for all of us and lack of food or insufficient quantity of foods may create several consequences of human life. Hunger is one of the consequence. Food security means the easy availability and access to food at all times in sufficient quantity in a safe and nutritious form to meet the dietary requirements and food preferences for an active, healthy and productive life. Poverty, food prices and hunger are inextricably linked. Poverty causes hunger. Not every poor person is hungry, but almost all hungry people are poor. Crop diversification can be used as a means to increase farm income, generate employment, alleviate poverty and conserve soil and water resources and is considered as an important strategy to overcome many of the emergencies faced by developing countries.

The present study conducted in Jorhat and dhemaji district of Assam, was designed to examine the extent of crop diversification with special reference to crop and variety. The relevant data were collected from a total of 96 respondents. A multistage purposive cum random sampling design was followed for selection of respondents. The data were collected by personal interview method with the help of a pre-tested structured research schedule measuring 17 different independent variables during February- March, 2016.

For estimation of crop diversification, Simpson's index of diversification was used and for estimation of variety diversification, Biodiversity index was used. Statistical techniques like frequency, percentage, mean, standard deviation and t-test were used for analyzing data and drawing inferences.

The study revealed that the majority (55.83%) of the respondents belonged to the age category of 35- 50 years. Majority of them (58.33%) were medium sized family of 5-7 members. About 40.63 per cent of respondents had education upto high school level. Majority of the respondents (55.21%) were small farmers with an annual income ranged between Rs. 30134-93979 (85.42%). Almost all respondents were found to have the necessary farm implements like hand hoe, sickle, khurpi. About 43.75 per cent of respondents were involved in only cultivation as their primary source of income and majority of the respondents (70.83%)

were distributed in moderate level of degree of commercialization. It was observed that 71.88 per cent of respondents had medium level of extension contact and 29.17 per cent of the respondents had attended 2 numbers of training. Majority of the respondents (68.75%) had medium level mass media exposure. About 61.46 per cent of the respondents used both family and hired labour and about 44.79 per cent of the respondents have access to daily market. Regarding perceived food availability, food grain was adequate for majority of the respondents (71.88%). Majority of the respondents (72.92%) belonged to category of medium level of risk bearing ability. It was observed that majority i.e. 65.63 per cent and 71.88 per cent of the respondents belonged to the category of moderate level of innovation proneness and decision making ability respectively.

From the study, majority of the respondents were following cereal based cropping pattern. It was observed that the existing cropping pattern did not totally satisfy the food requirement of the household. The most commonly used cropping pattern was 'Cereal + Vegetables'. Cereals and pulses were in surplus but there was deficit in pulses and oilseeds. Crop diversification as well as variety diversification within paddy crop showed an increasing trend but at a lower rate. Price fluctuation, perishability of horticultural crops, high cost of hired labour were found to be the major problems faced by the farmers.

The regulation of price of agricultural produce, proper infrastructural facilities and timely availability of agricultural inputs would help out to step up the adoption level of crop diversification.

An Assessment of Farmers' Training Programme on IPM (Integrated Pest Management) in rice production technology conducted by KVKs of UBVZ of Assam

Uddipana Phukan

The study was carried out in the state of Assam with following objectives-
1. To assess the quality and usefulness of training programmes as perceived by farmers.
2. To study the effect of training programmes in terms of gain in knowledge and extent of adoption of recommended rice production technology.
3. To find out the relationship, if any, between selected independent variables with the farmers' level of knowledge and extent of adoption of recommended rice production technology.
4. To find out the problems faced by the farmers in adoption of recommended technology.

A purposive cum random sampling design was followed for selection of the KVK and respondents. Five Krishi Vigyan kendras under Assam agricultural Universities, situated at Teok in Jorhat district, khumtai in Golaghat district, Nazira in Sivasagar district, Romaikordoibam in Dibrugarh district, Gelapukhuri in Tinsukia district were selected purposively for the present study. Out of four different categories of trainees in KVK, practicing farmers were selected as respondents. From this, a sample of 25 respondents from each KVK were selected by using random sampling method. This made the final size of respondents as 125. After reviewing relevant literature, 15 independent variables, 2 dependent variables and 3 descriptive variables were selected for the study. The frequency, percentage, mean, standard deviation, co efficient of variance, co efficient of correlation were the statistical techniques used for the analysis of collected data.

The study revealed that majority(50.4%)of the respondents were in the age group above 30, 26.5%were middle school passed,91.2%lived in joint family type, majority of the

respondents(59.00%) had marginal land holding and majority of the respondents (31.2%)family income ranges from Rs.1,05,000-1,20,000. The findings revealed that 75.2% were male respondents and 83.2% were married and 79.2% of the respondents belonged to medium sized family . The findings revealed that 76% of the respondents took only farming as main source of income and 75.2% took one day training.

Majority of respondents (58.75%) had medium level of knowledge and 52.80 per cent had medium extent of adoption of the selected technology practices that were imparted in the training conducted by the KVKs. Regarding overall quality of training programme, majority of respondents(61.25%)were perceived as 'good'. Regarding overall usefulness of training programme, majority of respondents (52.34%) were perceived as 'useful'.

Age, educational level, family size, size of operational land holding, annual family income, training exposure had significant and positive relationship with knowledge level while marital status were significant but negative correlation with knowledge test. It was also found that educational level, size of family, size of operational land holding, annual income and training exposure had strong, positive and significant relationship with extent of adoption. On the other hand, significant but negative relationship with extent of adoption was found in case of age and marital status. The multiple regression model with all predictors produced R^2=0.605, which means the variables jointly contributed 60.50 per cent in variation towards knowledge level of the respondents.

Major problems reported by the respondents were lack of knowledge about balanced use of fertilizers, non-availability of fertilizer, high wages of labour, laborious nature of IPM technology, non-availability of IPM tools and lack of skill in using IPM tools,non-availability of bio-control agents and bio-fertilizers, lack of knowledge and skill about pest-defender ratio, lack of knowledge and skill for determining ETL etc.

The suggestions put forwarded by the respondents for further improvement of training programme were to supply copies of lecture notes in locale language and to conduct more practical or method demonstration ,display of live specimen of pest and disease samples in the trainings etc.

A study on the extent of adoption of recommended package of practices of selected pulse crops by the farmers in Nagaon district of Asssam

Arup Jyoti Goswami

The requirement of pulses in Assam is 2.62 lakh ton and the deficit is Assam is at present 38 per cent of the total requirement. But the productivity of the pulse crops in Assam (695kg/ha) as well as in Nagaon District (584kg/ha) is low as compared to the national average (764 kg/ha) and the state has to import 62 per cent of the pulses requirement from other states of the country. As the production and productivity of pulses in the state is low and had import 60 per cent of the requirement from outside the states, question naturally arises why the production and productivity, what are the problem of farmers in cultivating pulse crops. The present study entitled "A study on the Extent of adoption of recommended package of practices of selected pulse crops by the farmers in Nogaon District of Assam" was therefore carried out to find out down to earth answers to the aforesaid questions purposively in Nogaon District with the following objectives:

1. To study extent of adoption of recommended package of practices of selected pulse crops by the farmers.
2. To identify the variables influencing the extent of adoption of recommended package of practices of selected pulse crops.
3. To identify the faced by the farmers in adoption of recommended package of practices of selected pulse crops.

The study was carried out to see the extent of adoption of recommended package of practices of selected pulse crops (Blackgram and Greengram) by the farmers of Hojai, Lanka, Raha and Samaguri Sub-division of Nogaon District of Assam. The survey was conducted in the month of February to March, 2016. A purposive cum simple random sampling technique was used for selection of 120 respondents. Data collection was carried out by personal interview technique administering a structured schedule. Statistics like percentage, frequency, mean, standard deviation, ranking, coefficient of variation and correlation were used for the analysis of data.

Abstract of M. Sc. Thesis
Department : Extension Education (BNCA)
Major Advisor : Dr. C.K. Deka

The study revealed that majority of the respondents (64.17%) belonged to middle aged group with middle school level of education (34.17%), marginal operation land holding (85.83%) and low level of area under pulses 955.83%). It was also found that majority of the respondents had big family size and urban contract once in a week (51.67%). Own source of credit was used by majority (60.00%) of the respondents. In case of annual income, majority of the respondents (68.33%) had medium level of annual income which range between Rs. 40299.32 to 135495.70. Majority of the respondents had low level of knowledge on scientific cultivation practices of Black gram and Green gram which is 71.67 and 74.17 per cent, respectively. Likewise, majority of the respondents (65.83%) had low level of innovation proneness and majority of the respondents (71.67%) had medium level of risk orientation ability.

The study further revealed that Majority of the respondents (63.33%) exhibited medium level of extent of adoption of recommended package of practices of Black gram and Green gram. The study revealed that in case of black gram and green gram, the cent percent of the farmers adopted sowing time and land preparation. Recommended seed rate, manual weeding operation and FYM were adopted by 95.85 HYV, 33.33 per cent farmers adopted HYV of black gram and 30.83 per cent adopted HYV of green gram. While 14.17 per cent adopted chemical pest control and the adoption of fertilizer application without rhizobium, chemical disease control and spacing were 8.33, 5.83 and 4.17 per cent, respectively. Nobody was found to adopt practices like seed inoculation with rhizobium, fertilizer application with rhizobium, chemical weed control and protection against storage-pests.

A positive and significant relation was found between extent of adoption and size of operational land holding, urban contact, knowledge on pulse crops and annual farm income. On the other hand, age, education level, family size, area under pulse crops, sources of finance, innovation proneness and risk orientation could not establish any significant relationship with the extent of adoption of scientific cultivation of pulse crops.

The most important problems faced by majority of the pulse growers which ranked 1st, 2nd and 3rd were non-availability of quality seeds, lack of irrigation facility and lack of knowledge on scientific cultivation of pulses. The other important problems which also need attention were high incidence of pest and diseases, post-harvest storage problem, price fluctuation in the market throughout the year, high cost of fertilizers and plant protection chemicals and flood damage the kharif crops, lack of proper marketing facility, high rate of interest on loan charge by the professional money lender, high cost of certified seed/quality seeds, high incidence of intervention of middle men, complicated procedure for obtaining loan from the credit institution, heavy rainfall and lack of proper extension service.

An analysis of sustainable rural livelihoods through selected livelihood capital assets in sand and silt deposited areas of Dhemaji district of Assam

Deep Shikha Sonowal

The study entitled **"An Analysis of Sustainable Rural Livelihoods through Selected Livelihood Capital Assets in Sand and Silt Deposited Areas of Dhemaji District of Assam"** was undertaken in sand and silt deposited areas of Dhemaji district in Assam, primarily to measure physical and social capitals as livelihood assets, compute Sustainable Rural Livelihood index in sand and silt deposited areas, study selected personal, socio-economic and psychological attributes of farmer respondents in sand and silt deposited areas as well as to find out the relationship, if any, between Sustainable Rural Livelihoods and the selected personal, socio-economic and psychological attributes of the respondents. A descriptive research design, following an *ex post facto* approach was utilised for the study. A multi-stage, purposive cum proportionate random sampling design was adopted for the study in order to select 100 respondents. Data was collected with the help of a pretested, structured research schedule, using the personal interview method. Appropriate statistical tools including measures of central tendency, measures of dispersion and measures of relationship were utilised to analyse the raw data in order to arrive at valid conclusions.
With respect to the selected personal, socio-economic and psychological attributes of the respondents, the study revealed that most of the respondents (88%) were young to middle aged, with only 12% falling in the old age category. While majority (57%) of the respondents had medium level of formal education, 32% had low level of formal education. Significantly, 21% of the respondents were illiterate. The study revealed that the proportion of farm families belonging to small and medium sized families were almost equal (46% and 43% respectively) and constituted the majority in the family size categories. Majority (61%) of the respondents were marginal farmers, followed by small farmers (31%). Majority of the respondents belonged to the low and medium level of annual income categories (respectively 41% and 46%). On the other hand, a large majority (70%) had low level of annual expenditure

pattern. The study further revealed that most of the respondents had medium level of economic motivation (68%) and risk bearing ability (70%). An analysis of the indicators of physical capital assets of the respondent families revealed that affordability of transport was medium for a vast majority (91%). Most of the respondents (60%) had medium type of house or shelter while 27% had good type of house/shelter. An overwhelming majority (98%) used wells/tube wells as their source of drinking water and most (60%) of the respondents families used firewood as their source of domestic fuel. Information source accessibility was found to be poor for 44% of the respondents and satisfactory for half of the respondents. Majority (84%) depended on neighbours and mass media to access information pertaining to on and off farm activities. While about half of the respondents (51%) had medium level of material possession, 31% had no material possession at all. The average Physical Capital Index (PCI) was on the lower side (49.12%).

An appraisal of the indicators of social capital assets of the respondent families highlighted that 54% of the respondents had medium level of socio-political participation while a large proportion (42%) had low socio-political participation. While half of the respondents (50%) had medium level of trust on other members of the village, 41% expressed low trust. The average Social Capital Index (SCI) was 50.66 %, which was of moderate strength.

On the basis of the PCI and SCI indices, the computed Sustainable Rural Livelihood Index score (49.89%) was found to be on the lower side, indicating its relatively low strength based on physical and social capital indices.

Correlation analysis of the independent variables of the study with Sustainable Rural Livelihoods revealed that five independent variables, viz., age, education, size of land holding, expenditure pattern and risk bearing ability were positively and significantly correlated with Sustainable Rural Livelihoods. The 'r' values against these variables suggest that the strength of relationship was on the higher side in case of size of land holding while they were moderate for the other four significantly correlated variables.

Skill development, promoting low cost, adaptive and mitigating agricultural technologies, Common Property Resource Management, implementing flagship social welfare programmes, strengthening agricultural extension, promoting animal sector, organising farmers, diversification, short term income generation, increasing risk bearing ability, capacity building and financial inclusion for the people in sand and silt deposited areas are the general recommendations of the study.

An assessment of the impact of technology showcasing Pprogramme of Assam Agricultural University in the North Bank Plain Zone of Assam

Dibya Jyoti Borah

The study entitled "**An assessment of the impact of Technology Showcasing Programme of Assam Agricultural University in the North Bank Plain Zone of Assam**" was conducted in Lakhimpur and Sonitpur districts of Assam with the following objectives:

1. Assess the attributes of selected technologies demonstrated in the Technology Showcashing programme as perceived by the participant farmers

2. Assess the impact of the Technology Showcashing programme in terms of the extent of adoption of recommended package of practices of demonstrated crops, crop productivity, farm income and Seed Replacement Rate (SRR)

3. Identify the factors influencing the extent of adoption of recommended package of practices of demonstrated crops by the participant farmers

'Technology Showcasing' was a flagship programme of Assam Agricultural University which was launched through KVKs in 2010-11 with the objectives to showcase the latest cost effective production technology in farmers' fields to produce quality seeds of cereals, oilseeds and pulses in a participatory mode with the farmers in an attempt to bridge the gap in seed requirement. The study was conducted in Lakhimpur and Sonitpur district of Assam where Technology Showcasing programme was conducted during the period from 2010-11 to 2014-15. A purposive cum random sampling design was followed for selection of participant farmers and non-participant farmers. The size of the sample of the study was 120 farmers, consisting of 60 participant farmers and 60 non-participant farmers. The data were collected with the help of a pretested structured research schedule by personal interview method. The statistical tools employed in the study for analysis and interpretation of data included frequency, percentage, mean, standard deviation, coefficient of variation, multiple correlation coefficient, multiple regression coefficient and t tests.

Findings revealed that majority of the participant farmers were found to be old aged (43.33%) with middle school level education (30.00%). Half of the participant farmers

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(50.00%) belonged to small farmer's category. Majority of the participant farmers had single family type (78.33%) with big family size (75.00%). Majority of them had membership in one organization (46.67%). Majority of the participant farmers were found with medium level of extension contact (80.00%), medium of degree of information exposure (68.33%), medium level of scientific orientation (81.66%), medium level of innovation proneness (66.66%) and medium level of economic motivation (56.67%). Majority of them had moderately favourable attitude towards improved agricultural practices (43.33%).

Among the non-participant farmers, majority of them were old aged (56.67%) with middle school level education (31.67%). Majority of them were (48.33%) marginal farmers with single family type (66.67%), big family size (66.67%) and membership in one organization (41.67%). Majority of the non-participant farmers were found with medium level of extension contact (75.00%), medium degree of information exposure (71.67%), medium level of scientific orientation (65.00%), medium level of innovation proneness (60.00%) and medium level of economic motivation (60.00%). Three-fourth of them (75.00%) had less favourable attitude towards improved agricultural practices.

Findings on perception of participant farmers regarding attributes of five rice production technologies revealed that the inputs needed to use the FYM/ compost in rice cultivation could be obtained most easily by the farmers as indicated by their mean perception score (3.39). Use of HYV seeds of rice was perceived to be the most profitable rice production technology. Use of chemical pesticide was perceived as moderately complex technology by the participant farmers. Use of FYM/ compost was perceived to be compatible with the participant farmers' existing farming situation, their existing investment capability and their local climate and soil condition. Use of FYM/ compost was perceived to be compatible with their local values and beliefs. Use of line transplanting in rice cultivation was perceived to be compatible with the participant farmers' existing knowledge and skills. Regarding risk, use of chemical pesticide was ranked first with the mean perception score of 2.68 indicating that use of chemical pesticide was perceived to involve some risk.

Findings on perception of participant farmers regarding attributes of four toria production technologies revealed that the inputs needed to use the FYM/ compost in toria cultivation could be obtained most easily by the farmers as indicated by their mean perception score (3.39). Use of HYV seeds of toria was perceived as the most profitable technology. Use of chemical pesticide in toria cultivation was perceived to be a complex technology. Use of FYM/ compost in toria cultivation was perceived to be compatible with the participant farmers' existing farming situation, their existing investment capability and their local climate and soil condition. Use of FYM/ compost in toria cultivation was perceived to be compatible with local values and beliefs of participant farmers. Use of HYV seeds of toria was perceived to be compatible with their existing level of knowledge and skills. Use of chemical pesticide in toria cultivation was perceived to be a risky technology.

Findings on extent of adoption of recommended package of practices of rice cultivation revealed that majority of the participant farmers (83.33%) had medium extent of adoption followed by 15.00 per cent with high extent of adoption and 1.67 per cent with low extent adoption of recommended package of practices of rice cultivation. Among the non-participant

farmers, majority of them (66.67%) had medium extent of adoption followed by 31.67 per cent with low extent of adoption and 3.33 per cent with high extent of adoption of recommended package of practices of rice cultivation.

Finding on extent of adoption of recommended package of practices toria cultivation revealed that majority of the participant farmers (70.00%) had medium extent of adoption followed by 28.33 per cent with high extent of adoption and 1.67 per cent with low extent of adoption of recommended package of practices of toria cultivation. In case of non-participant farmers, majority of them (47.06%) had low extent of adoption followed by 43.14 per cent with medium extent of adoption and 9.80 per cent with high extent of adoption of recommended package of practices of toria cultivation.

Results of the t-tests indicated that the programme interventions might have positive impact on the participant farmers with respect to the extent of adoption recommended package of practices of rice and toria cultivation.

As regards productivity of rice, majority of the participant farmers (61.67%) had medium level of rice productivity followed by 35.00 per cent with high level of rice productivity and 3.33 per cent with low level of rice productivity. Among the non-participant farmers, majority of them (55.00%) had medium level of rice productivity followed by 38.33 per cent with low level of rice productivity and 6.67 per cent with high level of rice productivity.

Regarding the productivity of toria, majority of the participant farmers (61.67%) had medium level of toria productivity followed by 36.67 per cent with high level of toria productivity and 1.67 per cent with low level of toria productivity. In case of non-participant farmers, majority of them (49.03%) had low level of toria productivity followed by 47.05 per cent with medium level of toria productivity and 3.92 per cent with high level of toria productivity. Results of the t-tests indicated that the programme interventions might have positive impact on the participant farmers with respect to the level of rice and toria productivity. Findings on farm income revealed that, majority of the participant farmers (78.33%) were in medium farm income category followed by 20.00 per cent in high farm income category and 1.67 per cent in low farm income category. Among the non-participant farmers, majority of them (80.00%) were in medium farm income category followed by 11.67 per cent in high farm income category and 8.33 per cent in low farm income category.

In case of seed replacement rate of rice, majority of the participant farmers (65.00%) had medium seed replacement rate followed 26.67 per cent with high seed replacement rate and 8.33 per cent with low seed replacement rate of rice. In case of non-participant farmers, majority of them (48.33%) had medium seed replacement rate followed by 41.67 per cent with low seed replacement rate and 10.00 per cent with high seed replacement rate of rice.

Regarding the seed replacement rate of toria, majority of the participant farmers (71.67%) had medium seed replacement rate of toria followed by 21.67 per cent with high seed replacement rate and 6.67 per cent with low seed replacement rate of toria. On the other hand, majority of the non-participant farmers (66.67%) had medium seed replacement rate followed by 21.67 per cent with low seed replacement rate and 11.67 per cent with high seed replacement rate of toria.

Results of the t-tests indicated that the programme interventions might have significant positive impact on the participant farmers with respect to their farm income and seed replacement rate in rice and toria cultivation.

Results of correlation analysis revealed that 8 variables *viz.* age, educational level, size of operational land holding, social participation, innovation proneness, perceived profitability, farm income and seed replacement rate were significantly and positively correlated with the extent of adoption of recommended practices of rice cultivation at 0.01 level of probability. The variable productivity of rice had a positive and significant relationship with extent of adoption at 0.05 level of probability. Similarly, 5 variables *viz.* age, educational level, productivity of toria, farm income and seed replacement rate were significantly and positively correlated with extent of adoption of recommended practices of toria cultivation at 0.01 level. The variables, *viz.* size of operational land holding and perceived profitability had positive and significant relationship with extent of adoption at 0.05 level.

The corresponding null hypotheses stating that there is no significant relationship between these independent variables and extent of adoption of recommended practices of rice and toria cultivation by the participant farmers were rejected and the alternative hypotheses were tentatively accepted.

Results of multiple regression revealed that out of 9 independent variables, 4 variables, *viz.* age, education level, social participation and farm income had significant influence in explaining the variation in the extent of adoption of recommended practices of rice cultivation. The value of R2 (0.6678) indicated that nine independent variables could explain 66.78 per cent of the variation in the extent of adoption of recommended practices of rice cultivation. Similarly, out of 7 independent variables, 3 variables, *viz.* age, education level and farm income had significant influence in explaining the variation in the extent of adoption of recommended practices of toria cultivation. The value of R2 (0.5832) indicated that seven independent variables could predict 58.32 per cent of the variation in the extent of adoption of recommended practices of toria cultivation.

A Study on adoption of recommended package of practices of major vegetable crops by the farmers of flood free and flood prone areas in Lakhimpur district of Assam

Kangkana Borah

The present study entitled **"A study on adoption of recommended package of practices of major vegetable crops by the farmers of flood free and flood prone areas in Lakhimpur district of Assam"** with the following objectives:

1. Study the socioeconomic characteristics of vegetables growers of flood free and flood prone areas

2. Determine the extent of adoption of recommended package of practices of major vegetables by the farmers of flood free and flood prone areas

3. Identify the factors influencing the extent of adoption of recommended package of practices of major vegetables by the farmers of flood free and flood prone areas

4. Identify the problems in adoption of major vegetables cultivation practices faced by the farmers of flood free and flood prone areas

The present study was carried out in Lakhimpur district where out of three agricultural sub-divisions (Dhakuakhana, North Lakhimpur and Narayanpur), two sub-divsions having both flood free and flood prone areas *viz*. North Lakhimpur and Narayanpur were selected at randomly. From each of the selected agricultural sub-divisions, 2 ADO circles were selected randomly having both flood free and flood prone areas. From each of the selected ADO circles, 2 VLEW *elekas* were selected randomly having both flood free and flood prone areas. From each of the selected VLEW *elekas*, 1 flood free and 1 flood prone village were selected randomly. From each of the selected flood free and flood prone village, 15 vegetable growers were selected randomly. Thus, 120 vegetable growers consisting of 60 vegetable growers from flood free areas and 60 vegetable growers from flood prone areas constituted the sample of the study.

Altogether 1 dependent variable and 17 independent variables were included in the study. The extent of adoption of recommended package of practices of major vegetables by the farmers of flood free and flood prone areas was treated as the dependent variable in the study. Procedure for measuring extent of adoption was followed in the light of the procedure used by Baruah (2004).

The independent variables were age, education, family type, family size, occupational status, institutional linkage, size of operational land holding, availability of working capital, farm mechanization, net farm income, degree of commercialisation, extension contact, mass media exposure, knowledge level, economic motivation, management orientation and risk bearing ability.

Findings of the study revealed that majority of the farmers of flood free areas were middle aged (60.00%), marginal farmers (75.00%) with middle school level education (51.67%) and only cultivation as occupation (93.33%). Majority of them had nuclear family (90.00%) with small family size (90.00%). Majority of them were with membership in one organisation (48.33%), medium extension contact (55.00%), medium economic motivation (70.00%), medium management orientation (75.00%), medium risk bearing ability (83.33%) and medium mass media exposure (76.67%). Majority of them were with medium level of knowledge (51.67%), medium availability of working capital (60.00%), medium net farm income (85.00%), medium farm mechanisation (80.00%) and medium degree of commercialisation (50.00%).

Similarly, majority of the farmers of flood prone areas were middle aged (43.33%), marginal farmers (60.00%) with middle school level education (45.00%), nuclear family type (93.33%) and small family size (93.33%). Majority of them were with membership in one organisation (45.00%), low extension contact (48.33%), medium economic motivation (63.33%), medium management orientation (53.33%), medium risk bearing ability (68.33%) and medium mass media exposure (70.00%). Majority of them had medium level of knowledge (66.67%). Majority of them had only cultivation as occupation (90.00%), medium availability of working capital (78.33%), medium net farm income (71.60%), medium farm mechanisation (66.67%) and medium degree of commercialisation (58.33%).

Finding revealed that majority of the farmers of flood free areas were had medium overall extent of adoption (61.66%), followed by low overall extent of adoption (31.67%) and high overall extent of adoption (16.67%) of recommended practices of four major vegetables.

Majority of the farmers of flood prone areas were found to have medium overall extent of adoption (45.00%) followed by low overall extent of adoption (30.00%) and high overall extent of adoption (25.00%) of recommended practices of four major vegetables. In case of tomato, majority of the farmers of flood free areas were found to have medium extent of adoption (50.00%) followed by low extent of adoption (45.00%) and high extent of adoption (5.00%) of recommended practices of tomato cultivation. Similarly, majority of the farmers of flood prone areas were had low extent of adoption (53.33%) followed by medium extent of adoption (33.33%) and high extent of adoption (13.34%) of recommended practices of tomato cultivation.

In case of cabbage, majority of the farmers of flood free areas were with medium extent of adoption (66.67%), followed by low extent of adoption (31.67%) and high extent of adoption (1.66%) of recommended practices of cabbage cultivation.

Similarly, majority of the farmers of flood prone areas were found with medium extent of adoption (60.00%), followed by low extent of adoption (38.33%) and high extent of adoption (1.67%) of recommended practices of cabbage cultivation.

In case of cauliflower, majority of the farmers of flood free areas were found to have medium extent of adoption(41.67%), followed by low extent of adoption (56.67%) and high extent of adoption (1.66%) of recommended practices of cauliflower cultivation. Similarly, majority of the farmers of flood prone areas had low extent of adoption (53.33%), followed by medium extent of adoption (41.67%) and high extent of adoption (5.00%) of recommended practices of cauliflower cultivation.

In case of potato, majority of the farmers of flood free areas were found with medium extent of adoption (48.33%), followed by low extent of adoption (35.00%) and high extent of adoption (16.67%) of recommended practices of potato cultivation.
Similarly, majority of the farmers of flood prone areas were found with medium extent of adoption (53.33%), followed by low extent of adoption (41.67%) and high extent of adoption (5.00%) of recommended practices of potato cultivation.

Finding of correlation analysis revealed that 9 independent variables, *viz.* occupational status, institutional linkage, size of operational land holding, availability of working capital, extension contact, mass media exposure, knowledge level, management orientation and risk bearing ability were positively and significantly correlated with the extent of adoption of recommended practices of major vegetables by the farmers of flood free areas at 0.01 level.

Similarly, 7 independent variables, viz. occupational status, institutional linkage, availability of working capital, extension contact, mass media exposure, knowledge level and risk bearing ability had positive and significant relationship with the extent of adoption of recommended practices of major vegetables by the farmers of flood prone areas at 0.01 level. Two variables, *viz.* economic motivation and management orientation were positively and significantly correlated with the extent of adoption of recommended practices of major vegetables by the farmers of flood prone areas at 0.05 level.

The findings of the regression analysis revealed that out of 9 independent variables, only 3 variables were found to contribute significantly towards the overall extent of adoption of recommended practices of vegetables by the farmers of flood free areas. While the variables institutional linkage and size of operational land holding contributed positively and significantly towards the overall extent of adoption at 0.01 level, the variable knowledge level on recommended practices of major vegetable cultivation contributed positively and significantly towards the overall extent of adoption of recommended practices of vegetables by the farmers of flood free areas at 0.05 level. Hence the corresponding null hypotheses stating that there is no contribution of these independent variables towards the extent of adoption of recommended practices of major vegetables by the farmers of flood free areas were rejected and alternative hypotheses were accepted. The R^2 value (0.779) indicated that 9 variables selected for regression could predict 77.90 per cent of the variation in the

overall extent of adoption of recommended practices of major vegetable cultivation by the farmers of flood free areas.

In case of farmers of flood prone areas, out of 9 independent variables, only 2 variables were found to contribute significantly towards the extent of adoption of recommended practices of vegetables. While the variable knowledge level on recommended practices of major vegetable cultivation contributed positively and significantly towards the overall extent of adoption at 0.01 level, the variable occupational status contributed positively and significantly towards the overall extent of adoption at 0.05 level. Hence the corresponding null hypotheses stating that there is no contribution of these independent variables towards the extent of adoption of recommended practices of major vegetables by the farmers of flood prone areas were rejected and alternative hypotheses were accepted. The R2 value (0.683) indicated that 9 variables selected for regression could predict 68.30 per cent of the variation in the extent of adoption of recommended practices of major vegetable cultivation by the farmers of flood prone areas.

In case of flood free areas, 'No opportunity for training on scientific vegetable cultivation practices' was the most important problem faced by the farmers of flood free areas in adopting recommended practices of major vegetables as reported by 88.33 per cent of the respondents of flood free areas. 'Lack of market information' was the second important problem faced by the farmers of flood free areas in adopting recommended practices of major vegetables as reported by 71.66 per cent of the respondents of flood free areas. 'Lack of technical guidance from extension agents' was the third important problem faced by the farmers of flood free areas in adopting recommended practices of major vegetables as reported by 70.00 per cent of the respondents of flood free areas. (58.33%) were the next three important problems faced by them which were ranked fourth, fifth and sixth.

In case of flood prone areas, 'No opportunity for training on scientific vegetable cultivation practices' was the most important problem faced by the farmers of flood prone areas in adopting recommended practices of major vegetables as reported by 86.66 per cent of the respondents of flood prone areas. 'Lack of technical guidance from extension agents' was the second important problem faced by the farmers of flood prone areas in adopting recommended practices of major vegetables as reported by 70.00 per cent of the respondents of flood prone areas. 'Inadequate irrigation facilities' was the third important problem faced by the farmers of flood prone areas in adopting recommended practices of major vegetables as reported by 68.33 per cent of the respondents of flood free areas. 'High cost of chemicals' (66.66%), 'Lack of market information' (71.66%), and 'Non-availability of quality seeds in proper time' (58.33%) were the next three important problems faced by them which were ranked fourth, fifth and sixth.

A study on the extent of adoption of improved ginger cultivation practices by the farmers in Ri-Bhoi district of Meghalaya

Nisha. V. Kharjana

The study entitled **"A study on the extent of adoption of improved ginger cultivation practices by the farmers in Ri-Bhoi district of Meghalaya."**was carried out to see the extent of adoption of improved ginger cultivation practices in Ri-Bhoi district of Meghalaya. The present study has been undertaken with the following specific objectives.

1. Study the extent of adoption of improved ginger cultivation practices by the farmers of Ri-Bhoi district of Meghalaya.

2. Study the factors influencing the extent of adoption of improved practices of ginger cultivation.

3. Study the constraints faced by the farmers in adopting improved ginger cultivation practices and the measures suggested by them.

The study was conducted in Ri-Bhoi district of Meghalaya. Ri-Bhoi district is a district which has three development blocks namely Umling, Umsning, Jirang block. Amongst these three blocks the Umsning block was selected purposively and six villages namelyUmroiMadan, Mawbri,Liarkhla, UmranNiangbyrnai, Nongladew, Kyrdem were randomly selected from selected development blockandselection of 120 respondents was done through the use proportionate random sampling technique.

Altogether ten independent variables viz., age, education, family type, size of operational land holding, annual income, occupational status, mass media exposure, extension contact, risk preference, economic motivation and one dependent variable i.e., extent of adoption were included in the study. Data collection was carried out by personal interview technique administering a structured schedule. Statistics like frequency, mean, percentage, standard deviation, coefficient of variation, Karl Pearson's correlation coefficient, regressionand ranking were used for analysis of data.

The study revealed that majority of the respondents (53%) were of the middle age group and majority(27.50%)of them were illiterate. Majority (55.83%) of the farmers belonged to joint family category and majority of the respondents (53.33%) were marginal farmers. Majority (90.83%)had medium range annual income and 42.50 per cent of the farmer'shad

cultivation as their occupational status. Most of the respondents (55.83%) had medium mass media exposure and regarding the frequency of contacts with different mass media it was found that majority(48.33%) of the respondents used agricultural bulletin as a source of mass mediawhereas none of the respondents used the internet as a source of mass media. It was found that (57.50%) had medium extension contact. Majority of the respondents (80.00%) had of medium level of risk preference and (63.33%) hadmedium level of economic motivation.

The study also revealed that majority of the respondents (72.50%) had medium level of adoption in terms of their overall extent of adoption of improved ginger cultivation practices followed by 16.67 per cent who had low extent of adoption and only 10.83 per cent of the respondents were found to be high in the adoption category.

The study on extent of adoption of selected improved ginger cultivation practices revealed that overall (100.00%) ofrespondents taken under study fully adopted the use of improved varieties. (34.17%) and(28.33%) of the respondents fully adopted the practices of using the right size of rhizomes and the right weight, respectively. All (100.00 %) of them fully adopted the practice of using the right size of beds for ginger cultivation. All respondents (100.00%) partially adopted the practice of using the right quantity of seed rate of ginger cultivation. All (100.00%)of the respondents fully adopted the recommended practice for planting or sowing of rhizomes at the correct time. Majority of the respondents (61.67 %)and (51.66 %) fully adopted the practice of plant to plant spacing and row to row spacing, respectively. Followed by 100.00 per cent who partially adopted the practice of sowing of seeds at the right depth. Now, (65.84%) of the respondents fully adopted the practice of mulching. When it comes to weeding, (100%) of the respondents fully adopted the practice of doing the right type of weeding and(44.16%) of the respondents fully adopted the practice of doing weeding at the right number of times.And lastly, all (100.00%) of the respondents fully adopted the practice of harvesting of the crop at the right time with the correct method and also with the most appropriate method. The study revealed that none of the respondents adopted the practice of seed treatment, fertilizer application and plant protection measure.

Correlation coefficient revealed a positive and significant relationship between the extent of adoption and variables namely family type, size of operational land holding, occupational status, mass media exposure, extension contact, risk preference, economic motivation. Whereas, for regression analysisthe variables which were found to have significant relationship with the dependent variable were considered. The multiple regression analysis with all the seven predictors produced $R^2=0.541$. Thus, this signifies that seven variables taken together could explain 54.1 percent of the total variation in respondent's extent of adoption.

The most important constraint faced by majority 100.00 per cent of the ginger growers was having no proper storage facilities and this was ranked as first amongst the other major constraints. The farmers had suggested a number of measures regarding solving of the problems they were facing but the most important measure suggested by majority 100.00 per cent of the ginger growers were that the Govt. should make arrangements for proper storage facilities. Hence, this measure was ranked first amongst other measures.

A study on adoption of improved practices of *boro* paddy cultivation by the farmers of Biswanath Sub-division, Sonitpur (ASSAM)

Purnima Saikia

The study entitled "A study on adoption of improved practices of *boro* paddy cultivation by the farmers of Biswanath Sub-division, Sonitpur (ASSAM)" was carried out during 2015-16. Ex-post-facto research design was followed. Purposive cum random sampling design was used for selection of respondents. A total of 120 respondents constituted the sample of the study. Data collection was done by adopting the personal interview technique administering a structured schedule. Frequency, percentage, mean, Standard deviation, co-efficient of variation, Karl Pearson's product moment coefficient of correlation, Multiple Regression and 't'-test were the statistical techniques used for the analysis of data.

The study revealed that majority of the respondents (45.84%) belonged to age group of up to 35 years and majority (30.00%) were illiterate. Moreover, majority of the respondents (84.16%) and (88.33%) had joint type family and medium level of annual income range between Rs.10156.34 to 134742.49, respectively. In case of operational land holding, it was found that majority of the respondents (43.33%) were marginal farmers and majority (60.00%) had only cultivation as occupation. Relating to mass media exposure, majority (44.16%) regularly get their information from newspaper. Regarding radio, internet, agricultural bulletins and documentary films, majority of the respondents (77.50%), (76.67%), (81.67%) and (100.00%) never used as their source of information, respectively. Majority (92.50%) and (75.84%) of the respondents regularly used television and mobile phones as their source of information respectively. Majority (86.67%) and (37.50%) of the respondents sometimes and never used exhibition and demonstrations as their source of information. Besides, other sources of information that were used by the respondents were KVKs, books etc. in following percentages 17.50 per cent used regularly, 30.84 per cent used often, 32.50 per cent used sometimes but 19.16 per cent never used. Majority of the respondents (62.50%) and (79.16%) had medium level of extension contact and social participation respectively. Regarding risk

preference and economic motivation, majority of the respondents (75.00%) and (85.84%) had medium level of risk preference ability and economic motivation respectively.

The study further revealed that majority (68.34%) of the respondents had medium level of extent of adoption in case of overall extent of adoption improved *boro*paddy cultivation practices. In case of recommended practice wise adoption level, the study revealed that all the respondents (100.00%) fully adopted the recommended varieties, practice of seed selection and sowing time of seed. Majority of the respondents (57.50%), (78.33%) and (77.50%) partially adopting the practices of nursery bed size, quantity of seed and plant protection measures in seed bed respectively. Majority of the respondents (65.84%) and (53.33%) partially and (65.84%) fully adopted the practices of manual weeding, numbers of weeding and time of gap filling respectively. Majority of the respondents (93.33%) and (79.16%) fully and partially adopted the practice of number of seedlings per hill and followed transplanting time respectively. Majority of the respondents (57.50%) partially, (55.84%) and (53.33%) fully adopted the practice of recommended fertilizer, urea and SSP in *boro* paddy respectively. Regarding the application of recommended dose of MOP, majority of the respondents (46.68%) did not adopt the practice. Majority of the respondents (90.00%) and (50.00%) fully adopted the practice of number of split application of urea and the practice of timing respectively and majority (82.50%) engaged in partial split application of urea. In case of pest and disease management, majority of the respondents (50.00%) and (80.84%) did not adopt the practice of quantity of chemical applied.

A positive and significant relationship was found between extent of adoption and type of family, size of operational land holding, annual income, occupational status, mass media exposure, extension contact, social participation and economic motivation. On the other hand, risk preference had a negative and significant relationship with the extent of adoption.

The most important problem faced by majority (95.00%) of the respondents was poor economic condition and it ranks first among their major problems. The most important measure suggested by majority (98.33%) of the respondents was strengthening of poor economic condition by providing financial assistance, input support etc. from govt., banks and other related agencies and it ranks first among their major measures.

A study on technological gap in adoption of scientific practices of tea cultivation by the small tea growers in Sonitpur district of Assam

Suman Parasar

The study entitled **'A Study on Technological Gap in Adoption of Scientific Practices of Tea Cultivation by the Small Tea Growers in Sonitpur District of Assam'** was conducted in Sonitpur district of Assam with the following objectives:

1. Study the socioeconomic characteristics of Small Tea Growers of Sonitpur district of Assam

2. Determine the extent of technological gap in adoption of scientific practices of tea cultivation by Small Tea Growers

3. Identify the factors influencing the extent of technological gap in adoption of scientific practices of tea cultivation by Small Tea Growers

4. Identify the problems in production and marketing of green tea leaves as perceived by the Small Tea Growers

Sonitpur district has three sub-divisions, namely, Tezpur, Biswanath and Gohpur. Out of which two sub-divisions (Tezpur and Biswanath) were selected at random. The sample of the study consisted of 100 respondents, out of these 50 respondents were selected from Tezpur sub-division and 50 respondents were selected from Biswanath sub-division. The data were collected with the help of a pre tested schedule by personal interview method. The statistical tools employed in the study included frequencies, percentage, mean, standard deviation, co-efficient of variation, multiple correlation co-efficient, multiple regression analysis and t- test were the statistical techniques used for analysis and interpretation of the data. Altogether 19 independent variables, viz., age, education, family type, family size, occupational status, institutional linkage, experience as tea grower, area under tea net annual income from tea , exposure to training, working capital availability for tea, utilization of information source, farm mechanization, economic motivation, management orientation, risk bearing ability, scientific orientation , decision making ability and knowledge level on scientific practices

of tea and 1 dependent variable viz., extent of technological gap in adoption of scientific practices of tea cultivation were included in the study. The procedure followed by Das (2013) was used to measure the extent of technological gap in adoption of scientific practices of tea cultivation.

Findings revealed that majority of the respondents (56.00%) belonged to the middle aged group while 25.00 per cent of the respondents belonged to the old aged group. Majority of the respondents (27.00%) had high school level of education followed by 24.00 percent respondents with middle school level of education. An equal proportion of them had higher secondary level of education. Majority of the respondents (77.00%) belonged to the nuclear family and had small family size (79.00%). Majority of the respondents (69.00%) had only cultivation as occupation followed by 18.00 per cent of respondents having cultivation + business as occupation. Majority of the respondents (38.00%) had membership of two or more organizations. Majority of the respondents (85.00%) had medium term (5 to 10 years) experience as a small tea grower followed by 15.00 per cent respondents with long term (more than 10 years) experience as a small tea grower. Most of them (78.00%) respondents having land area from 1.00 to 2.00 ha under tea cultivation followed by 18.00 per cent respondents having land area from 2.10 to 4.00 ha under tea cultivation. Majority of the respondents (82.00%) had medium net annual income from tea cultivation, medium level of working capital availability (90.00%) from tea cultivation. Majority of the respondents (83.00%) were not exposed to training on scientific tea cultivation. Majority of the respondents (59.00%) had medium information source utilization followed by 25.00 per cent with low information source utilization. Majority of the respondents (75.00%) had medium level of farm mechanization. Majority of the respondents (65.00%) had medium level of economic motivation, medium level of management orientation (55.00%), medium level of risk bearing ability (75.00%), medium level of scientific orientation (78.00%) and medium level of decision making ability (57.00%). Majority of the respondents (72.00%) had medium level of knowledge on scientific practices of tea cultivation, followed by 15.00 per cent respondents with low level of knowledge on scientific practices of tea cultivation.

With regards to technological gap majority of the respondents (71.00%) had medium overall technological gap in adoption of scientific practices of tea cultivation followed by 17.00 per cent respondents with low overall technological gap in adoption of scientific practices of tea cultivation. A small percentage of them (12.00%) were found with high overall technological gap in adoption of scientific practices of tea cultivation. The findings also revealed that practice wise maximum average technological gap was found in adoption of Doses of YTD mixture (70.90%) followed by Size of planting pit and Number of ploughing and harrowing with average technological gap scores being 61.71% and 57.21% respectively. The findings of correlation analysis revealed that variables family type, area under tea, economic motivation, management orientation, scientific orientation, risk bearing ability, exposure to training, decision making ability, knowledge level on scientific practices of tea cultivation and working capital availability had significant negative correlation with the extent of technological gap in adoption of scientific practices of tea cultivation by the small tea

growers. Variables age, education, family type, family size, institutional linkage, occupational status, net annual income from tea and farm mechanization had no significant positive correlation with the extent of technological gap in adoption of scientific practices of tea cultivation by the small tea growers.

The variables which were significantly correlated with the extent of technological gap in scientific practices of tea cultivation were further considered for multiple regression where the value of R^2 (0.5466) indicated that 10 independent variables could explain 54.66% of the variation in the extent of technological gap in adoption of scientific practices of tea cultivation by the small tea growers.

The most important problems faced by the small tea growers in production of green tea leaf in order of importance were scarcity of labour (rank I), incidence of Tea Mosquito Bug in green tea bushes (rank II), lack of knowledge regarding organic tea cultivation (rank III), lack of knowledge on scientific tea cultivation (rank IV), lack of land *patta* to avail incentives/facilities given by TBI (rank V), lack of cooperation from bought leaf factories (rank IV), lack of opportunity for training on scientific tea cultivation (rank VII), threat from stray animals (rank VIII), erratic climate factors (rank IX), high cost of irrigation (rank X) and high cost of chemical(rank XI). The most important problems faced by the small tea growers in marketing of green tea leaf in order of importance were low price of green leaves provided by the factories (rank I), lack of market information (rank II) and limited number of bought leaf factories (rank III).

Drying characteristics, mass transfer and assessment of nutrient loss of osmosized pineapple (*Ananas comosus*) slabs

Arup Hagrary

Fully mature good quality pineapples of 'Kew' variety were taken for the study. After cleaning and peeling, the fruits were then sliced into slices of 6 cm in diameter and 0.5 cm thickness. The pieces were weighed and immersed in osmotic solution made of sugar syrup at 50°, 60° and 70° Brix separately in two batches for 6 hours and 9 hour immersion time at room temperature. Pineapple slices were then dried in electrical oven (EOD), solar cabinet (CD) and solar conduction dryer (SCD) for 20h.

Physicochemical parameters of fresh pineapple and their changes in osmotically treated samples in different drying methods were evaluated. Results obtained were statistically analysed based on ANOVA. Significant differences were observed in respect of immersion time, syrup concentration and drying methods for all the parameters studied. The immersion time significantly interacted with syrup concentration and drying methods for all the characters. It was observed that, with increasing degree of Brix, loss of carotene increased significantly irrespective of immersion time. No significant changes were observed in ash content, crude fiber content, crude fat content due to increase in sugar concentration as well as immersion time. However, significant change was observed in protein content as a result of increase in sugar concentration and immersion time. Texture study results showed significant increase in hardness due to tissue hardening with increase in sugar concentration and immersion time. Changes in colour as a result of the treatments were non-significant. While analyzing the moisture loss data during drying in EOD, CD and SCD, it was observed that osmosized samples at lower concentration of sugar retain higher level of moisture which resulted in higher drying rate in all the drying systems. While studying the mass transfer behavior, it was observed that higher immersion time exhibited lower rate of mass transfer in comparison to lower immersion time and higher sugar concentration leads to higher rate of mass transfer.

Solid gain by pineapple slices increased with increase in sugar concentration at lower immersion time, whereas with increased immersion time the same was decreased.

Among the drying systems studied, electrical oven drying was found to be best from the perspectives of retention of physicochemical parameters, drying kinetics and desired mass transfer phenomena. Sensory evaluation of flavour, aroma, taste and overall acceptability resulted samples dried in EOD immersed for 6h at 70°Brix as the best treatment.

Formulation and evaluation of functional beverages from Jamun (*Syzygium cumini* L.) and Melastoma (*Melastoma malabathricum*)

Nandita Barman

The present investigation was conducted in the year 2016-17 with an aim to formulate and standardize functional RTS beverages from Jamun (*Syzygium cumini* L.) and Melastoma (*Melastoma malabathricum).* The initial physico-chemical and chemical color properties of the fruits were analyzed. Jamun fruit contains 22.60 mg/100g ascorbic acid, 13.68 g/100g total sugars, 5.24 g/100g reducing sugars, 2576.00 mg GAE/100g total phenols and 2381.00 mg QE/100g total flavonoids. Fruit extracts of Melastoma was found to have higher 6780.00 mg GAE/100g total phenols, 3844.00 mg QE/100g total flavonoids, 89.07 DPPH % Inhibition and anthocyanin content 983.40 mg/100g by single pH method and 823.44 mg/100g by pH differential method as compared to Jamun. Stevia Aqueous Extract showed relatively low sugar content and high antioxidant properties. Eight formulation of the RTS beverages (C_1, T_1, T_2 and T_3 with sugar and C_2, T_4, T_5 and T_6 with stevia) were prepared by blending the Jamun and Melastoma fruit juice in different proportions. With increase in incorporation levels of Melastoma fruit juice in the beverages, total phenols, total flavonoids, anthocyanin content, DPPH % Inhibition and CIE' L*a*b* color values increased as compared to the controls (100% Jamun). Based on the organoleptic evaluation T_2 and T_5 were selected for further processing and kept across storage conditions (refrigerated and room environment) for 180 days.

Across storage, physico-chemical parameters like pH, TSS, ascorbic acid was found to decrease significantly from 0 to 180 days with a significant increase in acidity, reducing sugar and total sugar content. However, among the beverages formulated with sugar, T_2 Preservative/ Refrigerated was recorded to have the minimum changes in physico-chemical properties followed by Pasteurized/ Refrigerated beverages. The chemical color properties and total phenols, total flavonoids, DPPH % Inhibition and anthocyanin content decreased with increases in storage period. However, significantly higher degradation in

physico-chemical and chemical color properties was observed in the beverages kept in room environment. Similar results were also observed for the beverages formulated with Stevia Aqueous Extract. The sensory attributes in terms of overall acceptability insicated that T_2 and T_5 can be stored successfully with preservatives in refrigerated conditions for a period of six month. The products were microbiologically safe for consumption.Thus, it can be concluded that the higher content of total phenolics, flavonoids and antioxidant capacity of *Melastoma* fruit suggests the possibility of its incorporation for development of newer speciality products with increased color stability. For low-calorie beverages Stevia (*Stevia rebaudiana*) can be used as natural sweetener with high antioxidant properties.

Preserving carambola (*Averrhoa carambola*) juice using hurdle strategy

Niranjan Kumar Sahu

Studies were carried out in the department of Horticulture, Assam Agricultural University during the period 2016-2017 with an objective of optimization of chemical preservative dose for preserving carambola juice using UV-C 254 nm radiation, pasteurizing temperature and preservative in a hurdle strategy and to make physiochemical, organoleptic and microbial evaluation of juice across storage period. So, the shelf life of the product shall be increased with the minimal loss of nutritional quality.

The juice extracted from ripe carambola was subjected to several treatments, viz., UV-C radiation 254 nm with a dose of 3.525 J/m², pasteurization at 78°C and sorbic acid salt of potassium sorbate as a preservative with the dose 200, 150 and 100 ppm, and their combinations.

Among all the treatments, UV-C radiation (T_1), pasteurization (T_2), preservative dose 200 ppm (T_3) the combination of pasteurization with UV-C radiation (T_6), pasteurization with preservative dosage (T_7, T_8, T_9), UV radiation with preservative dosage (T_{10}, T_{11}, T_{12}), and all the treatment combinations UV radiation, pasteurization and preservative dosage (T_{13}, T_{14}, T_{15}) was found most effective in the retention of shelf life. Physiochemical properties of the juice like ascorbic acid, total phenol content, and DPPH (%) inhibition decreased across the storage, while TSS, acidity, reducing sugar and total sugar values increased except (Control, T_4 and T_5) were decreased.

Among all the treatments, the treatment T_{10} (200 ppm of sorbic acid salt "Potassium sorbate" + UV-C) showed the highest ascorbic acid content (22.91 mg/100ml), the highest total phenol (71.66 mgGAE/100g) and DPPH (78.15%) inhibition, lowest decrease in pH (2.69) and lowest increase in total soluble solid (7.53 °Brix), acidity (0.73 %), total sugar (11.15 %), reducing sugar (7.09 %) during 90 days of storage. The microbial evaluation study also revealed that the treatment T_{10} showed no microbial growth till 120 days of storage, while in the control and only preservative treatment (T_4, T_5), microbial growth was

observed within 60 days of storage. There are two different genera of *Penicillium* spp. isolate 1 and isolate 2 were identified. In case of colour, it showed a minimum decrease in CIE L* value 34.86, with increase in a* value 3.77 and decrease in b* value 16.27

Though pasteurization is an effective process. In this experiment, it failed to retain the physiochemical and organoleptic properties due to the loss of heat labile nutrients.

Dehydration of Banana Blossom for Preservation and Development of Ready to Cook product

Pallab Malakar

Banana flower, or also known as banana inflorescence, banana heart, banana blossom and banana male bud is nutritional edible flower and is highly valued for its fibre content and other nutrients present. Consumption and utilization of banana flower is restricted due to cumbersome preparation procedures and the present investigation was carried out to develop ready to cook product by dehydration of banana blossoms of two different species namely *Musa balbisiana* (Bhimkal) and wild banana from hills. Florets beneath the bract were collected, pistil and membranous calyx removed, chopped and to prevent browning, immediately dipped into three different solution - 1% citric acid, 1% ascorbic acid and 5% salt solution for 30 minutes followed by drying in oven, under sunshine and with solar cabinet dryer. There were significant effects of drying methods, temperature and chemical treatments as well as their interaction on the different nutritional and phytochemical values of the processed products. Crude protein, crude fat, crude fibre, iron, potassium and flavonoid were found highest in products treated with 1% citric acid and dried in oven at 50^0C. L* value was highest at 50^0C, and decreased with an increase in temperature. Significantly greater L* value was observed in samples treated with 1% citric acid. There were no significant effects of drying temperature, chemical treatment or interaction between temperature and chemical treatment on rehydration ratio which was decreasing with increasing temperature. With higher crude fibre, ash, potassium and phytochemical contents, *Musa balbisiana* flowers are found superior over wild banana. Gradual decrease in the nutrient and phytochemical contents of dehydrated products across storage was observed for both the two species.

Antioxidant Properties in Green Tea as Influenced by Processing Techniques

Paramita Bharadwaj

Tea (*Camellia sinensis*) is primarily processed as black tea or green tea. Tea is one of the most widely consumed beverages worldwide due to the associated health benefits. In the recent past, consumer preference has been shifting towards green tea. The techniques of manufacturing green tea are relatively uncomplicated. Small tea growers in Assam have started manufacturing green tea from tea leaves plucked from their small holdings. However the techniques of manufacture vary among the processing units. Variations also exist in the manufactured tea depending on geographical conditions and planting materials used.

A study was carried out at Assam Agricultural University, Jorhat, to ascertain the variation in antioxidant properties as influenced by processing techniques. Green tea samples were collected from green tea manufacturers with different techniques of manufacture, during different flushes of tea, in April, May, August and October. The experiment was laid out in factorial completely randomized design with six treatments considering the processing techniques and the four different months of manufacture. The data revealed that the moisture content was highest in green tea manufactured during the month of August with 6.76% in treatment T_6 (pan roasting) and low in green tea manufactured during October with 3.30% in treatment T_3 (dipped in boiling water 1 minute). The mean highest moisture content was found to be in the range of 4.47% in green tea manufactured in April to 6.51% in green tea manufactured in August.

All the manufactured green tea samples were bright greenish yellow in colour with good cup characteristics. Biochemical analysis of the samples revealed that green tea manufactured by the treatment T_1 (steamed for 30 seconds) was the best among all the treatments and had highest antioxidant properties. Mean total polyphenol content was found to be in the range of 11.61 mg catechol equivalent g^{-1} to 15.42 mg catechol equivalent g^{-1}, with highest polyphenol observed in the treatment T_1 (steamed for 30 seconds) in green tea manufactured during August (20.38 mg catechol equivalent g^{-1}). Mean total flavonoid content was highest in treatment T_1 (steamed for 30 seconds) with 22.62 mg quercetin equivalent g^-

[1] and the lowest in treatment T_6 (pan roasting) with 18.23 mg quercetin equivalent g[-1]. Total flavonoid content was highest in treatment T_1 (steamed for 30 seconds) with 23.91 mg quercetin equivalent g[-1] in green tea manufactured during August and was lowest in treatment T_2 (dipped in boiling water for 10 seconds) with 13.66 mg quercetin equivalent g[-1] in green tea manufactured during April. The Total Antioxidant Activity was measured with the help of DPPH and it was expressed in percentage inhibition. Total antioxidant activity was highest in treatment T_1 (steamed for 30 seconds) in green tea manufactured during August (85.03%) and lowest in treatment T_6 (pan roasting) in green tea manufactured during April (61.33%). The mean highest antioxidant activity (78.76%) was recorded in treatment T_1 (steamed for 30 seconds) and mean lowest antioxidant activity (73.37%) was recorded in treatment T_3 (dipped in boiling water for 1 minute). The inhibition percentage was higher in green tea manufactured during August for all treatments.

Development and quality evaluation of 'ready-to-cook' steaks from Catla fish (*Catla catla*)"

Priyam Sharma

Good quality fish is not available throughout the year to meet the demand of people preferring fish as a part of their daily diet. Processing of raw fish to make it pan-ready is also time-consuming and not convenient for consumers particularly for the urban areas where the people are leading a very fast paced life. The present investigation was carried out to develop a 'ready-to-cook' fish product (fish steak) from Catla fish with good nutritional quality and longer shelf life. The work was conducted at Fisheries Research Center and Department of Biochemistry and Agricultural Chemistry, Assam Agricultural University, Jorhat, during 2016-2017.

Catla fish steaks treated with different preservatives *viz.,* dry salt (T_1), vinegar (T_2), salt + turmeric (T_3), salt+ turmeric+ vinegar (T_4) and vacuum packed, sealed and stored for a period of 21 days at -18°C was studied for different biochemical properties at different interval of time. A control set was kept without any preservative under vacuum packed condition. Out of the different treatments, T_4 was found the best treatment in view of the highest crude protein content (20.11%), overall acceptability (8.94), highest taste value (8.94) and flavor (8.44) and highest texture (8.81). Analysis of the microbial load revealed that all the treatments showed negative results, i.e., no microbial load in any of the treated samples were present. The control, although showed highest moisture content (78.30%), highest ash content (0.218%), highest fat content (2.63%), there was the presence of microbial load (7.08 cfu/g) and lowest protein content (17.90%) in all the replications.

From the findings of the study an economically viable protocol for commercial production of 'ready-to-cook' fish steaks from Catla fish (*Catla catla*) that is marketable and usable up to 21 days of storage, can be developed for commercial production and development of entrepreneurship.

Effect of milling on physical and nutritional properties of rice

Tania Bhattacharjee

Paddy is dehulled to obtain brown rice, which is milled before consumption. Degree of milling (DOM) affects various intrinsic and extrinsic properties of rice. Paddy (one each of glutinous and non- glutinous variety) was abrasively milled to various degree of milling (0-21%). The study was undertaken to model the milling qualities, colour, texture, vitamins and minerals i.e. with reference to milling qualities the head rice yield (HRY) which was found to decrease for non-glutinous rice variety from 66.87% at DOM 0% to 42.24% at DOM 21%. For glutinous variety, it was found to decrease from 71.38% at DOM 0% to 43.6% at DOM 21%. The total yield was also found to be decreasing with increase in DOM i.e. 74.09% at DOM 0% to 64.18% at DOM 21% for non-glutinous variety and for glutinous variety it was found to be 74.087% to 64.18% (DOM 0-21%).With increase of DOM the whiteness of the rice increased with an L* value ranging from59.58% to 67.96% on highest DOM. The colour difference was found to be very high varying from 0-21% DOM. Texture and other Nutritional qualities varied widely among the ranges of different DOM.

This research work was concerned with the loss of nutrients during the processing of rice using two varieties. Concentration of minerals was determined by using Atomic Absorption Spectroscopy (AAS). For mineral estimation rice samples were decomposed with concentrated nitric acid and absorbance of each sample and standards was noted. From graphs, concentration of minerals (Ca, Zn, Fe, P, Cu) was determined. With AAS mineral estimation, non glutinous rice was found to be more nutritious from nutritional point of view than glutinous variety. 6% DOM can be considered as overall threshold limit to retain nutritional properties. With increase in DOM, Fe and Cu loss in glutinous rice was less. From the study it can also be inferred that, brown rice is more nutritious as with polishing, nutrition level decreases abruptly. With increased DOM it further decreases and beyond 15%DOM nutritional benefits of rice are almost lost.

Thus, it was concluded in the study that degree of milling strongly affects the various quality aspects of milled rice which were successfully modelled during milling operation giving an average estimation that glutinous rice should not be subjected to DOM >6% for better economic return. However, for better market acceptability, non-glutinous rice can be subjected to 9-15% DOM from HRY perspective.

Foliar application of Gibberellic Acid on growth, flowering, yield and quality attributes of Gerbera (Gerbera jamesonii Bolus)

Abenla B. Jamir

The experiment entitled "Foliar application of Gibberellic Acid on growth, flowering, yield and quality attributes of Gerbera (*Gerbera Jamesonii* Bolus)." was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the year 2015-2016 and 2016-2017 with 7 treatments *viz.,* T_0 = Control, T_1 = 50 ppm GA_3, T_2 = 100 ppm GA_3, T_3 = 150 ppm GA_3, T_4 = 200 ppm GA_3, T_5 = 250 ppm GA_3, and T_6 = 300 ppm GA_3 in Randomized Block Design with 3 replications. The variety that was used during the experiment was Red Gem and the total area of the experiment was 99.75 m^2.

Pooled data over the two years indicated that the growth and flowering characters were significantly influenced by the application of different concentrations of Gibberellic acid. The highest value for most of the growth as well as flower attributing characters *viz*., plant height (48.36 cm), number of leaves per plant (32.12), leaf length (19.59 cm), leaf breadth (8.71 cm) leaf area (117.57 cm^2 $plant^{-1}$), leaf area index (2.32), number of suckers (15.10), number of flowers per plant (32.38), diameter of flower (11.58 cm), number of ray florets (44.63), number of disc florets (291.50), stalk length (44.13 cm), girth of flowering stalk (0.97 cm), longevity of flower (18.67 days), vase life (12.84 days), fresh weight of flower (12.74 gm) and dry weight of flower (2.49gm) were recorded by treatment T_3 (150 ppm). The early flowering in terms of days taken from planting to flowering (70.27 days), days to visibility of flower bud (61.35 days), days to bud opening from visibility (4.85 days) and days to full bloom from bud opening (4.00 days) were also exhibited by treatment T_3 (150 ppm), respectively. Similarly, T_3 (150 ppm) also recorded the highest value for chlorophyll content (11.56 mg g $^{-1}$). Available soil nitrogen (247.56 kg ha^{-1}), available soil phosphorus (39.78 kg ha^{-1}) and available soil potassium (119.42 kg ha^{-1}) was recorded highest by treatment T_0 (Control). Economics of cultivation revealed that the highest benefit cost ratio of 5.49 is obtained by T_3 (150 ppm) closely followed by T_4 (200 ppm) of 4.98.

It can be concluded that GA at 150 ppm has been able to positively influence the vegetative growth and flowering in gerbera resulting to be the best treatment among all the treatments taken during the course of this experimentation.

Abstract of M. Sc. Thesis
Department : Horticulture (BNCA)
Major Advisor : Dr. P. Mahanta

Effect of organic manure and pruning on growth, yield and quality of capsicum (*Capsicum annum* L.) grown under green house condition

Bhaibhav Gogoi

An experiment, entitled 'Effect of organic manure and pruning on growth, yield and quality of Capsicum (*Capsicum annum* L.) cv. Mahabharath' was carried out in the Experimental field of the Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University during 2015-16 in factorial randomized block design with four replications. The treatments comprised of four organics *viz*. Vermicompost (O1), FYM (O2), Enriched compost (O3), Compost (O4) and RDF (O5) as control and three levels of shoot pruning *viz*. Three stem (P1), Four stem (P2) and Zero pruning (P0) as control arranged in fifteen number of total treatment combinations. The crop was raised following the recommended package of practices with timely adoption of required plant protection measures. All the morpho-physiological, phenological characters, yield attributes, quality analysis and soil parameters were taken following standard methodology. The statistical analysis of the results clearly indicated significant variations with respect to all the above parameters under various treatments of organics and pruning.

The results revealed that among the morpho-physiological parameters, the highest plant height (120.50 cm), internodal length (17.38 cm), canopy spread (42.78 cm), LAI (2.94) and CCI (67.78) was observed under the treatment combination of O5P1 (RDF with three stem). Under the same treatment combination of O5P1, the crop required the minimum days for initiation of flowering (35.80 days), crown bud initiation (28.93 days), 50 % flowering (46.20 days) and harvesting (72.59 days). However, significantly more number of leaf (106.30) was found in O5P0. (RDF without pruning). In O5P2, the total dry matter was found significantly higher.

The yield attributes *viz.,* fruit length(8.17 cm) and girth(6.78 cm),fruit weight (181.50 g), fruit yield per plant (1453.30 g) and fruit yield per hectare (53.98 t ha-1) was recorded significantly higher in treatment combination of O5P2 *i.e.* RDF with four stem. However,

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the highest number of fruits per plant was recorded under O5P0.With regard to quality parameters, significantly higher values of TSS (4.98%) and ascorbic acid (68.13 mg/100g) were recorded under the treatment combination of O3P1 and O2P1, respectively.

Regarding the soil parameters, significantly higher values of soil pH (5.47) and organic carbon (0.75%) were recorded under organic treatments of T8 (enriched compost) and T2 (FYM) respectively. Soil nutrient status (NPK) was found superior in treatments consisting of recommended dose of fertilizers.

On the basis of morpho-physiological and phenological parameters, the treatment, T14 (O5P1 =RDF with three stem) was found as the best treatment. However, under the treatment, T15 (O5P2 =RDF with four stem), the highest yield and yield attributes were recorded. The quality parameters *viz.,* TSS and ascorbic acid were found significantly higher under the treatment of T8 (O3P1 =enriched compost with three stem) and T5 (O2P1 = FYM with three stem), respectively. The soil nutrient status was found superior under O5P2 (T15 = RDF with four stem).Study on economics of production showed that treatment combination O5P2 (T15 = recommended dose of fertilizer) gave the highest benefit-cost ratio of 4.8. Considering the growth, yield and economic of cultivation, the treatment consisting of RDF was found suitable under green house condition. However, comparing among the organic treatments, T9 (O3P2) can be considered as the better treatment with regard to improving yield and soil health.

Influence of Staking and Pruning on Growth and Yield of Tomato (*Solanum lycopersicum* Mill.)

Bikash Borah

The experiment entitled **"Influence of staking and pruning on growth and yield of tomato (*Solanum lycopersicum Mill.*)"** was carried out at the Instructional cum Research Farm, and in the laboratories of the Department of Horticulture and Department of Crop Physiology, B N College of Agriculture, AAU, Biswanath Chariali during 2015-16**.** The design of the experiment was Factorial Randomized Block Design with three replications. The two factors studied were: Factor A: staking and Factor B: pruning. There were four staking and four pruning levels *viz*. S1 = Staking with individual bamboo stick, S2 = Staking with bamboo fencing, S3 = Staking with vertical rope, S0= Control without staking, P1 = Maintenance of 1 stem, P2 = Maintenance of 2 stems, P3 = Maintenance of 3 stems and P0 = Control without pruning. As such there were 16 treatment combinations.

The morpho-physiological, yielding and quality parameters of tomato were significantly influenced by both staking and pruning treatments. Among the staking, S2 produced the maximum plant height (100.26cm), number of leaf (53.58), LAI (3.08), chlorophyll content index (29.29), chlorophyll stability index (80.63%), number of fruiting cluster (9.45), number of fruits per cluster (3.90), number of fruits per plant (34.99), individual fruit weight (29.04g), fruits yield per plant (934.14 g) and yield (41.50 t/ha). S2 was followed by S1 while, these were found to be lowest in S0.

Likewise, pruning gradually increased the plant height, leaf chlorophyll content index, chlorophyll stability index, number of fruits per cluster, fruit size and weight of individual fruit. Therefore, the best results were found in plant with one stem followed by double stem, triple stem and no pruning performed the poorest. However, the highest fruit yield per plant (888.79g), fruit yield per plot (17.77kg) and fruit yield (39.49 t/ha) were recorded in P2. The interaction effects of pruning and staking were also found to be significant in respect of these parameters during the study.

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Out of the different treatment combinations, S2P2 (bamboo fencing along with two stems) recorded the highest fruit yield per plant (1003.28g), fruit yield per plot (20.06 kg), fruit yield (44.57 t/ha) and B:C ratio (4.03:1) while, the lowest were recorded in S0P1 (no staking with one stem). In respect of fruit quality in terms of TSS and Ascorbic acid content the highest were recorded in S2T1 (7.11°Brix and 25.64 mg/100g respectively) followed by S2P2 (6.88 °Brix and 24.75 mg/100g respectively). The study therefore, suggests that staking with bamboo fencing and plant maintaining two stems (S2P2), which produced the highest yield with better fruit quality might be recommended among the tomato growers of this region for maximizing its production without compromising the quality.

Performance of gladiolus
(*Gladiolus grandiflorus* L.)" as influenced by
organic inputs

Dipanjali Baruati

An investigation was carried out during the period of 2015-2016 and 2016-2017 to study the performance of gladiolus (*Gladiolus grandiflorus* L.) as influenced by organic inputs in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat-13. The experiment was laid out with 8 treatments in Randomized Block Design and replicated 3 times. The treatments were T_1 {RDF(20:20:20g m^{-2} NPK + 4kg m^{-2} FYM)}, T_2 {Rock phosphate + Microbial consortium}, T_3{T_2 + Vermicompost (2.5 t ha^{-1})}, T_4 {T_2 + Vermicompost (5 t ha^{-1})}, T_5 {T_2 + Compost (2.5 t ha^{-1})}, T_6 {T_2 + Compost (5 t ha^{-1})}, T_7 {Enriched compost (2.5 t ha^{-1})} and T_8 {Enriched compost (5t ha^{-1})}. Pooled data analysis over two years revealed that growth, flowering, corm and cormel characters were significantly influenced by the application of different nutrient sources. Most of the growth, flowering, and yield characters were found highest in T_8 and T_4 which were at par. The earliest shoot emergence of 9.39 days and 9.46 days, highest plant height of 155.31 cm and 155.06 cm, highest 8.70 and 8.54 number of leaves, highest 141.55 cm^2 and 141.13 cm^2 leaf area and highest 1.51 and 1.50 leaf area index were observed respectively for T_8 and T_4 which were at par. For number of sprouts per corm planted T_4 recorded the highest 1.46 which was at par with 1.45 recorded for T_8

Early emergence of spike was recorded in the treatment T_8 *i.e.,* 69.30 days and T_4 recording 69.33 days, both being at par. This trend was reflected by early opening of the first floret (84.52 and 84.81days), highest number of spikes/corm (1.74 and 1.72), highest number of florets/spike (14.80 and 14.78), spike length (94.37cm and 94.03cm), rachis length (59.80 cm and 59.57cm) for T_8 and T_4 respectively. The highest self life of spike (17.84 days) and highest vase life of spike (14.17 days) were recorded in treatment T_8 which was followed by T_4 with a self life of 16.66 days and vase life of 12.92 days respectively. Likewise the maximum number of florets open at a time (8.22),largest size of floret (11.21 cm) and highest fresh weight of spike (100.41 g) was found in T_8 which was

followed by T_7 with number of florets open at a time (7.78), size of floret (10.59 cm) and highest fresh weight of spike (96.33 g) respectively.

In case of corm characters as well, T_8 and T_4 did not differ significantly exhibiting the highest weight of corm (91.19g and 90.37g) and largest corm size (7.86cm and 7.57cm) respectively while T_4 produced the maximum number of corms(1.83) but at par with T_8 (1.81). . These two treatments further exhibited highest and at par performance for most of the cormel characters.

Among the physiological parameters, the highest total chlorophyll content in leaf, highest LAD was recorded for T_8 but at par with T_4. Further T_4 and T_8 exhibited maximum NAR and highest LRWC without significantly differing from each other.

Soil parameters studies revealed that soil pH, OC, N, P, K, MBC and various soil enzyme activities were found highest in T_8.

Economics of production revealed that the highest B:C ratio of 3.72 was observed in the treatment T_4 followed by 3.68 in T_8. Hence considering the positive effect on growth, yield, quality and soil health, T_4 and T_8 both can be considered best for adopting at the field level to reap good economic yield with better quality, sustained soil health and high net return.

Growth and flowering of gerbera under hydroponics

Dolly Handique

An experiment was carried out at the experimental site, Department of Horticulture, Assam Agricultural University, Jorhat during September 2016 to May 2017 to study the "Growth and flowering of gerbera under hydroponics". The experiment was laid out in two factor Completely Randomized Design with three replications comprising of eight different growth media *viz.,* Control (untreated), T_1 (Sand gravel), T_2 (Coconut husk), T_3 (Coco peat), T_4 (Sand gravel+ Coconut husk), T_5 (Sand gravel + Coco peat), T_6 (Coconut husk+ Coco peat), T_7 (Sand gravel+ Coconut husk+ Coco peat) and four duration of nutrient application *viz.,* H_1 (Once daily), H_2 (Twice daily), H_3 (Alternate days) and H_4 (Two days interval).

The study revealed that growth media significantly influenced the growth and development of gerbera plants. Maximum plant height (32.62cm),leaves per plant (15.17), leaf breadth (9.04cm), leaf area (108.18cm^2), suckers per plant (4.63), early bud visibility (69.24 days), full bloom (17.79 days), flowers per plant (16.36), flower stalk length (51.90cm), flower diameter (8.59cm) and flower stalk dry weight (1.75g), self life (19.52 days), vase life (9.65 days), root fresh weight (10.72g), root dry weight (2.35g), root length (28.14cm), leaf relative water content (64.10%) and total chlorophyll content (1.405mg g^{-1}) were obtained in T_3. However, maximum leaf length (15.00cm), flower stalk fresh weight (10.68g) and roots per plant (14.62) was observed in T_6.

Regarding nutrient application, twice daily applied nutrient solution (H_2) significantly influenced the plant height (31.29 cm), leaves per plant (14.60) leaf length (14.32cm), leaf breadth (8.33cm), leaf area (100.49cm^2) suckers per plant (4.40), early bud visibility (75.43 days), full bloom (20.96 days), flowers per plant (14.46), flower stalk length (50.46 cm), flower diameter (8.23cm), flower stalk fresh weight (9.87g), flower stalk dry weight (1.42 g), self life (18.66 days) and vase life (9.02 days), root fresh weight (8.47g), root dry weight (1.63g) and root length (22.44cm), roots per plant (10.59), leaf relative water content (55.73 %) and total chlorophyll content (1.068mg g^{-1}).Treatment combination T_3xH_2 (Coco peat

with twice daily applied nutrient solution) was found best for all the recorded characters except leaf length (15.67 cm),flower stalk fresh weight (11.48 g) and roots per plant (15.31 g)which were maximum in T_6xH_2 (Coconut husk+ coco peat and twice daily applied nutrient solution) while dry weight of flower (1.80 g) was maximum in T_3xH_3 (Coco peat and nutrient solution applied at alternate days). Economics of production resulted that the highest B:C of 4.01 observed in treatment combination T_3xH_2. Thus, it can be concluded that growth media and duration of nutrient application significantly affect the overall growth and flowering in gerbera. Coco peat with twice daily applied nutrient solution could be recommended for better effect in gerbera.

Response of African Marigold to Pinching and Gibberellic Acid

Dweepjyoti Sarkar

The experiment entitled "Response of African Marigold to Pinching and Gibberellic Acid" (*Tagetes erecta* L) cv. Pusa Narangi Gainda was carried out at Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat (Assam) during 2015-17. The experiment was laid out in Factorial Randomized Block Design with three replications comprising 15 treatment combinations of five different concentration of gibberellic acid (GA$_3$ 0ppm, 50ppm, 100ppm, 150ppm and 200ppm) and three pinching levels *viz.,* no pinching, pinching at 20 days and pinching at 40 days after transplanting (DAT).

The result indicated that the important growth characters were significantly influenced by gibberellic acid and pinching treatments. The application of GA$_3$ at 200 ppm recorded significantly higher plant height (85.36cm), stem diameter (1.37cm), number of primary branches (15.65 branches/plant) and secondary branches (39.72 branches/plant), total leaf number (183.43) and Leaf Area Index (0.28). Among the pinching treatments, pinching at 40 DAT recorded significantly maximum number of primary branches (15.95 branches/plant) and secondary branches (40.55 branches/plant), stem diameter (1.35cm), total leaf number (180.54), Leaf Area Index (0.27); whereas maximum plant height (86.61 cm) and minimum days taken for flowering (43.86 days) was found under no pinching.

As far as flowering characters are concerned, days from bud to flower opening was significantly reduced (8.48 days) by the application of GA$_3$ at 200ppm. Duration of flowering (23.48 days), number of flowers (63.80), flower size (4.55cm), number of petals per flower (318.06) and flower yield (10.19t/ha) was also improved with the application of 200ppm GA$_3$. Among the pinching treatments, pinching at 40 DAT recorded highest blooming period (23.29 days), number of flowers (62.78), flower yield (10.20 t/ha) and self life of loose flower (7.21 days) followed by pinching at 20 DAT.

Physiological characters *viz*., Relative water content (67.96%) of petals, root length: shoot length (0.31), root volume (70.92cc) and total chlorophyll content (1.34mg g^{-1} FW) were increased considerably with GA$_3$ application at 200ppm. Among the pinching treatments, maximum root volume (69.77cc) and highest chlorophyll content (1.36mg g^{-1} FW) were obtained under pinching at 40 DAT.

Efficacy of biofertilizers and bioregulators in macropropagation of banana

Jonaki Narzary

An experiment was conducted under shade net house at the experimental farm, Department of Horticulture, Assam Agricultural University, Jorhat, during October 2016 to May 2017 to study "Efficacy of biofertilizers and bioregulators in macropropagation of banana". The experiment was laid out in Randomised Block Design with fourteen treatments comprising of two cultivars *viz.,* V_1 (Cheni Champa) and V_2 (Kachkal) and seven different substrates consisting of T_0 (Sawdust), T_1 [Sawdust+ VAM (30 g)], T_2 [Sawdust+ *Trichoderma viride* (30 g)], T_3 [Sawdust + VAM (30 g)+ *Trichoderma viride* (30 g)], T_4 [Sawdust+ IBA (2500 ppm)+ *Azospirillum* (30 g)], T_5 [Sawdust+ BAP (4 ml)+ *Bacillus subtilis* (30 g)] and T_6 [Sawdust+ BAP (4 ml)+ *Bacillus subtilis* (30 g)+ VAM (30 g)] replicated three times.

The results revealed that maximum growth and quality planting materials could be achieved by incorporation of additives like biofertilizers and bioregulators to the sawdust substrate. Among the treatments, V_1T_6 [Cheni Champa with sawdust+ BAP (4 ml)+ *Bacillus subtilis* (30 g)+ VAM (30 g)] had significant influence on time taken for bud initiation (23.22 days), number of secondary suckers (4.78), tertiary suckers (17.33) and percentage of suckers (90.33 %).

It was observed that with the advancement of the hardening period, the growth characters of tertiary suckers increased from the initial stage to the end of the hardening. In terms of growth parameters of tertiary suckers, sawdust+ BAP (4 ml)+ *Bacillus subtilis* (30 g)+ VAM (30 g) showed better result in both the cultivars. V_2T_6 [Kachkal with sawdust+ BAP (4 ml)+ *Bacillus subtilis* (30 g)+ VAM (30 g)] recorded significant influences on plant height (29.07 cm), stem girth (6.91 cm) and leaf length (35.63 cm) but V_1T_6 [Cheni Champa with sawdust+ BAP (4 ml)+ *Bacillus subtilis* (30 g)+ VAM (30 g)] gave best results for leaf breadth (15.33 cm), and weight of tertiary suckers (219.98 g), number of roots (19.56), root girth (1.45 cm) and the highest survival percentage (99.78 %). However,

V_1T_4 [Cheni Champa with sawdust+ IBA (2500 ppm)+ *Azospirillum* (30 g)] recorded the highest number of secondary roots (84.89), total chlorophyll content (1.53 mg/g FW) and leaf relative water content (73.95 %).

Economics of production revealed the highest B:C of 1.41 under V_1T_6 [Cheni Champa with sawdust+ BAP (4 ml)+ *Bacillus subtilis* (30 g)+ VAM (30 g)]. Thus, application of biofertilizers and bioregulators exhibited positive impact on macropropagation of banana.

Effect of Orchard Floor Management practices on Growth, Yield and Quality of Assam lemon (*Citrus limon* Burm.)

Jyaosi Roy

An experiment on "Orchard Floor Management Practices on Growth, Yield and Quality of Assam Lemon (*Citrus limon* Burm.)" was conducted during 2015-2017 at Instructional cum Research Farm, Department of Horticulture, B.N. College of Agriculture, AAU, Biswanath Chariali with three objectives to study (i) Effect of different orchard floor management practices on growth, yield and quality of Assam Lemon (ii) Effect of different treatments of orchard floor management on weed growth in Assam Lemon plantation, (iii) Effect of different treatments of orchard floor management on different properties of soil in Assam Lemon plantation. Eight treatment combinations were laid out in Randomized Block Design with three replications in the field. The treatments were T_1 (clean cultivation-removal of all weeds manually), T_2 (mulching with dry leaves -10 cm thick), T_3 (mulching with black polythene sheet -100 micron thickness), T_4 (cover cropping with cowpea-sown at 6 months interval), T_5 (green manuring with dhaincha -sown at 3 months interval), T_6 (cover cropping with sweet potato), T_7 (sowing of sesame in two seasons), T_8 (control *i.e.* without any treatment).

The results revealed that treatment T_3 (mulching with black polythene sheet -100 micron thickness) showed maximum plant height (190.40 cm), number of laterals per primary shoot (5.66), number of leaves (32.19) and total leaf area (961.20cm^2) with average number of hermaphrodite flowers (60.06) during April, 2016, fruit set (32.93 % in May, 2016), fruit retention (93.38 % in June, 2016), total number of fruits (810.18 per plant) harvested during one year of study and fruit yield (138.6 t/ha) with average fruit juice (27.55 %), titratable acidity (5.39 %), ascorbic acid content (39.31 mg/100 ml) were found to be highest in T_3 (mulching with black polythene sheet) while average fruit length (10.38 cm), diameter (5.47 cm), weight (155.30 g), volume (155.68 cc), pulp-peel ratio (3.46) in T_2 (mulching with dry

leaves). Assam Lemon fruits could be stored for 14 days by wrapping with shrink film under refrigerated condition with retention of green colour and minimum physiological loss in weight.

Total chlorophyll content was highest (1.25 mg g^{-1} of fresh weight) in T$_3$ (mulching with black polythene sheet). Soil moisture content in different treatments showed less variation among the treatments. However, moisture content was highest in July, 2016. Bacterial population increased significantly in different treatments over the bacterial population recorded before application of treatments whereas fungal population was found to be non-significant.

Postharvest studies on *Lilium*
(Asiatic lily cv. Black Out)

Kongkana Gogoi

The present investigation entitled "Postharvest studies on *Lilium* (Asiatic lily cv. Black Out)", was carried out in the experimental laboratory of Department of Horticulture, Assam Agricultural University, Jorhat, during January-February, 2017. During the entire course of study, two experiments i.e. standardization of suitable pulsing and holding solutions were conducted on lily flowers. Lily stems were harvested when the first flower bud showed full colour. The first experiment was laid out in Completely Randomized Design with 6 treatments and 2 pulsing duration (12 and 24 hours), replicated 3 times. The pulsing treatments were P_0 (distilled water), P_1 (10% sucrose), P_2 (100ppm $AgNO_3$), P_3 (10% sucrose+100ppm $AgNO_3$), P_4 (50ppm BA) and P_5 (10% sucrose + 50ppm BA). After the treatments, each stem was maintained for postharvest evaluation in an individual 300 ml conical flask with 100 ml of 2% sucrose solution. Within each treatment, the number of buds per stem were kept constant as possible for ease of data recording. Pulsing of cut stems with 10% sucrose and 50ppm BA (P_5) for 24 hours was observed to be best in terms of vase life (13.00 days), quality parameters and biochemical parameters *viz.,* uptake of pulsing solution (6.21 ml/ stem), higher rate of vase solution uptake and fresh weight, flower diameter (17.67 cm), total chlorophyll content (1.17 mg/g FW), relative water content (86.14%) and total soluble solid (4.45°Brix). However, P_5 was statistically at par with P_3, which gave the highest reducing sugar (5.18%) in tepals under 24 hours.

The experiment on standardization of holding solutions was also laid out in Completely Randomized Design with 10 treatments replicated thrice. The holding treaments were T_0 (distilled water), T_1 (2% Sucrose + 100ppm 8-HQC+100ppm GA_3), T_2 (2% Sucrose + 200ppm 8-HQC+100ppm GA_3), T_3 (2% Sucrose + 300ppm 8-HQC+100ppm GA_3), T_4 (2% Sucrose + 20ppm $AgNO_3$ + 150ppm Citric acid), T_5 (2% Sucrose + 30ppm $AgNO_3$ + 150ppm Citric acid), T_6 (2% Sucrose + 40ppm $AgNO_3$ + 150ppm Citric acid), T_7 (2% Sucrose+ 500ppm $Al_2(SO_4)_3$), T_8 (2% Sucrose+ 500ppm $Al_2(SO_4)_3$ +100ppm GA_3) and T_9

(2% Sucrose+ 500ppm $Al_2(SO_4)_3$ + 150ppm Citric acid). Among the treatments, T_5 resulted in highest vase solution uptake, fresh weight, delayed chlorophyll degradation, highest relative water content (84.24%), reducing sugar (5.53%) and minimum loss of dry weight (25.14%) which finally reduced the onset of petal senescence and recorded longest vase life (12.00 days). However, T_2 exhibited the largest flower diameter (16.76 cm) and highest TSS content (4.95°Brix).

Hence, considering the positive effects on post harvest quality, P_5 (10% sucrose + 50ppm BA) for 24 hours and T_5 (2% Sucrose + 30ppm $AgNO_3$ + 150ppm Citric acid) could be considered as the best for pulsing and holding solution, respectively.

Influence of biofertilizers on growth, flowering, yield and quality of Gerbera (*Gerbera jamesonii* bolus)

Nilasree Borah

An investigation was carried out during the period of 2015-2016 and 2016-2017 to study the "Influence of biofertilizer on growth, flowering, yield and quality of Gerbera *(Gerbera jamesonii* Bolus)" in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat-13. The experiment was laid out with 9 treatments in Randomized Block Design and replicated 3 times. The treatments were T_0 (Control), T_1 {*Bacillus subtilis* (4% solution per plot)}, T_2 {*Microbacterium laevaniformans* (4% solution per plot)}, T_3 {NPK (@15:10:20) g m^{-2}}, T_4 {Vermicompost (5 kg per plot)}, T_5 (½NPK + ½Vermicompost + *Bacillus subtilis*), T_6 (½NPK + ½Vermicompost + *Microbacterium laevaniformans*), T_7 (½NPK + ½Vermicompost + Consortia) and T_8 (Consortia). Pooled data analysis over two years revealed that growth, flowering, yeild and quality characters were significantly influenced by the application of different nutrient sources along with control. Most of the growth, flowering, quality and yield characters were found highest in T_7 The highest plant height (59.24cm), highest number of leaves (33.72), highest leaf area (3366.25cm^2), highest plant spread (43.45cm), highest leaf area index (1.79) and highest number of suckers per plant (13.33) were observed respectively for T_7. For most of the characters treatment T_7 and T_6 were at par.

Early visibility of bud from planting was recorded in the treatment T_7 *i.e.,* 61.09days. This trend was reflected by early opening of bud (8.65days), days taken for early full bloom from bud opening(3.55days), longer duration of flower(124.10 days), highest number of flowers per plant(34.33), highest flower diameter(9.78cm), highest disc diameter(3.70cm), length of flower stalk (50.37cm), girth of flower stalk(0.66cm) for T_7 respectively. The highest self life of flower(16.21days) and highest vase life of flower(10.78days) were recorded in treatment T_7 respectively. Likewise highest fresh weight of flower (12.85 g) and highest dry weight of flower (2.06 g) was recorded in treatment T_7 respectively.

Among the soil parameters studies revealed that highest soil pH (5.26), Organic Carbon (0.86%), N (276.9 kg ha^{-1}), K(135.1 kg ha^{-1}), MBC(379.23 µg g^{-1}soil 24 hour^{-1}) were found highest in T$_4$. For P(44.6 kg ha^{-1}) and Electrical Conductivity(0.19 ds/m) was recorded highest in treatment T$_7$.

Economics of production revealed that the highest B:C ratio of 4.85 was observed in the treatment T$_7$ followed by 4.57 in T$_6$. Hence considering the positive effect on growth, yield, quality and soil health, T$_7$ can be considered best for adopting at the field level to reap good economic yield with better quality, sustained soil health and high net return.

Performance of ridge gourd (*Luffa acutangula* Roxb.) as influenced by organic inputs

Nishant Barik

An investigation was carried out during the period of 2016 and 2017 to study the 'Performance of ridge gourd (*Luffa acutangula* Roxb.) as influenced by organic inputs' in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. A local OP variety of ridge gourd was used for the present study. The experiment was laid out in Randomized Block Design and replicated three times. There were seven treatments consisting of T_1 [RDF(20:30:30kg ha^{-1} NPK + 10t ha^{-1} FYM)], T_2 (Rock phosphate + Biofertilizer consortium + Compos t@ 2.5t ha^{-1}), T_3 (Rock phosphate + Biofertilizer consortium + Compost @ 5t ha^{-1}), T_4 (Rock phosphate + Biofertilizer consortium + Vermicompost @ 2.5t ha^{-1}), T_5 (Rock phosphate + Biofertilizer consortium + Vermicompost @ 5t ha^{-1}), T_6 (Enriched compost@ 2.5t ha^{-1}) and T_7 (Enriched compost @ 5t ha^{-1}).

Pooled data analysis over two years revealed that growth, flowering, yield and yield attributes were significantly influenced by the application of different nutrient sources. T_1[RDF(20:30:30kg ha^{-1}NPK + 10t ha^{-1} FYM)] recorded the highest value in all the growth and most of the flowering, yield and yield attributes among all the treatments. However, among the organic treatments the highest vine length (5.09m) in T_2, number of laterals (5.11) in T_5, number of nodes (37.72) in T_3 were observed. Regarding flowering parameters, the minimum days for appearance of the first male flower was recorded in T_7 (35.93 days) whereas for the first female flower appearance the minimum days were observed in T_5 (38.67 days). T_7 also recorded the minimum days to 50% flowering (36.22 days), the lowest node number of 3.44 and 5.33 at which the first male and female flower appeared respectively. T_5 recorded the highest female flowers (29.22). Regarding the yield and yield attributes, among the organic treatments T_5 recorded the highest fruits per vine (15.28), fruit girth (12.80cm) and fruit weight (92.85g). T_7 exhibited the highest fruit length (19.09cm). The highest fruit set percentage was observed in T_4 (54.48%). Both the minimum days to first picking (50.83 days) and the maximum days to last picking(104.06 days) were recorded in

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T_7 (Enriched compost@ 5t ha^{-1}). T_5 (Rock phosphate + Biofertilizer consortium + Vermicompost @ 5t ha^{-1}) exhibited highest yield per vine (1.42kg) and per hectare basis (118.40q ha^{-1}) among the organic treatments respectively which was followed by T_7.

In quality parameters, the organic treatments recorded superior results when compared to inorganic treatment. T_7 (Enriched compost @5t ha^{-1}) recorded the highest value on ash content (7.65%), total sugar (5.44%), reducing sugar (4.05%) which were followed by T_5. The highest leaf phosphorus (0.27%) and potassium (2.79%) were also observed in T_7. However, T_6 (Enriched compost@ 2.5t ha^{-1}) recorded the highest ascorbic acid (4.53 mg 100g^{-1}) which was followed by T_7. However, T_1 recorded the highest moisture content (93.60%) and leaf nitrogen (0.29%) which were followed by T_7 *i.e.* moisture 93.12% and leaf nitrogen (0.25%) The lowest physiological loss in weight (18.60%) was recorded in T_7 (Enriched compost @5t ha^{-1}) followed by T_5. However, the highest physiological loss in weight was recorded in T_1 [RDF (20:30:30kg ha^{-1} NPK + 10t ha^{-1} FYM)] and which reduced the storage life of fruits.

Regarding soil chemical parameters, T_7 (Enriched compost @ 5t ha^{-1}) recorded the highest pH (5.69), organic carbon (1.50%), available phosphorus (68.39kg ha^{-1}) and potassium (135.64kg ha^{-1}). However, the highest available nitrogen (278.92kg ha^{-1}) was recorded in T_5 (Rock phosphate + Biofertilizer consortium + Vermicompost @ 5t ha^{-1}). The highest microbial biomass carbon (494.82µg g^{-1} soil 24h^{-1}) along with the highest dehydrogenase activity (118.63µg TPF g^{-1}soil 24 hour^{-1}), fluoroscein diacetate activity(8.20 µg fluorescein g^{-1} soil h^{-1}), phosphomonoesterase activity (66.37µg p-nitrophenol g^{-1} soil h^{-1}), aryl sulphatase activity (21.14ìg p-nitrophenol g^{-1} soil h^{-1}), aryl esterase activity(154.41ìg p-nitrophenol g^{-1}soil h^{-1}) along with the highest microbial population of bacteria (6.55 log cfu g^{-1} soil) and fungi(3.93log cfu g^{-1} soil) were recorded in T_7 (Enriched compost @ 5t ha^{-1}).

The economics of production indicated that the highest benefit cost ratio of 3.37 was recorded in T_1[RDF(20:30:30kg ha^{-1}NPK + 10t ha^{-1}FYM)] followed by 2.29 in T_5 (Rock phosphate + Biofertilizer consortium + Vermicompost @ 5t ha^{-1}) with the highest net income of Rs 329797.12 per hectare among the organic treatments.

Hence considering the positive effect on growth, yield, quality and soil health, T_5 (Rock phosphate + Biofertilizer consortium + Vermicompost @ 5t ha^{-1}) is considered as the best for adopting at the field level to reap good economic yield with better quality, shelf life, sustained soil health and high net return.

Integrated Plant Nutrient Management in Guava (Psidium guajava L.)"

Porismita Dutta

An experiment was conducted to study the "Integrated Plant Nutrient Management in Guava (*Psidium guajava* L.)" in the Experimental Farm and Laboratory, Department of Horticulture, Assam Agricultural University, Jorhat during 2015-2017. A total of 9 (nine) treatments including a control with three replications and two seasons were laid out in a Randomized Block Design. The treatments comprising of T_0: Recommended dose of fertilizers (RDF) and manures as control; T_1: T_0 + 0.4% $ZnSO_4$; T_2: T_0 + 0.4% Boric Acid; T_3: T_0 + 0.4% $ZnSO_4$ + 0.4% Boric Acid; T_4: Half of RDF + 20kg FYM + 100g microbial consortium; T_5: Half of RDF + 20kg FYM + 100g microbial consortium + 0.4% $ZnSO_4$ + 0.4% Boric acid; T_6: Half of RDF + 10kg Vermicompost + 100g Microbial consortium; T_7: Half of RDF + 10kg Vermicompost + 0.4% $ZnSO_4$ + 0.4% Boric Acid; T_8: Half of RDF + 10kg Vermicompost +100g microbial consortium + 0.4% $ZnSO_4$ + 0.4% Boric Acid with the objectives to standardize the IPNM in guava for enhancing the yield and quality and to assess the soil chemical and biological properties under the IPNM. The treatments were applied in two different seasons: (1) Winter season, October 2015 (2) Rainy season, April 2016.

During the period of investigation, the treatments showed varied response to flowering, fruiting, yield attributing characters, yield and quality of the fruits. The highest flowers per branch (22.67), fruit set (79.52%) and the fruits per branch (18.00) were recorded in treatment T_8 during the rainy season. The highest fruit length (10.12cm), fruit girth (21.28cm), fruit weight (163.12g), fruit volume (141.42cc) and number of days for maturity (128.29 days) were recorded the highest in T_8 during the winter season while the lowest values were recorded in T_0 (Control). The yield was found to be the highest (24.24kg/plant) in T_8 during the rainy season.

Among the quality parameters, the treatment T_8 recorded the highest TSS (10.63°Brix), reducing sugar (3.72%), total sugar (7.21%), sugar acid ratio (39.49%), ascorbic acid content (261.47mg/100g) of the fruits, while non reducing sugar (3.62%), pectin (1.39%) and juice content (46.25%) were found to be the highest in T_7 during the winter season.

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After the application of the treatments, the highest leaf N, P, K contents were recorded in the treatment T_8. Soil parameters studies revealed that, organic carbon, soil pH, N, P, K, MBC and various soil enzyme activities were found to be the highest in T_8.

Evaluation from the economics of cultivation showed that, the highest benefit-cost ratio of 3.01 was obtained in T_8 followed by 2.42 in T_7. The lowest B: C ratio (1.51) was recorded in T_0 (Control). Thus, it can be suggested that, the treatment T_8 is the most profitable IPNM to improve flowering, yield and quality of guava.

Effect of orchard floor management practices on growth, yield and quality of banana cv. Malbhog (AAB)

Prajalita Dutta

The experiment on "Effect of orchard floor management practices on growth, yield and quality of banana cv. Malbhog (AAB)" was carried out at Instructional cum Experimental farm, Department of Horticulture, B. N. College of Agriculture, AAU, Biswanath Chariali during 2016-2017 to study the effect of orchard floor management practices on growth, yield and quality of Malbhog (AAB) banana, weed growth and on soil properties. Eight different treatments were laid out in Randomised Block Design with three replications in the field. The treatments were T_1: Clean cultivation by removing all the weeds at monthly interval, T_2: Post emergence application of glyphosate @ 3.0 l/ ha at 3 months interval, T_3: Mulching with dry leaves (10 cm thick), T_4: Mulching with black polyethene sheet (100 micron thickness), T_5: Cover cropping with cowpea (sown at 6 months interval), T_6: Green manuring with dhaincha (sown at 3 months interval), T_7: Cover cropping with sweet potato and T_8: Sowing of sesame in two seasons. Uniform size suckers of Malbhog banana were planted at a spacing of 2.1 m x 2.1 m in first week of April, 2016 following all the recommended pre-planting treatments. There were nine plants in each treatment.

All the treatments significantly influenced the growth, yield and quality of Malbhog banana. Among the treatments, T_3 (mulching with dry leaves) recorded tallest plant (143.33 cm), higher number of functional leaves (9.78), leaf area (5.62 m^2) and leaf area index (1.27) at vegetative stage while plant girth was higher at vegetative stage (39.67 cm) and at shooting (76.47 cm). Phyllochron (7.48 days), planting-shooting interval (312.55 days) and crop duration (399.50 days) were also found to be significantly shorter in T_3 as compared to other treatments. T_3 recorded the highest bunch weight (11.53 kg/plant), yield (26.15 t/ha), 2nd hand weight (2.01 kg), fruit length (20 cm) and circumference (14.17 cm), fruit weight (134.03g), pulp-peel ratio (4.65). Qualitative characters namely, TSS (22.84^{0}Brix), reducing sugar (6.81 %), non-reducing sugar (1.55 %) and total sugar (8.37 %) were also higher in

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T_3. The plants under T_8 (sowing of sesame in two seasons) showed longest phyllochron (8.51 days) and required longer duration of planting-shooting interval (361.78 days).

The most dominating weed was *Oxalis corniculata* (wood sorrel) and the least number of weeds was found in T_7 (40 nos./m^2) followed by T_3 (66 nos./m^2). Soil moisture content was highest during May, 2017 in 0-20 cm depth and during August, 2016 in 20-40 cm depth. Soil microbial count of bacteria and fungi increased over initial status and higher population of bacteria (7.82 log cfu/g) and fungi (7.04 log cfu/ g) were counted in T_4 (mulching with black polythene sheet) and T_5 (cover cropping with cowpea) respectively at harvest. Higher benefit-cost ratio of 3.51 was recorded in T_3 while the T_1 (clean cultivation) recorded the lowest benefit-cost ratio (1.65).

Effect of number of suckers per hill on growth, yield and quality of banana cv. Malbhog (AAB) in ratoon crop

Rupshree Borah

An experiment was carried out at instructional cum experimental farm, Department of Horticulture, BNCA, AAU, Biswanath Chariali during 2015-2016 to "study the effect of number of suckers per hill on growth, yield and quality of banana cv. Malbhog (AAB) in ratoon crop". The treatments were T_1 (mother plant + one sucker), T_2 (mother plant + two suckers), T_3 (mother plant + three suckers), and T_4 (mother plant + four suckers). There were two spacing - S_1 (2.1 m x 2.1 m) and S_2 (2.5 m x 2.5 m) for all the treatments. One treatment with recommended package of practices (control) was also included in the experiment. Nine treatment combinations were laid out in RBD with three replications. Growth and yield of Malbhog banana and quality of fruits were influenced by different treatments and spacing. T_4 (mother plant + four suckers) registered higher plant height (293.99 cm) than the control (269.44 cm) at shooting. But other morphological characters like plant girth, numbers of functional leaves, LAI were gradually decreased with the increased number of suckers per plant. Shortest crop duration (277.72 days) was recorded in S_2T_1 than other treatment combinations.

Number of fingers (92.75), finger weight (83.65 g), number of hands (7.27), bunch weight (9.41 kg /plant) were higher in S_2T_1 (mother plant + one sucker/plant in 2.5 m x 2.5 m spacing) Though the plants under control produced highest yield (22.84 t/ha) with higher benefit: cost ratio (5.19) but these plants required longest duration (159.95 days) from harvesting of first crop to harvesting of first ratoon crop. On the other hand, T_2 (mother plant + two suckers) recorded the shortest period (69.42 days) followed by 72.92 days in T_1 (mother plant+ one sucker) for harvesting of first ratoon crop from harvesting of first crop. Light intensity (31.67 lux) and CCI (37.65) were higher in T_1 (mother plant + one sucker) at shooting but in control these were 66.67 lux and 39.18, respectively. The fingers produced in T_1 (mother plant + one sucker) recorded higher contents of total sugars (15.14%), reducing sugars (7.97%), and TSS (26.28^0Brix). Considering higher yield (19.73 t/ha), shorter period from harvesting of first crop to harvesting of first ratoon crop (72.92 days) and benefit-cost ratio (4.75), S_1T_1 (mother plant + one sucker/plant with recommended spacing) might be considered for recommendation.

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Performance of lettuce (*Lactuca sativa*) types with staggered planting

Simanta Das

An experiment titled "Performance of lettuce (*Lactuca sativa*) types with staggered planting" was carried out in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2014-2015 with the objectives: to determine the best time of planting with identified suitable variety for Assam condition and to determine cost economics of the crop. The experiment was laid out in split-plot design with three main plot and six sub plots which was replicated three times. Three planting time i.e., S_1 (1st December, 2014), S_2 (15th December, 2014) and S_3 (1st January, 2015) were allotted as main plots and six varieties i.e., V_1 (Grand rapid), V_2 (Aryan), V_3 (Red sails), V_4 (Parris Island cos), V_5 (Summer time) and V_6 (Butter crunch) were allotted randomly as sub plots within the main plots.

The mean performance for growth characters revealed that S_1 (1st December, 2014) planting had recorded maximum for most of the growth as well as yield attributing characters *viz*., number of leaves plant^{-1} (20.54), leaf canopy spread (17.71 cm), fresh weight of plant (91.24 g), leaf moisture content (87.62%) and leaf yield hectare^{-1} (10.29 tha^{-1}). Similarly, S_1 also recorded the highest leaf phosphorus (27.2 mg), potassium (225.0 mg), â-carotene (1895.37 µg) as well as iron content (0.77 mg). S_2 (15th December, 2014) planting recorded more plant height (11.61 cm) and leaf dry weight (13.33 g). In respect of variety, V_3 (Red sails) had recorded maximum leaf fresh weight (111.72 g), dry weight (16.61 g) and leaf yield hectare^{-1} (12.74 tha^{-1}). While, V_2 (Aryan) had recorded maximum plant height (10.07 cm) and leaf canopy spread (20.37 cm). In case of interaction between planting time and variety, S_1V_3 (Red sails planted in 1st December, 2014) had recorded maximum leaf yield hectare^{-1} (13.97 tha^{-1}) with maximum leaf phosphorus (33.0 mg), potassium (237.67 mg) and iron content (1.21 mg). While, S_1V_1 (Grand rapid planted in 1st December, 2014) had recorded maximum number of leaves plant^{-1} (26.79), leaf ascorbic acid (4.22 mg) and â-carotene (2137.59 µg) content. S_2V_3 (Red sails planted in 15th December, 2014) had recorded maximum plant height (13.04 cm) and leaf fresh weight (118.49 g). S_2V_4 (Parris

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island cos planted in 15th December, 2014) had recorded maximum leaf nitrogen (4.25%) and crude protein (26.58%) content.

The cost economics indicated superiority of S$_1$V$_3$ (Red sails planted in 1st December, 2014) with 6.27 benefit cost ratio followed by 5.84 (B:C) in S$_2$V$_3$ (Red sails planted in 15th December, 2014).

Standardization of growing media and its depth for Rooftop Gardening of flower and vegetable crops

Subhankar Saha

An experiment was carried out on the rooftop of the Administrative Building of Assam Agricultural University, Jorhat during the year 2014-16 with a view to standardize the growing media and depth most suitable for rooftop gardening of flower and vegetable crops. Four crops each of flower and vegetable were selected representing different root forms for year round cultivation. The crops were subjected to five growing media at three different depths to study their effect. The experiment was laid out in factorial completely randomised block design with three replications. The crops were grown in five growing medias comprising of different components by volume at three different depths, *viz.* D_1:10cm, D_2:20cm and D_3: 30cm depths. The media compositions were G_1: soil + sand + coco peat + vermicompost (1:1:2:2), G_2: sand + coco peat + vermicompost (1:2:2), G_3: sand + coco peat + vermicompost + vermiculite (1:2:2:0.5), G_4: sand + coco peat + vermicompost + perlite (1:2:2:0.5) and G_5: sand + coco peat + vermicompost + vermiculite + perlite (1:2:2:0.25:0.25).

The results revealed that the growth, flower and flowering attributing characters of gerbera were significantly increased in the media, G_5 with the increase in depth of growing media. The highest plant height (40.83cm), plant spread (55.16cm), leaves per plant (47.35), leaf area (3646.21cm^2), root volume (104.18cc), root length (25.48cm) and root number (276.82) was recorded for D_3G_5. This interaction also recorded the least days to full bloom (82.22 days), largest flower diameter (10.09cm) and longest flower stalk (45.47cm). It also recorded the highest chlorophyll content (1.92mg g^{-1} FW) and the highest moisture content in plant (84.54%).

The highest mean of plant height of 44.64cm was recorded in G_5 and 50.18cm in D_3 in chrysanthemum. This had been reflected in their interaction D_3G_5 which recorded the highest among all the plant and flower characters with a spray number of 10.49. It also recorded the longest vase life (21.64 days) and the longest duration of bloom (64.76 days). The results also revealed the highest chlorophyll content and moisture content of 3.49mg g^{-1} FW and 91.11% respectively for D_3G_5.

The mean performance of growth and yield characters of lettuce revealed that the treatment D_3G_5 significantly produced the highest plant spread (42.94cm), root volume (30.77cc), root length (20.47cm), root number (184.64) and head yield (397.41g). The plant analysis further revealed 0.44mg g^{-1} FW chlorophyll content and 94.61% moisture in plant which were significantly higher compared to other treatments.

In broccoli, D_3G_5 produced maximum plant height (41.89cm), leaf area (941.00cm^2), plant spread (67.56cm), root volume (101.98cc), root length (19.65cm) and root number (99.37). The treatment further induced earliness as the days to head maturity of 94.13 days was recorded as lowest. The head diameter of (16.89cm) and yield per plant (384.85g) was recorded as highest for treatment $D_3 \times G_5$.

In summer marigold the results revealed that the growing media G_5 and the increased level of growing media depth had significant effect on growth, flower and flower attributing characters. Growing media G_5 at depth D_3 recorded the highest for plant height (65.49cm), plant spread (60.33cm), leaf area (579.14cm^2) and root length (25.88cm). Similarly for flower characters, the days to full bloom of 68.28 days was lowest and the flower diameter of 4.97cm was highest in treatment D_3G_5. Flower yield (237.21g) per plant and duration of flowering (63.68 days) was highest for D_3G_5.

Likewise in tuberose, combination D_3G_5 recorded the highest plant height (128.90cm), number of leaves (107.34), plant spread (61.22cm), leaf area (203.94cm^2), root volume (123.33cc), root length (26.44cm), weight per clump (670.85g) and number of bulbs (49.32). The days to opening of first pair of floret (106.67 days) were recorded as lowest indicating earliness and the highest number of florets of 47.57 were recorded for treatment D_3G_5. The longest spike (56.95cm) and maximum number of spike (1.74) were also recorded in treatment D_3G_5. The chlorophyll content (1.16mg g^{-1} FW) and plant moisture content (92.70%) were also highest for this treatment combination.

In okra, D_3G_5 exhibited highest plant height (128.12cm), maximum numbers of pods per plant (15.55) and highest yield per plant (323.75g). Further it produced produced the maximum leaf chlorophyll content (2.69mg g^{-1} FW).

Various growth characters of cucumber *viz*., vine length and number of branches have been found to be significantly different for different treatments. The longest vine (148.31cm) and highest number of branches (2.81) were produced by D_3G_3. Among the yield characters D_3G_3 produced maximum number of fruits (13.19) and the highest yield per plant (3.35kg) which was closely followed by D_3G_5 with values of 12.08 for number of fruits and 2.99kg yield per plant. The maximum leaf chlorophyll content (1.29mg g^{-1} FW) was observed for D_3G_3 treatment.

It may be inferred from the result of the present investigation, that a media composition of sand + coco peat + vermicompost + vermiculite + perlite in the ratio 1:2:2:0.25:0.25 by volume with a media depth of 30cm in the container could be considered as ideal for rooftop cultivation of flower and vegetable crops is best suited for rooftop cultivation of flower and vegetable crops.

Effect of organics on growth, yield and quality of Turmeric (Curcuma longa.L) cv. Tall clone

Takar Ronya

An experiment was carried out at the Instructional cum Research Farm, Department of Horticulture, B.N. College of Agriculture, AAU, Biswanath Chariali during 2016-17 to study the "Effect of organics on growth, yield and quality of Turmeric (*Curcuma longa* L) cv. Tall Clone". Experiment was laid out in an organic block where experiment was continued last two years (15.02.2014 to 15.02.2016) under NICRA, All India Coordinated Research Project for Dryland Agriculture, BNCA. The experiment was laid out in Randomized block design with seven treatments replicated four times. The treatments were T1: Recommended dose of fertilizer, T2*: In-situ* incorporation of Dhaincha, T3: FYM @ 10 t ha-1, T4: Enriched compost H" FYM @ 10 t ha-1 in the furrow at planting, T5: Vermicompost H" FYM @ 10 t ha-1+ Microbial consortia as slurry for treatment of rhizome at planting, T6: Microbial consortia as slurry for treatment of rhizome with vermiwash (1:7) + vermiwash spray (1:7) every month up to seven months of planting, T7: FYM @ 10 t ha-1+ Microbial consortia as slurry for treatment of rhizome at planting. Healthy rhizomes were planted in each plot with spacing of 45cm x 25cm in 4th week of April 2016. The treatments positively responded to the manures in respect to morphological, Physiological and yield attributing characters.

Among all the treatment, the recommended dose of fertilizer (T1) registered highest plant height (167.23 cm), number of leaves per plant (23.46), number of tillers per plant (3.90), leaf area of a single leaf (648.33cm2), leaf area per plant (15209.82cm2), leaf area index (12.42), Chlorophyll content index (32.14) and they were followed by treatment T7 and T4, these parameters were lowest in treatment T6. The highest light intensity of (77.50 105 lux) was observed in treatment T6. On the other hand, the highest number of mother rhizome (2.15), number of primary rhizome (6.54), number of secondary rhizome (16.79), number of tertiary rhizome (6.12), length of mother rhizome (11.16cm), length of finger rhizome (11.35), girth of mother rhizome (6.62cm), girth of finger rhizome (3.57cm), fresh weight of rhizome (424.25 g), dry weight of rhizome (72.08 g), and yield (335.25 q ha-1) were highest in T1 which were followed by T7 and T4 and these parameters were lowest in treatment T6.

The results revealed that the curing per cent and curcumin content was significantly influenced by different treatments. Amongst all the treatments (T7) showed better performance in terms of curing percentage (18.09%) and curcumin content (3.62%). No serious pests and diseases were observed in the experimental plot during the course of experiment. The treatment T5 showed the maximum soil PH of 5.50 while treatment T1 exhibited the maximum organic carbon (0.90%), available soil N (328.16 kg ha-1), P2O5 (36.28 kg ha-1) and K2O (215.17 kg ha-1). Soil moisture content showed highest of 14.22% in T7 and the maximum moisture content was recorded in the month of July. Studies on economics of production showed that the maximum benefit: cost ratio of 3.15 was obtained in the treatment T7.

From the present investigation, it can be concluded that after three years of cultivation organic manures (T7 and T4) could also perform equally with inorganic fertilizers in terms of growth and yield rather, perform better than inorganic in respect of quality of turmeric and was found to be optimum for economic cultivation of turmeric.

Bunch Feeding of Nitrogen (N) and Potassium (K) in Banana cv. Barjahaji (Musa AAA group)

Thanuram Teron

The present investigation entitled "Bunch feeding of nitrogen and potassium in banana (*Musa* spp.) cv. Barjahaji" was carried out at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during March 2015 to June 2016.

The experiment was laid out in Randomized Block Design and replicated thrice with nine treatments. The treatments comprised of T_1 (500g fresh cowdung), T_2 (500g fresh cowdung + 7.5g Urea), T_3 (500g fresh cowdung + 7.5g KCl), T_4 (500g fresh cowdung + 7.5g K_2SO_4), T_5 (500g fresh cowdung + 7.5g KNO_3), T_6 (500g fresh cowdung + 7.5g Urea + 7.5g KCl), T_7 (500g fresh cowdung + 7.5g Urea + 7.5g K_2SO_4), T_8 (500g fresh cowdung + 7.5g Urea + 7.5g KNO_3) and T_9 (Control). The bunch attributes and quality parameters were studied.

With respect to yield and yield attributing parameters, highest yield of (58.65 t ha^{-1}), highest finger length (22.28 cm), finger girth (14.10 cm), volume of fingers (254.25 cc), weight of fingers (148.73 g), weight of second hand (4.00 kg), and bunch weight (19.00 kg), were observed with T_7 (500g fresh cowdung + 7.5g Urea + 7.5g K_2SO_4).

The highest pulp to peel ratio of 3.40 was recorded in T_6 (500g fresh cowdung + 7.5g Urea + 7.5g KCl). Maximum rind thickness (3.56 mm) was observed in T_3 (500g fresh cowdung + 7.5g KCl) and T_5 (500g fresh cowdung + 7.5g KNO_3) with regard to fruit quality parameters, less acidity (0.23), the highest total soluble solids (29.23 °Brix), total sugars (17.42%), reducing sugar (9.09%), and non-reducing sugar (8.33%), were observed in the treatment T_7 (500g fresh cowdung + 7.5g Urea + 7.5g K_2SO_4).

In respect to shelf life, bunch feeding with 500g fresh cowdung + 7.5g Urea + 7.5g K_2SO_4 had attained the highest shelf life (7.67 days). Bunch feeding of 500g fresh cowdung + 7.5g Urea + 7.5g K_2SO_4 was superior in terms of maximum gross returns (Rs. 169867.52 ha^{-1}), net returns (416632.48 ha^{-1}) and benefit cost ratio (2.45) were obtained.

Hence bunch feeding of 500g fresh cowdung + 7.5g Urea + 7.5g K_2SO_4 can be recommended for banana cv. Barjahaji (AAA) for getting higher yields with best quality fruits of higher shelf life.

Comparative performance of few F_1 hybrids of cucumber (*Cucumis sativus* L.) under poly-house as off-season crop and as normal crops in open condition

Twarita Das

An experiment was conducted on cucumber (*Cucumis sativus* L.) at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2015-16 to study the "Comparative performance of few F_1 hybrids of cucumber (*Cucumis sativus* L.) under poly-house as off-season crop and as normal crops in open condition". A total of six varieties with five replications were laid out in a Randomized Block Design. The varieties grown were Don, Malini, Sedona, NS 404, Alisha and Noori for both polyhouse and in open condition. The studied characters showed significant differences among the varieties under two different growing conditions. The highest vine length (285.61cm) was observed in hybrid Don under polyouse. In open condition, the highest vine length (170.80 cm) was observed in variety Noori and the lowest was observed in NS 404.

Regarding the reproductive parameters minimum number of days to first pistillate flower appearance and early nodal position (30.80 and 27.40 days) and (3.18 and 3.96) under both polyhouse and open condition was recorded in Malini. The total number of pistillate flower (27.0), fruit number (21.0) was counted highest in Don under polyhouse and therefore, the fruit set per cent (77.77) was also highest. However, in open condition Noori was found to have the highest total number of pistillate flower (22.4), fruit number (17.0) and fruit set per cent (75.82). With regard to fruit characteristics, the shortest period of days taken for first fruit picking (44.0 and 41.4) under polyhouse and in open condition, respectively was noticed in hybrid Malini. Hybrid Sedona performed better with regard to fruit length, fruit diameter and fruit volume by registering 17.18cm, 4.42cm and 268.60cm^3 under polyhouse and 16.59cm, 4.13cm and 257.40cm^3 in open condition, respectively.

All the varieties showed significant differences in yield as a result of more number of pistillate flowers per vine and total number of fruits per vine. Don and Noori expressed

their superiority over other hybrids in terms of higher yield (4.75kg vine^{-1} and 3.92kg vine^{-1}) under polyhouse and in open condition, respectively. The highest average fruit weight under both polyhouse and open condition was recorded with Sedona (243.79g and 240.37g).

The highest TSS content (4.06°B), highest total sugar 3.46% and reducing sugar 0.58% was observed in Malini under polyhouse. However, Sedona was found to have highest maximum TSS content (4.22°B), total sugar 3.51% and reducing sugar 0.61% in open condition. High ascorbic acid content as mg 100g^{-1} under both polyhouse and in open condition (6.38 and 6.25) and the highest SOD activity (28.47 and 26.94ì mg^{-1} protein), respectively was observed in Alisha.

Under polyhouse the maximum B:C ratio of 9.38 was obtained in hybrid Don and where as in the open condition Noori was found to have the highest B:C ratio of 1.41. Hence, it can be concluded that under polyhouse higher productivity and maximum benefit was obtained than the open condition in subtropical climate like Jorhat, Assam.

Integrated Nutrient Management in Okra [*Abelmoschus esculentus* (L.) Monech]

Vikash Kumar

A field experiment was conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during March to July 2016 to study the effect of "Integrated Nutrient Management in Okra [*Abelmoschus esculentus* (L.) Monech]". The experiment was laid out with Randomized Block Design and replicated three times. There were seven treatments consisting of T_1 [RDF (50:50:50 kg N,P,K ha^{-1} + FYM @ 10 t ha^{-1})], T_2 [75% RD of N,P,K + Vermicompost @ 1 t ha^{-1} (mixed with microbial consortium)], T_3 [50% RD of N,P,K + Vermicompost @ 2 t ha^{-1} (mixed with microbial consortium)], T_4 [75% RD of N,P,K + Microbial consortium as seed coat + Vermicompost @ 1 t ha^{-1}], T_5 [50% RD of N,P,K + Microbial consortium as seed coat + Vermicompost @ 2 t ha^{-1}], T_6 [FYM @ 10 t ha^{-1} (mixed with microbial consortium)] and T_7 [Microbial consortium as seed coat + FYM @ 10 t ha^{-1}] with an objective to study the effect of organic, inorganic and biofertilizers on growth, yield and quality of okra as well as soil chemical and biological properties. The results revealed that growth and yield attributing characters were significantly influenced by the application of INM treatments. The highest plant height (118.52 cm), branches per plant (1.80), number of leaves per plant (14.66), leaf area index (1.36), chlorophyll content of leaf (0.210 mg g^{-1}), days taken to 1st flowering (46.20) and days taken to 1st fruiting (47.33) were recorded in T_1 [RDF (50:50:50 kg N,P,K ha^{-1} + FYM @ 10 t ha^{-1})] followed by T_2 [75% RD of N,P,K + Vermicompost @ 1 t ha^{-1} (mixed with microbial consortium)]. The highest number of fruits per plant (16.00), fruit length (14.62 cm), fruit girth (4.64 cm), fruit weight (12.56 g), fruit yield per plant (190.96 g) and fruit yield per hectare (12.70 t) were found in treatment T_1. However, among the INM treatments T_2 [75% RD of N,P,K + Vermicompost @ 1 t ha^{-1} (mixed with microbial consortium)] recorded the highest number of fruits per plant (14.90), fruit length (13.10 cm), fruit girth (4.44 cm), fruit weight (11.50 g), fruit yield per plant (176.35 g) and yield per hectare (11.75 t). All the growth, yield and yield attributing parameters were significantly poor in T_7 [Microbial consortium as seed coat + FYM @ 10 t ha^{-1}].

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Major Advisor : Dr. J. Saikia

Among the quality parameters, T_3 [50% RD of N,P,K + Vermicompost @ 2 t ha^{-1} (mixed with microbial consortium)] recorded the highest carbohydrate content (6.98 g 100g^{-1}) and ash content (9.07%) which was also found to be at par with T_5 followed by T_2. However, T_1 [RDF (50:50:50 kg N,P,K ha^{-1} + FYM @ 10 t ha^{-1})] exhibited highest moisture content of 91.64 per cent and crude fiber of 17.37 per cent.

The results of soil analysis after harvest clearly indicated that the available NPK in all the treatments improved over initial availability. The microbial population and various enzymatic activity also improved markedly over the initial value. However, soil parameter studies revealed that soil organic carbon, N, P, K, Microbial Biomass Carbon and various soil enzyme activities were found highest in T_3 [50% RD of N,P,K + Vermicompost @ 2 t ha^{-1} (mixed with microbial consortium)] which was also found to be at par with T_5 followed by T_2.

Economics of production showed that the highest B:C ratio of 3.89 was observed in T_1 [RDF (50:50:50 kg N,P,K ha^{-1} + FYM @ 10 t ha^{-1})] followed by INM treatment T_2 [75% RD of N,P,K + Vermicompost @ 1 t ha^{-1} (mixed with microbial consortium)] with 3.63. Hence, considering the positive effect on growth, yield, quality and soil health, T_2 [75% RD of N,P,K + Vermicompost @ 1 t ha^{-1} (mixed with microbial consortium)] can be considered as the best for adopting at the field level to reap good economic yield with better quality, sustained soil health and high net return.

Integrated management of *Meloidogyne incognita* and *Sclerotinia sclerotiorum* disease complex on French bean (*Phaseolus vulgaris* L.)

Ananya Dutta

In the present study on the interaction of *Meloidogyne incognita* and *Sclerotinia sclerotiorum* on French bean, the results indicated that the dual inoculation treatments significantly decreased plant growth parameters over the treatments with *S. sclerotiorum* @ 0.2% w/w and *M. incognita* @ 1000 J_2/kg of soil. The treatment with *M. incognita* @ 1000 J_2/kg of soil and *S. sclerotiorum* @ 0.2 % w/w simultaneous inoculation was statistically superior in decreasing the plant growth parameters of French bean. However, the number of galls, eggmasses and final nematode population in soil were found maximum in single inoculation treatment than dual inoculation treatments. The highest number of galls, eggmasses and nematode population were observed in the treatment with *M. incognita* @ 1000 J_2/kg of soil. Maximum disease incidence was recorded in the treatment with *M. incognita* @ 1000 J_2/kg soil + *S. sclerotiorum* @ 0.2% w/w after 15 days inoculation.

Studies on the efficacy of biocontrol agent and chemicals against *M. incognita* and *S. sclerotiorum* disease complex on French bean under net house condition showed that all the treatments differed significantly over control in respect of increasing plant growth parameters. The seed treatments with *T. harzianum* @ 5ml/ kg + seed treatment with carbendazim 0.05% w/w + soil application with carbofuran @ 0.5 kg a.i/ha was found to be most effective in increasing plant growth parameters of French bean. All the treatments significantly decreased the number of galls, eggmasses and final nematode population in soil except control and the treatment with carbendazim @ 0.3% w/w. However, the treatment with carbofuran @ 1 kg a.i/ha was found to be best in suppressing the number of galls, eggmasses and final nematode population in soil. Maximum reduction in disease incidence was recorded in the seed treatment with *T. harzianum* @ 5ml/ kg + seed treatment with carbendazim 0.05% w/w + soil application with carbofuran @ 0.5 kg a.i/ha.

Management of root knot nematode, *Meloidogyne incognita* on carrot

Keshab Hazarika

In the present study on use of chopped leaves for the management of *Meloidogyne incognita* on carrot under pot condition showed that all the treatments were found to be effective in increasing plant growth characters, reducing number of galls and egg masses per root system and final nematode population in soil over control. The treatment with *Azadirachta indica* @ 1.5% (w/w) was found to be effective in increasing plant growth characters. Maximum reduction, in number of galls and egg masses per root system, and final nematode population was observed in the treatment with *A. indica* @ 1.5% (w/w) followed by *Tagetes erecta* @ 1.5% (w/w).

Studies on management with *Glomus fasciculatum*, consortia (*Trichoderma viride*, *T.harzianum* and *Pseudomonas fluorescenes*) vermicompost alone or in combination on carrot, under field condition showed that all the treatments had effectively increased plant growth parameters and yield of carrot over control with corresponding decrease in number of galls and egg masses per root system and final nematode population in soil. The treatment with *G. fasciculatum* @ 300 spores/m^2 + consortia @5ml/lt + vermicompost @ 1.25kg/ha was found to be most effective in increasing plant growth parameters, yield of carrot and reducing number of galls and egg masses per root system and nematode population in soil.

Exploitation of native biocontrol agents for the management of Meloidogyne incognita infecting okra

Kurulkar Uday J

Survey was conducted during 2014-15 for the isolation of native fungal biocontrol agents from eggmasses of *Meloidogyne incognita* infecting various crops in Assam. A total of 29 fungal isolates comprising of 7 genera with 9 species viz., *T. harzianum, P. niphetodes, A. falciformi, F. oxysporum, F. solani, A. niger, A. flavus, V. leguminacea, Penicillium* sp. were recovered from five different locations of Jorhat and golaghat district of Assam viz., Charigaon ,Alengmora, Danichopari, Namdeori and Barbheta. All the species showed varied relative frequency of occurance, *F. oxysporum* being the most frequently occurred species with 31.03 per cent of total fungal isolates. Further, these bioagents including unidentified species were evaluated for their efficacy on parasitism of eggs, egg hatch and juvenile mortality of *M. incognita* under *in-vitro* conditions. Among the bioagents *T. harzianum, P. niphetodes, A. falciformi, F. oxysporum and F. solani* were found to be egg parasitic in nature. However, the efficacy varied among bioagents and high percentage of egg parasitism, egg hatch inhibition and mortality of *M. incognita* juvenile with low LC_{50} value of culture filtrate at different exposure time were recorded in the bioagent *T. harzianum* and found to be best bioagent. Hence *T. harzainum* was selected for studying its efficacy against *M. incognita* under pot conditions. For this, *T. harzianum* was applied either as seed treatment and/or soil application or both. Carbosulfan as seed treatment and carbofuran as soil application were applied as chemical checks both either singly or in combination. The results showed that either *T. harzianum* or the chemicals (Carbosulfan and Carbosulfan) when applied together as seed treatment and soil application, significantly improved plant growth parameters of okra and reduced nematode multiplication as compared to when they were applied either as seed treatment or soil application. Application of chemicals either as seed treatment or soil application emerged as most effective treatment as compared to *T. harzianum* increase in plant growth parameter and reducing nematode multiplication.

However, in respect of *T. harzianum* when applied together as seed treatment and soil application showed significantly better results in increasing in plant growth and reduction in nematode multiplication as compared that of the treatments with carbosulfan as seed treatment and carbofuran as soil application alone. Further, all the treatments significantly improved the plant growth parameters of okra and reduced the nematode multiplication from that of control.

Mechanism of fungal bioagents in the management of root knot nematode, *Meloidogyne incognita*

M. Annapurna

Four fungal bioagents *viz*., *Trichoderma viride*, *T. harzianum*, *Pochonia chlamydosporia* and *Purpureocillium lilacinum* were screened for their efficacy against *M. incognita* under *iv-vitro* conditions. The culture filtrates of these fungal bioagents were found to be effective in inhibition of egg hatch and mortality of second-stage juveniles at various concentrations. Among them *T. harzianum* was found to be most effective bioagent against *M. incognita* in respect of larval mortality and egg hatch inhibition. However in respect of egg parasitism, *P. chlamydosporia* was found to be most effective. Dose-response models were used in the larval mortality test to determine the concentration of culture filtrate required to kill 50 per cent of the juveniles. The culture filtrate of *T. harzianum* showed the highest activity with a LC_{50} value of 29.617 at 96 hrs of exposure.

In another experiment, analysis of defense related enzymatic activities of the bioagents *viz*., T. *viride*, *T. harzianum*, *P. chlamydosporia* and *P. lilacinum* against *M. incognita* on Tomato were carried out and showed profound influence on induction of defense related enzymatic activity against *M. incognita*. Among the bioagents *T. harzianum* showed highest activity of PO, PPO, PAL and total phenol content after 15, 30 and 45 DAI. In respect of plant growth parameter and nematode multiplication, these bioagents were found to be increasing the plant growth parameters of tomato and decrease galls and egg masses in roots and final nematode population in soil as compared to the control. However, *T. harzianum* was found to be most effective in increasing plant growth parameters and decrease in galls and egg masses in roots and final nematode population in soil. The results of present investigation revealing some of the mechanisms of fungal bioagents against root knot nematode might beef great help in formulating root knot nematode management programme.

Morphological and Morphometric variations of Genus, *Paratylenchus* and *Macroposthonia* in Assam

Namita Hazarika

The present investigations were carried out to study the morphological and morphometric variation of genus *Paratylenchus* and *Macroposthonia* from Upper Brahmaputra Valley Zone of Assam. Altogether 354 soil samples were collected from four districts of Upper Brahmaputra Valley Zone and *Macroposthonia viz*., Jorhat, Golaghat, Sivasagar and Dibrugarh from the rhizosphere of rice, maize, brinjal, banana, citrus and tea. The population of both the genera collected from four districts were identified as *Paratylenchus curvitatus* and *Macroposthonia onostris*. The present study revealed that 'V' ratio and stylet length were the stable characters (C.V. 1.16-4.89%) for *Paratylenchus curvitatus* while, body length, a, b, lip height and lip width, MB , basal bulb width, lip width are the least variable characters (C.V. 4.17-12%); c, c´, basal bulb are moderately variable character (C.V. 10.53-20.50%).

The study on morphometric and allometric variations of *Macroposthonia onostris* from Upper Brahmaputra Valley Zone of Assam concludes that V ratio and MB ratio were the stable characters (C.V. 0.55-7.32%) for *M. onostris* while a, b c, c´, lip annules, Roes, Rex, Rv, Ran, are the moderately variable characters (C.V. 2.29-18.82%). Body length, R, Rst, Rvan are highly variable characters (C.V. 6.37-36.93%) for *M. onostris*.

Survey and management of citrus nematode on khasi mandarin

Palash Lushon Borthakur

The present investigations were carried out to know the occurrence and distribution of plant parasitic nematodes associated with citrus plants of different citrus orchards in Dibrugarh district. Soil sample were collected from the different citrus orchards of seven blocks from Dibrugarh district. Eight genera of plant parasitic nematodes were found to be associated with citrus plants of Dibrugarh district. Genera of plant parasitic nematodes recorded were namely *Tylenchulus*, *Hoplolaimus*, *Helicotylenchus*, *Tylenchorhynchus*, *Meloidogyne*, *Xiphinema*, *Paratylenchus* and also nematodes genera found under criconematids.

Community analysis of plant parasitic nematodes revealed that the genus *Hoplolaimus* ranked first in relative frequency, absolute frequency, absolute density, relative density and prominence value. Genus *Helicotylenchus* ranked second in absolute density, relative density and prominence value and genus *Tylenchorynchus* ranked third in case of absolute density absolute frequency and prominence value. Results shown that *Tylenchulus semipenetrans* ranked second in absolute frequency and relative frequency and fourth in prominence value.

Studies on the effect of *Paecilomyces lilacinus, Glomus fasciculatum, Trichoderma harzianum,* vermicompost and carbofuran 3G in the management of *Tylenchulus semipenetrans* on khasi mandarin under pot condition showed that all the treatments were effective in increasing plant growth parameters of khasi mandarin. All the treatments significantly decreased final nematode population in soil and root over control. The treatment with vermicompost @ 15g/plant+ *T. harzianum* 10g/plant found to be most effective in plant growth parameters of khasi mandarin. The treatment with carbofuran 3G@ 4g/plant was found to be best in suppressing the final nematode population in soil and root followed by the treatment with *G. fasciculatum* @ 150spores/plant + *P. lilacinus*@10g/plant.

Biocontrol potential of *Pasteuria penetrans* against *Meloidogyne incognita*

Pallabi Roy

In the present investigation an effort was made to study the biocontrol potential of *Pasteuria penetrans* against *Meloidigyne incognita*. Two isolates of *Pasteuria penetrans* Assam isolate (AM) and Delhi isolate (DL) were taken for the purpose of this experiment. The isolates were taken in the form of root powder suspension in different concentration. Study on the spore encumbrance on root-knot juvenile and on the number of encumbered juvenile revealed that Assam isolate of *Pasteuria penetrans* is more effective than Delhi isolate. Highest number of encumbered J2 and number of spore per J2 was recorded in the highest level of bacterium inoculums in both the isolates.

Studies on management of root-knot population by the bacterial isolates showed that, both the isolates were effective in reducing nematode population in tomato roots, thereby improving the plant growth parameters. Plant growth parameters like plant height, fresh and dry shoot weight increased in accordance with the increase in bacterial inoculum levels. Likewise, number of galls, egg masses and nematode population also declined with corresponding increase in inoculum levels of bacterial parasite. There was an increase in the density of bacterial spores with increase in inoculum levels of *Pasteuria* in both the isolates.

Preliminary screening of some botanicals on Brinjal (*Solanum melongena* L.) against Root-Knot Nematode, *Meloidogyne incognita*

Pranjal Bhuyan

Nematicidal activity of twenty one leaf aqueous extract of botanicals like *Melia azadarach, Nycanthus arbor-tristis, Ocimum gratissimum, Piper betle, P. nigrum, P. hydropipper, Ricinus communis, Terminalia arjuna, Vitex negundo, Acarus calamus, Azadirachta indica, Bacopa monnieri, Annona squamosa, Psidium guajava, Mimosa pudica, Acorus calamus, Cymbopogon citratus, Pogostemon cablin, Ipomoea carnea, Mikania micrantha* and *Iberis linifolia* were tested against *Meloidogyne incognita* to know their influence on as mortality and egg hatch inhibition under *in vitro* condition. The study revealed that all botanicals showed nematode toxicity by killing juveniles (J_2) and inhibited egg hatch at 1, 5, 10 per cent concentration at 2, 4, 8, 12 and 24 hours of incubation but among them ten botanicals like *A. indica, M. azedarach, P. nigrum, R. communis, M. micrantha, P. betle, O. gratissimum, C. citratus, N. arbor-tristis* and *P. hydropopper* showed strong nematicidal activity and selected for pot experiment.

In pot experiment 10 promising botanicals from *in vitro* test namely *A. indica, M. azadarach, P. nigrum, R. communis, M. micrantha, P. betle, O. gratissimum, C. citrans, N. arbor-tristis* and *P. hydropipper* evaluated for their efficacy to manage root-knot nematode problem on brinjal. The study revealed that all the plant extract showed strong nematicidal activity with increasing plant growth parameter of brinjal as compared to untreated control. Among the 10 botanicals the *A. indica, M. azadarach, P. nigrum, P. betle* and *M. micrantha* showed strong nematicidal activity against *M. incognita,* by reducing galls, eggmass/root system and egg/eggmasses with final neamtode population. These plant also increased plant growth parameters like plant height, shoot and root (fresh and dry weight) of brinjal.

In the field experiment best five botanicals from pot evaluation such as *A. indica, M. azadarach, P. nigrum, P. betle* and *M. micrantha* were selected and evaluated against RKN on brinjal. These five botanicals showed nematicidal activity against *M. incognita* and improved plant growth parameters of brinjal under field condition as compared to untreated control. But among these *A. indica* showed maximum plant growth parameters with reduced nematode population.

Identification and mass production of entomopathogenic nematodes

Rinki Mani Kalita

An experiment entitled "Identification and mass production of entomopathogenic nematodes" was conducted in the laboratory of Department of Nematology, Assam Agricultural University, Jorhat. A systematic survey was undertaken in Assam Agricultural University, Jorhat Campus for the occurrence of entomopathogenic nematodes during the year 2015-16. A total of 200 soil samples were collected randomly during the period November, 2015 to March, 2016 from four habitats (vegetation type) *viz*., Instructional-cum-Research (ICR) Farm, Experimental farm of Department of Horticulture, Experimental farm for plantation crops and Fallow land. From each habitat 50 numbers of samples were collected. Survey data revealed that out of 200 soil samples, eight samples were positive for entomopathogenic nematodes (4%), with containing 4 isolates were assigned the genus *Steinernema* (2%), 2 isolates were assigned to the genus *Heterorhabditis* (1%) and 2 isolates were assigned to the genus *Oscheius* (1%). Steinernematid isolates were designated as EPN-S-J-1, EPN-S-J-2, EPN-S-J-3. The isolates were found from rhizosphere of mung bean, arahar and cowpea respectively from ICR Farm, AAU, Jorhat. Another isolate of steinernematid (designated as EPN-S-J-4) was found from rhizosphere of citrus from the Experimental farm of the Department of Horticulture. One heterorhabditid isolate (designated as EPN-H-J-1) was found from rhizosphere of citrus and one isolate of *Oscheius* (designated as EPN-O-J-1) was found from rhizosphere of coconut in the Experimental farm of the Department of Horticulture. One heterorhabditid isolate (designated as EPN-H-J-2) and another isolate of *Oscheius* (designated as EPN-O-J-2) were found from tea garden of Experimental farm for plantation crops of AAU, Jorhat. Entomopathogenic nematodes were not recovered from the fallow land. EPN species were identified as *Heterorhabditis bacteriophora*, *Steinernema aciari*, *Oscheius chongmingensis* based on their morphological and morphometrical study of different life stages (infective juveniles, adults of both generations).

Abstract of M. Sc. Thesis
Department : Nematology
Major Advisor : Dr. (Mrs) G. Devi

The mass multiplication of three isolates *Heterorhabditis bacteriophora*, *Steinernema aciari*, *Oscheius chongmingensis* were done on different artificial media (plant and animal origin media). In plant origin media consisted of nine treatments including a control with three replications were laid out in a Completely Randomized Designs. The treatments were T1 (Wheat flour and sunflower oil), T2 (Wheat flour and soya oil), T3 (Wheat flour and coconut oil), T4 (Soya flour and sunflower oil), T5 (Soya flour and soya oil), T6 (Soya flour and coconut oil), T7 (Green gram flour and sunflower oil), T8 (Green gram flour and soya oil), T9 (Green gram flour and coconut oil) and control (Soya flour and corn oil). Among these treatments, T9 containing green gram flour and coconut oil which was found to be highest multiplication rate in all EPN specis *viz.*, *Heterorhabditis bacteriophora*, *Steinernema aciari*, *Oscheius chongmingensis* 97.92×10^5, 114.17×10^5, 104.10×10^5 IJs/flask, respectively. Out of these EPNs spp. *Steinernema aciari* was found to be more yield (114.17×10^5) in T9. The medium containing wheat flour and sunflower oil (T1) recorded lowest multiplication rate for *Oscheius chongmingensis* (3.68×10^5) and the medium containing wheat flour, soya oil (T2) recorded lowest multiplication rate for *Heterorhabditis bacteriophora* (5.19×10^5) and *Steinernema aciari* (2.67×10^5). In animal origin media comprising of varied sources of proteins and lipids of animal origin and consisted of three treatments including a control with five replications were laid out in a Completely Randomized Designs. Treatments were T1 (Dog biscuit), T2 (Goat waste homogenate), T3 (Pork homogenate) and control (Chicken offal homogenate). Among these treatment, T3 containing pork homogenate which was found to be highest yield in three isolates *viz.*, *Heterorhabditis bacteriophora*, *Steinernema aciari*, *Oscheius chongmingensis* were 6.54×10^5, 17.24×10^5, 5.99×10^5 IJs/100 flask respectively and more yield was found *Steinernema aciari*. T2 containing goat waste homogenate recorded the least multiplication rate of all three isolates *viz.*, *Heterorhabditis bacteriophora*, *Steinernema aciari*, *Oscheius chongmingensis* were 3.67×10^5, 6.75×10^5, 3.47×10^5 IJs/100 flask, respectively.

Molecular Characterization and Pathogenicity of Entomopathogenic Nematode Infecting White Grub

Saimone Delabaka

The present investigation was undertaken for the Molecular Characterization and Pathogenicity of Entomopathogenic Nematodes infecting White Grub. The ITS region of rDNA of the EPN isolated was successfully amplified using species specific primers by Joyce *et al.* (1994) and was found to have 750 base pairs. The sequence (1-750bp) when subjected to BLAST at NCBI showed maximum identity with *Heterorhabditis* sp. PAK.S.S.302 (A) 18S (99.0%), *H. indica* strain Cohen 21 18S (99.0%), isolate BN2 18S (99.0%), isolate CK5 18S, (99.0%), and strain Lennon 7 18S (99.0%). This confirms our unknown isolate of EPN as *H. indica.*

The pathogenicity of *H. indica* was evaluated against white grub under laboratory bioassay which includes four different IJs concentrations of *H. indica viz.*, 100, 200, 400, 600, 800, 1000 IJs ml^{-1}. The white grub mortality ranged between 18.43 and 95.21 per cent. The treatment with 1000 IJs ml^{-1} was found to be the most significantly superior over the rest of the five treatments throughout all the exposure periods with hundred per cent mortality achieved within 8 days after treatment. The maximum LD$_{50}$ value was 1006 IJs ml^{-1} at 144 hours while the minimum was 194 IJs ml^{-1} at 288 hours. Similarly the maximum LT$_{50}$ recorded was 278 hours obtained at the dose of 200 IJs ml^{-1} while the minimum was 139 hours obtained at the dose of 1000 IJs ml^{-1}.

Efficacy of silver nanoparticles on management of root-knot nematode, *Meloidogyne incognita* on green gram

Suman Kumari

Studies on the effect of AgNPs with five different concentration *viz.*, 0.0015 ppm, 0.003 ppm, 0.015 ppm, 0.03 ppm and 0.15 ppm on the mortality of *M. incognita* showed that all the treatments with AgNPs were found to be effective in causing mortality of *M. incognita*. The mortality of *M. incognita* increases with increase in concentration and time of exposure. All the treatment were found to be effective in causing mortality of *Meloidogyne juveniles*. Out of six treatments, the treatment with 0.15 ppm concentration were found to be the best treatment in causing maximum mortality and the next best treatment was the treatment with 0.03 ppm concentration.

In the investigations, on the effect of AgNPs on the management of *M. incognita* in green gram, the results showed that all the treatments were found to be effective in increasing all growth parameters. Maximum growth parameter *viz.*, plant height, fresh and dry weight of shoot and root were recorded in the treatment with 0.15 ppm AgNPs + *M. incognita*. Maximum reduction in galls, eggmasses and final nematode population in soil were recorded in the treatment with 0.15 ppm AgNPs. All the treatments significantly differed from control except the treatment with 0.0015 ppm AgNPs + *M. incognita*

Abstract of M. Sc. Thesis
Department : Nematology
Major Advisor : Dr. (Mrs) B. Mahanta

Influence of seed priming on germination and seedling growth of Capsicum, Coriander and Bitter gourd

Arshia Debbarma

Vegetables are important constituents of Indian agriculture and nutritional security due to short duration, high yield, nutritional richness and economic viability. Chilli (*Capsicum annuum* L.), coriander (*Coriandrum sativum* L.) and bitter gourd (*Momordica charantia* L.) are the major vegetable crops widely cultivated throughout the tropical and subtropical countries. The major constrains affecting these crops are poor and slow emergence of seedlings due to sub optimal temperature and thick seed coat imposing mechanical restriction on embryo growth. The problem of poor or slow seed germination can be solved through many techniques and one of them is seed priming. Seed priming is a pre-sowing seed hydration treatment that allows them to imbibe water, go through first stage of germination but does not permit radical protrusion.

For the present investigation seeds of bitter gourd, chilli and coriander were hydroprimed, osmoprimed with -1.1 Mpa and -1.5 Mpa PEG 6000 concentration and hormonal primed with 50 ppm, 100 ppm and 150 ppm GA3 for three durations *viz*., 12, 24 and 36 hours to evaluate the effect of different priming agents and duration on germination and early growth of the crops. Germination test was carried out in the laboratory of the Department of Plant Breeding and Genetics, Assam Agricultural University, Jorhat during 2016 and 2017. Different parameters like germination percent, fresh ungerminated seed, hard seed, mean germination time, germination index, seed vigour index, root and shoot length, seedling fresh and dry weight and seedling emergence were observed.

Different priming treatments exhibited marked influence on seed germination and seedling growth. In all the three crops, most of the seed germination parameters *viz*., germination percentage, fresh ungerminated seed percentage, germination index, seed vigour index and seedling emergence responded well in PEG 6000 priming irrespective of

concentration and duration; and seed growth parameters like shoot and root length, seedling fresh and dry weight were influenced by GA3 priming. However, for mean germination time, hydro priming was found to be best. For different priming agent, different durations were found to be best. For hydropriming and GA3 priming, it was 12 hours and for PEG 6000 priming, it was 24 hours. As for concentration 50 ppm GA3 and -1.1 MPa PEG 6000 were observed to be best for most of the traits.

Performance evaluation of bio priming for upland direct seeded rice in organic condition

Bijit Koch

Rice is the world's most important crop and is a staple food for more than half of the world's population. Worldwide, rice is grown on 161 million hectares, with an annual production of about 744.4 million tons of paddy (FAO, 2014). Rice production and consumption in India have increased during the last quarter of century. In the last two decades, seed priming an effective seed invigoration method has become a common seed treatment to increase the rate and uniformity of emergence and crop establishment in most crops. Bio-priming is a process of biological seed treatment that refers to the combination of seed priming and inoculation of seed with beneficial organism to protect seed and improve the quality.

Experimental findings revealed that field emergence percentage significantly varied in response to seed treatment with different bio agents and highest field emergence was observed in T7 (hydration) and least was observed in (T8) control. Effect of seed treatment was non-significant for seedling/m^2, but it shows significant variation in growth parameters like seedling height and seedling biomass. Among the vigour indicators root length and shoot length varied significantly in response to different treatments. Plant growth response was found to be non-significant for different seed treatment except total biomass production which varied significantly among the treatments. The total biomass production was found to be higher in treatment with consortium (T6) and *Bacillus cereus* (T4) .Total biomass production was found to be significantly higher in treatments with 10% reduced seed rate. All the recorded yield and yield attributes were found to be non-responsive to seed priming with bio agents except harvest index. Highest harvest index was observed in treatment (T_2) *T. harzianum* followed by (T_8) control and (T_7) hydration. The treatment effects of reduced seed rate (10 %) were found to be at par with normal seed rate, it may be because of less competition for inputs in the early vegetative stage. Weed density is found to be affected by the treatment variation at early stage. The highest weed density was observed in treatment T_8 (control) and least was observed in treatment T_4 (*Bacillus cereus*) .The laboratory test indicates high positive correlation between field emergence and few vigour indicators viz seed vigour index I, seed vigour index II and seedling dry weight. The present study of seed treatment has significant positive effect on field emergence, hence can be successfully employed for better field emergence in organic condition.

Abstract of M. Sc. Thesis
Department : Plant Breeding & Genetics (Seed Science and Technology)
Major Advisor : Dr. (Mrs) S. Dutta Deka

Screening of rice germplasm for anaerobic germination and its enhancement

Dhonada Doley

Rice (*Oryza sativa* L.) is the most important staple food crop of India, ranking first in the world in area and second to China in production. In Assam, rice occupies about two-third of the total cropped area of the state. Improvement of tolerance of rice to flooding during germination and seedling growth is important for direct seeding in lowland rice eco-systems. Direct seeding has a number of benefits to farmers, including lower labour costs, reduced water use and early harvest. The purpose of this study was to evaluate a set of genotypes for anaerobic germination and to study effects of pre-sowing seed treatments in improving germination and early seedling growth in anaerobic condition. The treatments included pre-sowing soaking, hydro-priming, priming with 1% KCl and priming with 5% PEG, all for 24 hours. The experiments were conducted in shade net house of the Department. At first stage, the 243 Asra rice genotypes were screened for anaerobic germination. Then seeds of three genotypes showing high anaerobic germination, three showing low anaerobic germination and three genotypes showing no anaerobic germination were subjected to above mentioned seed treatments. Only 43 genotypes showed germination under 10 cm of flooding in plastic trays and pots. In anaerobic condition highest germination%, vigour index and coleoptile length were found in Jalkuwari and Jalashree. Kach Badal was found to have the highest á-amylase activity. All the seed treatments were effective compared to the control for enhancing anaerobic germination. Priming could induce anaerobic germination even in the genotypes that failed to germinate in submerged condition without priming. High germination index, vigour index, shoot length, root length, coleoptile length and shoot and root dry weight were found in hydro priming and highest germination percentage and shoot and root fresh weight were observed in 1% KCl. Jalkuwari, Jalashree and Ranjit Sub1-C-376 showed the best performance among all the genotypes. These three genotypes could be used in breeding programme for improvement of anaerobic germination.

Effect of drying temperatures on seed quality of greengram

Girija Gautam

Green gram(*Vignaradiata*) is one of the most important and most widely cultivated pulse crops in India. The knowledge of seed drying and storage mechanism of green gram crop is essential to minimize the loss and quality standards of the seed. The present study is a preliminary step for identification of storage potential of green gram variety Pratap. A laboratory experiment was carried out to evaluate the effect of drying temperatures on various seed quality parameters and evaluation of these quality parameters over subsequent storage period. The experiment was carried out in the Seed Technology and Research Laboratory of Assam Agricultural University. In the present study four different drying temperatures were used viz. 35°C, 40°C,45°C and 50°C and sun drying was taken as control. After a particular drying period (for each treatment different drying period), when it reaches the desired moisture content (8%, wet basis), the seeds were removed from the hot air oven and stored in HDPE (high density poly ethylene) interwoven bags.. Observations were taken at bimonthly interval and the final observations were taken at the nine months of storage. Based on the results it was found that drying at 50°C decreased the drying time by almost 50% compared to drying at 35°C but it was detrimental to embryo viability and germination. The highest germination, seed vigour index, seed viability and field emergence were found in the samples dried at 35°C which was at par with sun drying. The lowest pest incidence was observed in the samples dried at 50°C, whereas the highest pest incidence percentage was found in samples dried under sun and it was statistically different with all other treatments. However, with the increase in storage duration, the seed quality parameters were found to be decreased except pest infestation which was found to be increased. Although in most of the cases drying temperature 35°C was found at par with sun drying but due to unpredictability and inherent disadvantages along with resultant high pest infestation during storage it cannot be recommended. Thus, from the present study drying temperature of 35°C is recommended for drying and subsequent safe storage of green gram seeds.

Efficacy of some plant products against beetle, *Callosobruchus chinensis* (Coleoptera; Bruchidae) on stored Green gram Seed

Jirka Hansepi

An experiment was conducted during 2016-17 in the laboratory of National Seed Project (crops), Assam Agricultural University, Jorhat to evaluate the efficacy of some plant products against pulsebeetle, *Callosobruchuschinensis*and their effects on seed viability and seedling vigour in green gram seed under laboratory storage conditions.

Greengram seeds are infested by various storage pest among which *Callosobruchuschinensis* is the most important and common of all bruchid pest in India. Although, synthetic pesticides are effective in controlling the pest, environment and health hazards of these chemicals are of increasing concern. The study assessed efficacy ofnine botanical products namely Neem seed kernel powder, Basil leaf powder, Black pepper powder, Sweet flag rhizome powder, Turmeric powder, Ginger powder, Sesamum oil, Groundnut oil, Mustard oil were used in the experiment with malathion 5% dustas check. The different observations *viz.,* per cent germination, seedling vigour index, per cent moisture content, per cent insect infestationwere evaluated at 0, 15, 30, 60, 120 and 180 days after treatment of the seeds stored in porous HDPE bags. The results revealed that most of the treatments were significantly superior to untreated check. The treated check *i.e.*malathion 5% dust(per cent germination; 93.33, seedling vigour index; 1404.60, per cent infestation; nil, per cent moisture content; 11.94) @ 2.5g per kgwas found to be the best treatment followed by sweet flag rhizome powder (per cent germination; 91.33, seedling vigour index; 1355.06, per cent infestation; 0.75, per cent moisture content; 11.99), vegetable oils such as mustard oil, groundnut oil, sesamum oiland black pepper powder after six months of storage.

For evaluation of insecticidal activity of different plant products against pulse beetle,*Callosobruchuschinensis* in green gram seeds stored in glass jars, the different observations *viz.,* per cent infestation, per cent weight loss, per cent germination, seedling

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vigour index were evaluated at 15, 30, 60 and 120 days after the release of insects. Here, also malathion 5% dust (per cent germination, 93.66), (seedling vigour index, 1528.96), (per cent infestation, nil), (per cent weight loss, 0.09)@ 2.5g per kg was found to be the best treatment as no infestation was recorded upto 120 days. The results were in conformity with the seeds stored in HDPE bag in case of other plant products. The present findings revealed that sweet flag rhizome powder, vegetable oils and black pepper powder can be used as an alternative to chemical insecticides against pulse beetle, *Callosobruchuschinensis* in stored green gram seed.

Efficacy of some chemicals in controlling pre-harvest sprouting in wheat

Klirdap Tokbipi

A field investigation entitled "Efficacy of some chemicals in controlling pre-harvest sprouting in wheat (*Triticum aestivum* L.) was conducted at the Instructional-cum-Research farm, Assam Agricultural University, Jorhat during the *rabi* season of the year 2016-2017 with two wheat varieties K-1006 and HD-2967 to study the efficacy of certain chemicals in controlling pre-harvest sprouting in wheat. The experiment was laid out in a split plot design with three replications. Seven treatments *viz.*, T_1: 0.01% Ammonium molybdate, T_2: 0.05% Ammonium molybdate, T_3: 0.10% Ammonium molybdate, T_4: 10 mM Ascorbic acid, T_5: 50 mM Ascorbic acid, T_6: 100 mM Ascorbic acid and T_7: Control was applied. Ammonium molybdate was applied at tillering and booting stage and Ascorbic acid at 20 days prior to physiological maturity. Different morphological, growth and seed yield attributing parameters were studied along with in-ear grain sprouting in wheat.

Experimental findings revealed significant variations among the varieties and treatments for all the characters except for spike length and 1000-seed weight. The variety HD-2967 showed superior performance for seed yield and other characters and pre-harvest sprouting in this variety was significantly less than the other variety. Application of 0.05% Ammonium molybdate significantly increased number of spike/m^2 and seed yield. In-ear seed sprouting decreased with the application of increasing concentrations of both the chemicals. However, the effect of applications of 0.10% Ammonium molybdate and 100 mM Ascorbic acid were statistically *at par*. Glumes and chaff tightness were denser and waxiness was also strong in the variety HD-2967 as compared to that in K-1006, which might had caused lower absorption of rain water resulting in lower in-ear grain sprouting in HD-2967.

The highest number of spikes/m^2 as well as seed yield was observed when T_2 (0.05% Ammonium molybdate) was applied to the variety HD-2967, followed by the same treatment when applied to the other variety K-1006 whereas, the lowest value for this character was recorded in the control in case of the variety K-1006. In-ear seed sprouting

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at 10 and 17 days after physiological maturity was found to be the lowest in the treatment combination variety HD-2967 and 100 mM Ascorbic acid, which was *at par* with the treatment combination K-1006 and 100 mM Ascorbic acid. Application of Ascorbic acid @ 100 mM indicated reduction in in-ear seed sprouting at 10 days by about 80% in HD-2967 as compared to the control. Therefore, Ascorbic acid @ 100 mM may be applied as foliar spray 20 days prior to physiological maturity or, alternatively, Ammonium molybdate @ 0.10% may be applied at tillering and booting stage to reduce the risk of pre-harvest sprouting in wheat. Results of the study also indicated that application of Ammonium Molybdate had the added advantage of enhancement in seed yield and component characters.

Effect of pre-sowing seed treatments and sowing dates on yield and quality of greengram seeds in summer and kharif season

Krishna Devi

Greengram (*Vigna radiata* (L.) Wilczek) is an important pulse crop of India. A study was conducted in 2016 in the laboratory and experimental farm of the Department of Plant Breeding and Genetics, Assam Agricultural University, Jorhat to evaluate the effect of pre-sowing seed treatments and sowing dates on yield and quality of greengram seeds in summer and *kharif* season. Ten different seed treatments namely water soaking for overnight, $MnSO_4$ 100 ppm, neem extract 1%, GA_3 @ 5 ppm, KCl 1%, linseed oil @ 10 ml per kg of seed, rhizobium, neem+rhizobium, linseed oil+ rhizobium, trichoderma, were used along with a control. In laboratory experiment before sowing highest germination percent, lowest hard seed, highest seedling length, highest vigour index and highest seedling dry weight were observed in gibberellic acid treated seed, while neem treated seed showed lowest dead seed and KCl treated seed showed lowest fresh ungerminated seed. In laboratory experiment summer season was better than *kharif* for all the seed traits except for fresh ungerminated seed which was not affected by season. In field experiment gibberellic acid treated seed outperformed then other treatments showing highest seedling emergence and highest shoot and root length at 20 DAS, lowest days to 50% flowering and maturity, highest raw and graded seed yield, highest pure live seed, highest hundred seed weight. Untreated control performed very poorly followed by linseed oil coated seed. Most of the characters studied were found to be unaffected by season except for raw and graded seed yield as well as hundred seed weight for which summer crop performed better than *kharif*. In laboratory experiment after harvest highest germination percentage, seedling length, seed vigour index, seedling dry weight and lowest hard seed and fresh ungerminated seed was found in gibberellic acid treated seed. Summer season was better than *kharif* for seed yield and quality. Pre-sowing seed treatment considerably enhanced seed yield and quality where priming with 5 ppm gibberellic acid outperformed all other treatments.

Synchronization of flowering in hybrid seed production of rice (Oryza sativa L.)

Miro Doley

Two hybrid combinations namely IR68888A/LuitR and IR79156A/IR 65515-56-1-3-19R as main plots were evaluated with seven sub-plot treatments involving A lines with application of GA_3, SSP, MOP and Boric acid and R lines with staggered sowing/planting, application of Urea and removal of panicles for synchronization of flowering and to optimize the hybrid seed production using male: female row ratio of 2:8 and thrice supplementary pollination in a split plot design with three replications. Application of SSP induced maximum advancement (>2 d) in heading date of the CMS lines followed by MOP (>1 d) and Boric acid spray (>1 d). In the restorers, staggering at 5, 9 and 15 DAS of A lines caused maximum delay in heading (5-6 d) followed by panicle removal (5 d), staggering at 4, 7 and 9 days (4 d) and Urea broadcasting (3-4 d). Maximum synchronization of flowering (0.92) was attained between IR 68888A and LuitR with application of SSP on the A line and the R line staggered at 4, 7 and 9 DAS of A line. In IR 79156A/IR 65515-56-1-3-19R, maximum synchronization (0.94) was achieved with the application of Boric acid to the A line and Urea foliar spray on the R line. The analyses of variance for the CMS lines indicated significant variation in the main plot treatments for days to 1st and 50% flowering, panicle exsertion, seed set and seed yield; the sub-plot treatments for days to 1st and 50% flowering, pollen sterility, angle of glume opening, seeds per panicle, seed set and seed yield; and the interaction effects for pollen sterility, angle of glume opening, stigma exsertion, seed set and seed yield. In the restorer lines, significant variation was registered in the main plot treatments for days to 1st and 50% flowering, panicle length and 100-seed weight; the sub-plot treatments for all the characters except panicle length and spikelet fertility; and the interaction effects for seeds per panicle, 100-seed weight and seed yield. Mean performance of IR 79156A over the treatments was higher than that of IR 68888A for pollen sterility, angle of glume opening while for seed set and seed yield, IR 68888A was superior to IR 79156A. The highest angle of glume opening was induced by Boric acid spray in IR 68888A while application of MOP caused the highest glume opening angle in IR 79156A. The application of MOP induced

maximum stigma exsertion in IR 68888A whereas IR 79156A showed maximum exserted stigmas with Boric acid spray. Boric acid spraying on IR 68888A resulted in maximum seed set with concomitant high seed yield whereas the highest seed set and seed yield was registered in IR 79156A following SSP application. Luit R was earlier and had longer panicles and greater seed size than those of IR 65515-56-1-3-19R. Urea broadcasting contributed maximum to seeds per panicle, 100-seed weights and seed yield of LuitR. Maximum seed yield was recorded in IR 65515-56-1-3-19R staggered sown at 4, 7 and 9 DAS of A line and panicles removed. Significant reduction in angle of glume opening and increment in seed set and seed yield was observed in IR 68888A following GA_3 application. GA_3 induced significant increases in seed set and seed yield in IR 79156A. Application of SSP on the CMS lines significantly hastened the days to flowering (2.2 & 2.9 d) followed by MOP application (1.4 & 1.6 d) and Boric acid spraying (1.1 & 1.6 d). Application of SSP and Boric acid resulted in significant positive shift in seed yield of IR 68888A. In IR 79156A, SSP application registered significant positive shift in seed set and seed yield. Removal of panicles once at heading induced maximum delay in days to flowering of the restorer lines (5.1 & 4.7 d). Broadcasting of Urea had significant positive effects on seeds per panicle and seed yield of LuitR. Significant increment in seeds per panicle was recorded in IR 65515-56-1-3-19R with staggered sowing/planting in both the sequences. Seed yield of the CMS lines was positively and moderately influenced by panicle exsertion and seeds per panicle and strongly influenced by seed set. Days to 1st flowering had very high positive direct effect on seed yield followed by seed set and angle of glume opening. In the restorers, the yield correlation with days to flowering, effective tillers, panicle length, seeds per panicle and spikelet fertility were positive and moderate. Days to 1st flowering had high positive direct effect on seed yield followed by panicle length and seeds per panicle. The seeding of R lines at 4, 7 and 9 DAS of A lines with application of Urea @ 50 kg ha^{-1} on LuitR in combination with IR 68888A, and application of SSP @ 100 kg ha^{-1} on IR 79156A in combination with IR 65515-56-1-3-19R were suggested for seed production in the early *Ahu* season.

Effect of seed inoculation treatments on seed yield and quality of greengram

Priyanka Sharma

In addition to the prevalent practice of seed inoculation with nitrogen fixing bacteria, several other biological control agents are also applied to green gram for management of diseases affecting the crop in the form of seed treatment particularly for organic cultivation of green gram.

To study the effect of such seed inoculation treatments with biological agents on seed germination, field emergence and its effect on seed yield and component characters, a field experiment was conducted during summer season, 2015 at the organic plot of the Instructional Cum Research (ICR) Farm of Assam Agricultural University (AAU), Jorhat. Seeds of green gram variety Pratap (SG-1) were treated with microbial formulations of *Rhizobium, Bacillus megaterium, Trichoderma harzianum, Trichoderma viride* and their combinations. The seven treatments consisted of-*Rhizobium* (T_1), *Trichoderma harzianum* (T_2), *Trichoderma viride* (T_3), *Bacillus megaterium* (T_4), *Trichoderma harzianum + Trichoderma viride + Bacillus megaterium* (T_5), *Rhizobium + Trichoderma harzianum + Trichoderma viride + Bacillus megaterium* (T_6) and Control (T_7). The experiment was laid out in Randomised Block Design with four replications. The unit plot size was 1.5 m x 3 m with a row to row spacing of 30 cm and 10 cm between plants. After 20 days of sowing, shoot length, root length and seedling dry weight were recorded and observations on nodulation, yield and yield contributing characters were recorded at maturity. In addition, germination characteristics of the seeds treated with various inoculants were studied in the laboratory.

Analysis of variance revealed significant variations among the treatments for all the characters except root length and number of seeds pod^{-1}. Seeds treated with combined inoculation of *Rhizobium* @ 4 g + *Bacillus megaterium* @ 5ml/1000 ml of water + *Trichoderma harzianum* @ 5ml/1000 ml of water + *Trichoderma viride* @ 5ml/1000 ml of water (T_6) recorded significantly higher field emergence (91.25%), speed of emergence (42.14), seedling dry weight (1.67mg), shoot length (25.48 cm), seed yield (992 kg ha^{-1}),

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Stover yield (1870 kg ha^{-1}), number of pods plant^{-1} (37), number of seeds pod^{-1} (13.25), 100 seed weight (3.63g) root length (9.22 cm), nodulation (15) except disease incidence (3.95%) which was the lowest. The same treatment (T$_6$) showed best performance under laboratory conditions for germination characteristics such as germination percentage, speed of germination and hard seeds percentage. These results, thus, indicated that the combined inoculation treatment of *Rhizobium* with other biological agents improves vigour characteristics and seed yield in green gram.

Effects of botanicals and bio agents on storage behaviour of black gram (*Vigna mungo*) seeds

Surabhi Datta

Black gram (*Vigna mungo*) is the fourth important pulse crop in India, covering an area of about 3.1 million hectares and contributing to 10-12 per cent of national share among the total pulse production. Due to the tropical and humid climate of India, storage of black gram seeds till next sowing season is the most severe problem, with an average damage percentage of nearly 14.97 under storage conditions. Since, pre-storage seed treatment is very important to keep the seed quality good up to next season, in the present investigation, the effect of a few botanicals and bioagents was observed on the storage behaviour of black gram seeds.

The seeds were treated with three botanicals *viz*., Turmeric powder, Neem leaf powder and Black pepper powder and with two bioagent formulations *viz*., Biogreen and Biotime. Different seed quality parameters like moisture content, germination percentage, seedling vigour index, field emergence and mycoflora association were observed initially and at an interval of two months up to nine months (270 days) of storage.

At the end of nine months of storage, lowest moisture content was observed in Turmeric powder treated seeds (8.90 per cent), followed by the untreated control (9.00 per cent), Black pepper treated seeds (9.16 per cent) and Neem leaf treated seeds (9.30 per cent). However, all these treatments were statistically at par. Highest germination (78.67 per cent) and seed vigour index (1517.63) were observed in the seeds treated with Black pepper powder which were at par with those of Neem leaf powder treated seeds and Turmeric powder treated seeds. Highest field emergence after nine months of storage, was observed in seeds treated with Neem leaf powder (75.33 per cent) followed by seeds treated with Turmeric powder (73.51per cent) and Black pepper power (72.41per cent). The seeds treated with bioagents showed low germination as well as low vigour throughout the storage period. Five organisms *viz*., *Aspergillus flavus*, *A. niger*, *Rhizopus* spp., *Fusarium* spp. and *Penicillium* spp. were found to be associated with the seeds under storage. However, in the seeds treated with bioagents *Fusarium* and *Penicillium* were absent. The present findings revealed that the seeds treated with botanicals had good effect on seed quality and can be used as an alternative of chemicals in seed treatment.

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Evaluation and DNA Fingerprinting of *Sub1* introgressed lines in Ranjit and Bahadur

Ashish Gautam

Submergence stress is a major constraint to rice production and adversely affects farmers living on 10-15 million ha of rain fed lowland rice in south and south-east Asia. Sustainable and permanent solutions are needed to overcome this problem. One of the most promising solutions is to develop high yielding varieties in popular rice variety background that are submergence tolerant and that are more likely to be rapidly adopted by farmers in the target regions. Submergence tolerance is controlled by a single major quantitative trait locus (QTL) on chromosome 9, along with a number of minor QTLs. The major QTL, named *Sub1,* with a R^2 value of 69%, provides tolerance to complete submergence for up to 2 weeks. The study material consisted of 24 numbers of BC_2F_3 lines of the cross -Ranjit x Swarna-Sub1 and 8 numbers of BC_2F_3 lines of the cross -Bahadur x Swarna-Sub1. The confirmation for presence of *Sub1* was carried out using molecular marker - Sub1BC2. Twenty two lines in Ranjit background and all the lines in Bahadur background recorded the presence of the *Sub1* QTL. The presence of *Sub1* QTL corroborated with the phenotyping data. There is significant variation in the *Sub1* introgressed lines and therefore selection will be effective for further improvement.

DNA fingerprinting is a technique for analyzing and comparing DNA from different sources based on the unique banding patterns and the unique fingerprinting profiles. The DNA fingerprinting of the best selected lines amongst the test entries can be used as an identification mark for varietal protection. The background recovery of the recurrent parent was carried out with 62 morpho physiological traits. The *Sub1* lines exhibited background recovery in the range of 56.45 to 79.04 per cent. The best lines with more than 74 per cent background recovery were selected for DNA fingerprinting and the background recovery of these selected lines with molecular markers was found to be in the range 86.68 to 97.82 per cent. Therefore the morpho-physiological traits can also be used for recovering the recurrent parent in any introgression programme.

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Studies on Introgression of blb Resistance in the Rice Variety-Ranjit

Gitashree Borah

Bacterial Leaf Blight (BLB) is one of the devastating diseases of rice. BLB causes grain yield reduction upto the tune of 20-50%. *Xanthomonas oryzae* pv.*oryzae* is the pathogen responsible for BLB. It causes drying of leaves beginning of the tip of the rice leave and spreads down one or both the sides of the leaf or through the mid-vein. The development of the resistant cultivar is the most effective and economical strategy to control BLB disease of rice. BLB was not a major constrain in Assam upto 20th century. However, with higher adaptation of high yielding and hybrid varieties along with higher application of nitrogeneous fertilizers, BLB is becoming a serious concern in our state.The most popular rice variety of our region- Ranjit is also becoming susceptible to the disease.Therefore, to combat this disease and increase the productivity of the rice cultivation, introgression of BLB resistance genes in the popular rice variety- Ranjit is a need of the hour to combat the disease in Assam.

Marker aided selection helps to pyramid the different important genes in a variety. For BLB resistance, understanding pathotype diversity within the targeted geographical area is very important to combat the disease. After knowing the prevalent pathotypes within the locality, we can target different resistance gene/gene combination for deployment. In this study, the necessary BLB resistance genes was identified to be deployed in the popular variety, Ranjit. The genes required are *xa13* and *Xa21*. For these, the donor variety Improved Samba Mahsuri(ISM) was selected as there is similarity in genealogy with the variety Ranjit. By using ISM we can reduce the linkage drag. Further, identified the marker xa13promoter for the gene *xa13* and pTA248 for the gene *Xa21* for foreground selection. Screened 150 markers for background selection and identified 61 polymorphic markers to carry out background selection. The cross was also attempted between Ranjit-Sub1 and ISM and hybridity test was also conducted for transferring the required resistance to the popular rice variety, Ranjit.

Assessment of S_1 lines of local maize (*Zea mays* L.) germplasms for morphological and low N-stress tolerance traits

Hiramoni Barman

The present study was conducted with the objectives of assessing S_1 lines derived from local maize germplasms for morphological and low N-stress tolerance traits, estimating genetic variation and determining correlation of grain yield with other yield attributing characters. Ten S_1 lines along with three hybrids were evaluated in randomized block design. The experiment consisted of two trials with the same set of genotypes in two different nitrogen levels, *viz.*, 80 kg N ha^{-1} and 0 kg N ha^{-1}. Analysis of variance revealed presence of sufficient amount of variation among the genotypes for the traits except ears per plant at both N_0 and N_{80} levels. For grain yield and nitrogen use efficiency, the S_1 lines *viz.*, MIZ-2 and MEG-11 were identified as promising at N_{80} level and MEG-11 and TR-1 were identified as promising at N_0 level. At both levels of nitrogen, MIZ-1 was the latest genotype and MAN-4 was the earliest genotype in respect of flowering traits. MAN-4 was identified as short duration variety at N_0 level while MIZ-1 was identified as long duration variety with respect to days to75% dry husk. MIZ-2, AR-1, MIZ-7 and TR-1 had less ASI at N_0 level. It indicates that those lines could be tolerant to low N-stress. At N_{80} level, moderate to high estimates of GCV and PCV recorded for grain yield per plant, ear height, number of kernels per row, ear length, days to 50% pollen-shed, 100 kernel weight, NRA and NUE indicated sufficient variability in the set of germplasm. Moderate to high estimates of GCV and PCV were recorded for grain yield per plant, plant height, ear length, ear height, number of kernels per row, days to 50% pollen-shed, days to 50% silk, 100 kernel weight, leaf area, chlorophyll content, NRA, plant nitrogen and NUE at N_0 level. All the characters exhibited high heritability except ASI and plant nitrogen at N_{80} level indicating that those characters were least influenced by environmental effects. Most of the traits *viz.*, plant nitrogen, plant height, ear height, kernels per row, ASI, days to 50% pollen-shed, days to 50% silk at N_0 level and for NRA, NUE, days to 50% pollen-shed, days to 50% silk, ear length, 100 KW

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and grain yield per plant at N_{80} level exhibited high heritability with high to moderate magnitude of genetic advance as per cent of mean indicating the preponderant role of additive gene action for their inheritance. Correlation analysis at N_0 level, grain yield had significant correlation with plant height, ear height, ear length, kernel rows per ear, kernels per row, 100 KW, days to 50% pollen-shed and days to 50% silk at genotypic level. At N_{80} level revealed that there was positive and significant correlation of grain yield with plant height, ear length, ear diameter, kernels per row, 100 KW and days to 75% dry husk at genotypic level.

Study on *in vitro* response and evaluation of antioxidant activity of *Phlogacanthus thyrsiflorus* Nees- a medicinal plant

Indubala Nongthombam

Phlogacanthus thyrsiflorus Nees, a medicinal plant grows extensively in the north-eastern part of India. It is known for the presence of antioxidant property and secondary metabolite and it is commonly used in various ailments by the people of north-eastern India. Flowers are antidote to pox; prevent skin disease like sore, scabies etc, also used in jaundice. It is also used in folklore remedies for treatment of cough, bronchitis, fever, asthma, cancer and many other ailments.

In the present experiment, explants such as young leaf, nodal and internodal segments were cultured on MS media with various growth regulators alone or in combination for callus induction and to test presence of secondary metabolites in callus. The presence/absence of phytoconstituents such as tannins, saponins, steroids, terpenoids, flavonoids, phytosterol and phenol were tested in callus extracts. About 50g of matured leaf and 150g fresh flower were shade dried, ground to form powder and phytochemical screening was done. Antioxidant activity was tested from fresh as well as dried leaves and flowers using DPPH scavenging activity.

Among the various explants cultured, response of leaf explants (58.41%) was found to be best. Ninety percent of leaf explants produced callus and maximum callus index recorded was 360 in media supplemented with 2.0mg/L of 2,4-D and 1.0mg/L of BA. Presence of secondary metabolites such as tannins, steroids, terpenoids, flavonoid, phytosterol and phenol were observed in different extracts prepared from callus *viz*., ethanol, methanol and aqueous. In test for saponin, ethanol and aqueous extracts showed presence of saponin but no saponin were seen in methanol extracts. Different extracts showed different intensity of colour in each test.

Both dried flower extracts and dried matured leaf extracts showed equal response for presence of tannins and saponins. However, based on the intensity of colour, dried flower

extracts were found to contain higher amount of steroids, terpenoids, flavonoids and phenol than the dried leaf extract.

Edible plant parts *viz*., fresh young and matured leaf, fresh flower, dried flower and dried matured leaf showed antioxidant activity and there was significant difference in the IC_{50} values of the plant parts studied. The highest antioxidant activity was observed in dried leaf with lowest IC_{50} value of 7.86±0.35. The lowest antioxidant activity was observed in fresh young leaf with the highest IC_{50} value 57±0.96. Fresh matured leaf samples were also found to have more DPPH scavenging activity than the flower samples. Dried flower sample had higher antioxidant activity than fresh sample of flower.

Interspecific hybridization between Vigna radiata (L.) Wilezek and Vigna mungo (L.) Hepper through conventional and embryo rescue techniques

Jumi B. Gohain

India is the world's largest producer of green gram and black gram. Pulse crops are rich in protein and forms main source of protein for vegetarian people. Green gram has some desirable characters such as large number of seeds per pod and high protein which is easily digestible and also some undesirable characters such as susceptible to Yellow Mosaic Virus and seed shattering. Black gram on the other hand is resistant to Yellow Mosaic Virus and seed shattering. During the last decade although considerable progress has been made in the improvement of these two pulse crops but their yield has remained almost static. The present investigation is an attempt to combine the desirable traits of both the species and produce interspecific hybrids through conventional and *in vitro* methods and also to evaluate fertilization barriers. The crops, green gram and black gram were sown in the field and crosses were made including reciprocal. Solutions of plant growth regulators were applied to the pedicel at the time of pollination. Parental and hybrid seeds were sown and morphological data and visual characteristics were recorded. Pollen morphology and pollen tube growth were also studied.

Crossing was again done in the field and the embryos were cultured at different ages in MS media modified by adding Casein hydrolysate. At the best age hybrid and parental embryos were again cultured in MS media modified by adding zeatin, NAA and Kinetin.

Application of growth hormone combination of GA_3 (100 mg/L), NAA (25 mg/L) and KN (5 mg/L) was observed to be best for pod retention. Although crossability percentage was (56.25) when green gram was used as the female parent, only few hybrid seeds could be obtained because the pods were partially filled. In the reciprocal cross when black gram was used as the female parent, crossability was (21.25%) but hybrid seeds could not be obtained. Mean pod length was observed to be 6.74 cm and 4.32 cm for *V. radiata* and *V. mungo* respectively whereas in the hybrids, it was observed to be 4.60 cm.

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Hybrid seeds showed (42.80%) germination while the parents recorded more than (90%) germination. However, only few hybrid plants survived till maturity and hybrid lethality of (55.50%) was recorded. The F_1 hybrid resembled in some characters one parent or other and was intermediate in other characters. Plant height, length of pod and seeds per pod of the hybrid was *at par* with that of male parent *V. mungo*. F_1 had less number of branches and low pod formation compared to parents. When visual observations were made, the F_1 plants were observed to be intermediate in expression of characters like stem, leaf and flower colour.

The overall morphology and shape of pollen was similar in F_1 and parents. P/E ratio of F_1 pollen was intermediate between the parents. Failure of seed formation in the cross when black gram was used as female parent is due to embryo abortion and degeneration during embryogenesis.

When hybrid embryos were cultured at different ages starting from 6 DAP to 16 DAP, it was observed that 14 DAP embryos responded best in terms of shoot development and growth. Response to shoot formation declined with increase in age of the embryo, i.e. 16 DAP. The excised 14 DAP embryos of both the parents and hybrid developed plantlets by 20 days of culture. For both parents and hybrids, percentage of embryos developing into seedling was highest in the media supplemented with zeatin, followed by NAA. Effect of kinetin was found to be detrimental for embryo germination and growth.

Genetic variability, character association and path analysis in white jute (*corchorus capsularis* l.)

Khwmdwn Gayary

Jute *Corchorus* species is a natural fiber cash crop and is second in the world after cotton in terms of global production, consumption and availability. Jute plays a vital role in Indian economy in general, and the eastern region in particular. In India jute is cultivated mainly in the eastern states like West Bengal, Assam, Tripura, Bihar, Orissa and to some extent in Uttar Pradesh. The present investigation was conducted for estimation of genetic variability, character association and path analysis of fibre yield and its attributes were studied on 50 genotypes of white jute including two check varieties JRC-517 and Apeswaree. The study was conducted in randomized block design experiment with 2 replications. The seeds were sown in *kharif* season (April, 2016) with plot size 2 m x 0.75 m and spacing 25 cm row to row and 6 cm plant to plant spacing.

Analysis of variance revealed presence of significant amount of variation among all the genotypes for all the characters. Estimates of GCV and PCV were found to be high and had close agreements in plant height, reed length, effective reed length, basal diameter and fibre yield per plant, indicating less influence of environmental effects. High heritability coupled with high genetic advance was recorded for quantitative traits.

Correlation studies revealed highly significant genotypic and phenotypic association between fibre yield per plant and its components, like reed length, stick weight per plant and plant height. Therefore, it is concluded that these traits can be used as primary selection criteria for improving jute fibre yield stability.

Variability among the genotypes may be utilized by the breeders in future for breeding programme. Also, the results of this study suggest that plant height, reed length, effective reed length, green weight and stick weight per plant should be used as selection parameters.

Genetic Divergence and DNA fingerprint analysis in Sesame (*Sesamum indicum* L.)

Labhya Rani Gogoi

The present study was conducted with 33 sesame genotypes collected from different North East region of India with an objective to determine genetic divergence among the genotypes using both morphological and molecular markers and character association. Morphological data recorded on 11 quantitative traits were analysed for analysis of variance, phenotypic and genotypic coefficient of variation, heritability, genetic advance, genetic divergence based on Mahalanobis's (D^2) statistic and DNA fingerprint analysis using 50 SSR primers. Analysis of variance revealed significant variation among genotypes for most of the characters except for number of branches per plant. The maximum mean performance for yield and yield attributing characters was exhibited by TKG 308, Rama, Bahua Bheti and KolaTil_Nalbari. The GCV and PCV estimates were observed to be high for capsule per plant and height of 1st capsule bearing node. Heritability coupled with genetic advanced as % of mean was observed for yield per plant followed by 1000 grains weight. Moderate heritability with moderate genetic advance was observed for most of the yield related traits, signifying that these attributes are governed by both additive and non-additive genes action. Based on D^2 values, the genotypes were grouped into eight clusters. The clustering pattern suggested that genotypes of the same origin were distributed into different clusters, indicating the absence of parallelism between clustering and geographic distributions. Maximum inter cluster distance was observed between clusters 8 (Punjab Til 1) and 6 (TKG 308) followed by cluster 7 (Nga Na) and 6 (TKG 308) while lowest distance was noticed between cluster 3 (KolaTil_Tezpur) and 5 (AhuTil_Koliabor). Traits *viz.,* yield per plant, days to 50% flowering and 1000 grain weight had highest contribution towards genetic divergence. None of the characters showed significant association with yield per plant, however there were significant association among many other traits. Path analysis revealed that days to 50% flowering and 1000 grain weight found to have high direct effect on seed yield and high indirect effect via height of 1st capsule bearing node, branches per plant and seeds per

capsule. So these traits may be used as selection criteria for the improvement of seed yield of sesame. Marker analysis showed seven of the primers, *viz*., SSR 2, SSR 6, SSR 8, SSR 10, SSR 14, SSR 36 and SSR 48 showed 100% polymorphism across all populations and primer SSR 46 showed the highest PIC value of 0.99. Average Jaccard's coefficient similarity (0.754) signified presence of genetic divergence among the sesame genotypes. Three major clusters were observed based on the use of 78 bands using 27 SSR primers. The clustering pattern indicated that geographical origin did not play role in cluster composition even at molecular level also.

Assessment of combining ability, gene action and heterosis in brinjal (*Solanum melongena* L.)

Niranjan Kumar Chaurasia

The present study was conducted with six lines and three testers in L x T mating design to assess the combining ability, nature and magnitude of gene action and heterosis for yield and yield contributing traits of brinjal during *rabi* 2015-16 and 2016-17. Analysis of variance revealed the presence of great diversity among the parental lines used in study. The estimate of *gca* for lines and *sca* for hybrids represented that the lines Sagoli Xingiya, Baromohiya, MLC-1 and the testers SM-6-7 and Longai were best general combiners for most of the traits whereas the hybrids Utsav x Longai, Dari Hariharka x Longai, MLC-3 x SM-6-7, MLC-1 x JC-1, Baromohiya x SM-6-7 and SX x JC-1 were the best specific combiners for yield and yield contributing traits. The ratio of *gca* and *sca* variance ranged from 0.04 to -1.44. The variance due to *sca* was higher then *gca* for all the characters except number of branches per plant indicating the preponderance of non-additive gene action which can be utilized for the development of hybrids or high yielding varieties. The hybrid SX x SM-6-7 (40.05 per cent) followed by the hybrids BM x SM-6-7 (39.09 per cent), SX x Longai (36.39 per cent), DH x Longai (35.84 per cent), SX x JC-1 (35.19 per cent), MLC-1 x JC -1 (33.62 per cent) and MLC-1 x Longai (30.50 per cent) showed maximum heterosis for yield and yield attributing traits over standard parent. The hybrids DH x Longai, BM X SM-6-7, MLC-1 X Longai which were generated from good X good general combiner parents were highly significant for yield attributing traits. The hybrids MLC-3 x SM-6-7, BM x JC-1, JC-1, Utsav x Longai, DH x JC-1, BM x Longai, Utsav x Longai, DH x Longai, MLC-3 x SM-6-7, MLC-1 x JC-1, BM x SM-6-7 and SX x JC-1 which were also highly significant for yield and its attributing traits arose from combinations involving good X poor or poor X good general combiners indicating that two parents with high *gca* may not always result in combinations with high *sca* effect and these traits cannot be improved through heterosis breeding. The exploitation of both additive and non additive gene effect may be done through hybridization followed by recurrent selection. The hybrids

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MLC-3 x SM-6-7 (poor x poor general combiner) has significant positive *sca* effect for yield contributing traits which may be due to the presence of high non additive gene action that could be utilized for commercial exploitation of heterosis. The study also highlights the facts that not always good combiner x good combiner gives cross combinations with high *sca* effect, even cross combinations with poor general combiners can be equally exploited for crop improvement. The hybrid combinations Utsav x JC-1, Utsav x Longai, DH x SM-6-7, MLC-3 x JC-1, MLC-3 x Longai, MLC-1 x JC-1, MLC-1 x SM-6-7, MLC-1 x Longai and BM x JC-1 showed field resistance to all the three biotic stresses like phomopsis blight, bacterial wilt and brinjal fruit and shoot borer under natural field condition which could be exploited commercially.

Assessment of early generation inbred lines of maize (*zea mays* l) for morphological traits and phosphorus use efficiency

Partha Jyoti Borah

The present study was conductedwith the objectives of assessing S_1 lines derived from local maize germplasms for morphologicaltraits and phosphorus use efficiencyand estimating genetic variation and correlationfor various traits. Twelve S_1 lines of local maize germplasm of North East India along with a hybrid were evaluated in randomized complete block design. The experiment included two different trials with the same set of genotypes in two different phosphorus levels, *viz.*40 kg P/ ha and 0 kg P/ha. Analysis of variance revealed significant variation among the genotypes for all the characters at both levels of P except the character days to 75% dry husk. The S_1 lines *viz.*MIZ-6, MIZ-11 and AR-2 were identified as promising for high grain yield and high phosphorus use efficiency. At P_0level, high estimates of GCV and PCV were observed for leaf area which was followed by PUE. At P_0, heritability and expected genetic advance (% of mean) was high for leaf area and chlorophyll content. At P_{40}level, PUE showed high GCV and PCV. High heritability and high genetic advance (% of mean)was recorded for leaf area and phosphorus use efficiency. Among the morphological traits, highest estimates of both GCV and PCV were observed for grain yield followed by plant height at both P_0 and P_{40}level. Heritability was found to be high for all the morphological characters at both P_0 and P_{40}level. Ingenetic correlation study, ear height, ear length and 100-kernel weightwere found positively correlated with grain yield at both $P_0$and P_{40} levels.

Equiproportional varietal blend in green gram (Vigna radiate (L.) wilczek

Porinita Borah

Green gram [*Vigna radiata (L.)* Wilczek] with diploid chromosome number of 2n=22 is a leguminous crop belonging to the Fabaceae family. India is the world's largest producer as well as consumer of green gram. Green gram output accounts for about 10-12% of total pulse production in the country. Yield potential of most of the present day cultivars of green gram are low. The reasons for low yield of the present day cultivars is mainly due to narrow genetic variability in the primary gene pools and this limited gene pool of the cultivated species of *Vigna* has restricted the conventional plant breeding programme to improve the yield of green gram. Blending is an important approach to broaden the genetic base of green gram. Blends are defined as the mixture of seeds from two or more varieties. The performance of a blend is much affected by the blend composition and environments in which the blend will be grown .The present investigation entitled "Equiproportional varietal blend in green gram [*Vigna radiata* (L.) Wilczek]'' was taken up with four green gram varieties to assess their performance in equiproportional varietal blends and their sensitivity to environmental fluctuation by growing them in six environment created by organic *vs.* inorganic supplementation in normal and delay sowing conditions. Four green gram varieties Pratap (v1), K851 (V2), SGC 16 (V3), SGC 20 (V4) and their six equiproportional blends B1 (Pratap and K851), B2 (Pratap and SGC 16), B3 (Pratap and SGC20), B4 (K851 and SGC16), B5 (K851 and SGC20), B6 (SGC16 and SGC20) were studied in six environments. The experiment was conducted in randomized block design with three replications in each of the environments. The twelve different characters were observed at different growth stages. The mean performance of the genotypes under study revealed that blends performed better than the pure stand cultivars for different characters except seeds per pod and plant's height. The blend cultivar B4 (K851 and SGC16) produced highest seed yield per. Other genotype such as Pratap (V1), Pratap and 851 (B1), Pratap and SGC16 (B2), SGC 16 and SGC20 (B6) were found promising for seed yield. Stable

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genotypes were classified according to Eberhart and Russel model (1966). Ideal genotypes with bi =1 and S^2_{di} =0 were V3 (SGC 16), V4 (SGC 20), B4 (K851 and SGC 16), B5 (K851 and SGC 20) for flower bud initiation. For pod initiation pure stand V4 (SGC 20), V3 (SGC 16), B2 (K851 & SGC16) and B3 (K851 & SGC 20) for primary brunches, V2 (K 851), V3 (SGC 16), B2 (Pratap & SGC 16) and B6 (SGC 16 & SGC 20) for secondary brunches, V4 (SGC 20) for seeds per pod, 100- grain weight V1 (Pratap) and for no. of nodules all the varieties except V2 (K851) and B4 (K851 and SGC 16).

These genotypes perform uniformly under all environmental situations. The present investigation generated information for the pulse breeders to address a few issues in order to enhance green gram productivity through an approach of developing appropriate varietal blends. More number of different varieties should be included in blends with different proportions to study competitive influence and competitive ability of the component varieties so as to develop appropriate varietal blends. Phenotypic stability of the component pure stands and their varietal blends need to be adequately assessed over different locations and seasons so that component compensation for stability in yield attributes could be exploited to bring about stability of varietal blends.

Mutation induction through ems in grass pea (lathyrus sativus l.) for forage yield and quality

Priyanka Das

Lathyrus sativus, commonly known as grass pea is the most economically important and widely cultivated species of the genus *Lathyrus* belonging to the family or *Fabaceae*. Grass pea is grown as a forage crop as well as for its grain for human consumption and as a stock feed.

The main limitation of this crop is low productivity and presence of the toxin â-L-oxalyl-2,3-diaminopropionic acid (â-L-ODAP) in its seeds and green tissues, which can cause paralysis in humans if grass pea is consumed for long period. Improvement of crops in regard to quality and economic traits can be achieved by hybridization and breeding programmes. But it has been thought that the improvement of crops is normally not achieved by hybridization within shortest time. Induced mutations are helpful in enlarging the pace of improvement of various crops where even the improvement efforts by conventional breeding need streamlining and strengthening. In view of this the present investigation was carried out during *rabi*, 2016 and 2017 in two generations. Nirmal is a highly productive *Lathyrus* variety recommended for all India level for both forage and grain. The seeds of variety "Nirmal" were treated with EMS with 10 different doses from 0.1% to 1.0%. The experiment was conducted in randomized block design with three replications in M_1 generation and augmented block design in M_2 generation. The findings revealed that M_1 generation the treatments exhibited significant variation for all the characters except plant height and in M_2 generation all the characters were significant. 0.3% EMS treatment showed high mean performance in plant height, green fodder yield and dry matter yield per plant in both generations. Mean performance of primary branches, secondary branches and pods per plant were highest in 0.1% EMS treatment followed by 0.2%, 0.3% and 0.4% EMS treatment. Pods per plant, green fodder yield, dry matter yield and leaves per plant showed highest GCV and PCV, heritability and genetic advance, whereas primary branches per plant and secondary branches per plant showed high heritability and moderate genetic advance. 0.1% and 0.2% EMS treatment showed lowest ODAP% in seed and leaf, respectively. 0.2%

EMS treatment also showed the highest crude protein percentage. So it could be used for further study .3% EMS treatment showed good performance in respect of plant height, green fodder yield, dry matter yield and leaves per plant showed high heritability so selection for improvement of these characters may be useful. Hence, 0.3% EMS treatment may be taken for further evaluation and improvement.

Genetic variability in F_2 populations and inheritance of foot length in Indian Mustrad [Brassica juncea (L.) Czern. & Coss.]

Raj Kumar Goswami

Indian mustard [*Brassica juncea* (L.) Czern. & Coss.] is one of the most important oilseed crops in the world. In India, it the second most popular oilseed crop after groundnut. Mustard is not favoured in Assam because of its longer duration. Hence, the development of a mustard variety of medium height and duration can become a very profitable crop in Assam. The study was conducted with an objective to study the genetic variation, inheritance of foot length and correlation of foot length with yield and other yield attributes. Seventeen genotypes were grown in the *Rabi* 2015-16 consisting of 11 varieties and 6 F_2 populations. Crosses were made between selected parents to produce F_1 progeny and backcrosses were made to selected F_2 populations to produce backcross progeny which were subsequently grown in *Rabi* 2016-17.

Analysis of variance revealed presence of significant amount of variation among the genotypes. In the first year all the characters exhibited high to moderate heritability for all the characters except maximum root length. All characters except seed weight per plant showed moderate to low GCV. In the second year all characters showed moderate to low heritability. All characters except number of secondary branches per plant and seed weight per plant showed moderate to low GCV. D^2 analysis grouped 17 genotypes of the first year into 6 clusters and 15 genotypes of the second year into 4 clusters.

Analysis of variance for NCD III was done for two crosses, namely TM 106 x TM-2 and DRMR 150-35 x TM-2 for the character of foot length and revealed that significant difference were present among the parents in the first cross but not for the second cross. Narrow sense heritability for foot length was found to be 61% for the first cross and 35% for the second cross.

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Correlation analysis for the first year revealed that there is significant negative correlation between foot length and all the characters except plant height, days to maturity and days to 50% flowering. Seed yield per plant was significantly correlated to all the characters except plant height, days to maturity and days to 50% flowering. In the second year, foot length was correlated only to number of primary branches per plant and stem thickness. Seed yield per plant was significantly correlated to all characters except days to 50% flowering, foot length, number of secondary branches, root length, biological yield per plant and harvest index.

Evaluation of selected segregating populations of Indian rapeseed (*Brassica rapa* L.) for yield, nitrogen use efficiency and self-compatibility

Smrita Gogoi

Rapeseed (*Brassica rapa*) and mustard (*B. juncea*) are the major oilseed Brassica species of world. It is the second most important oilseed crop in India after soybean. Toria (*B. rapa*) is the predominant oilseed crop of Assam and NE India. Productivity of rapeseed-mustard in Assam is very low compared to all India. Therefore, continued efforts are necessary to achieve high seed yield through breeding high yielding varieties. The present study was conducted with the objectives to evaluate the segregating populations of some toria x yellow sarson crosses for yield and related traits, to assess the level of self-compatibility and to analyze inheritance of NUE and yield components. During *Rabi* 2015-16, 21 populations consisting of 5 parents, 3 F_1s and 13 F_3s were grown. Six generations (P_1, P_2, F_1, F_2, B_1, B_2) of two crosses viz., Jeuti x B9 and YSH401 x B9, were evaluated in *Rabi* 2016-17. Highly significant differences were obsetrved among the populations for different yield attributing characters evaluated during 2015-16. High GCV and PCV were observed for number of secondary branches per plant, seed yield/plant, biological yield/ plant and harvest index. High heritability was observed for days to 50% flowering, seed yield per plant and plant height. High genetic advance was recorded for number of secondary branch, seed yield/ plant, biological yield/ plant, harvest index and days to 50% flowering. During 2016-17 level of self-compatibility was observed. F_2 (YSH401xB9), F_1 (YSH401xB9), B_2 (YSH401xB9)xYSH401 and B9 exhibited high self-compatibility in terms of percentage of siliquae formation and seeds per siliqua under bagging. Jeuti and its cross derivatives showed in general low self-compatibility. YSH401xB9 (F_1) developed more number of seeds per siliquae (22.9) under bagging than in open. Nitrogen use efficiency, worked out as agronomic efficiency evaluated at N0 and N60 among the generations of the two crosses was high for JeutixB9)xB9, B9, YSH401xB9(F_1), JeutixB9 (F_1) and JeutixB9 (F_2). In the

generation mean analysis with 3 parameter model by Cavalli's joint scaling test, the m, [d] and [h] parameters were mostly significant and the chi square was highly significant for NUE and yield components. Thus this model was not adequate, which could be due to presence of digenic or higher order epistasis and G x E interactions for these traits. In the perfect fit solution of 6 parameters, almost all characters showed highly significant values of the parameters. However, further studies are necessary for testing the adequacy of these parameters.

Established of green synthesised silver nanoparticles within the plants for studying its physiological effects on host

Afrina Ara Ahmed

Silver nanoparticles (AgNPs) were successfully synthesized from a potential fungal antagonist *Trichoderma asperellum* through a simple green and eco-friendly route using cell filtrate. Silver nitrate was used as the precursor for the synthesis of the silver nanoparticles. The Ag NPs thus formed were then characterized by using various equipment *viz.* UV-Vis spectrophotometer, Dynamic Light Scattering (DLS), Zetasizer, Transmission Electron Microscope (TEM) and Energy Dispersive X-Ray Analysis (EDX). The UV-Vis spectroscopy showed a characteristic Surface Absorption Band at 420 nm which confirmed the formation of silver nanoparticles. DLS study showed that size of the synthesized nanoparticles was 68 nm with a polydispersity index of 0.857. This indicates that the biosynthesized nanoparticles were polydispersed in nature. The charge of silver nanoparticles was determined by zeta sizer and found to have a negative potential value of -1.34 mV and indicated stable on dispersion. TEM study revealed the uniform and well-dispersed nature of the biosynthesized nanoparticles with a spherical shape. The average particle size recorded was 8.26 nm with a size range from 4-14 nm. The EDX study showed that the biosynthesized material contained 32.18% silver, 10.16% oxygen, and 57.66% carbon. The physiological effects of Ag NPs on the host crop i.e. tea (clone-TV21) was evaluated at 100% concentration. Silver nanoparticles were introduced into the host by five different treatment methods *viz.* cutting treatment (one leaf bud cutting), injection method, foliar spray, soil application and seedling root dip treatment with 10 replicates for each. Observation on changes in chlorophyll content, moisture content, relative water content, total soluble sugar, total protein, lipid peroxidation (MDA content), secondary metabolites *viz.* phenol, alkaloid, and flavonoid was analyzed after 45 days of the treatment. Results showed that silver nanoparticles can induce the plants in increasing all the physiological parameters

mentioned above. Out of all the five treatments, the foliar spray followed by seedling root dip treatment were found to be the best treatment for establishing silver nanoparticles in the plant system with maximum positive effects on all the parameters compared to other treatments as well as control. It was recorded that the silver nanoparticles did not have any harmful effect on tea. Also, a few soil parameters were evaluated *viz.* soil pH, soil microbial count, soil organic carbon and soil microbial biomass carbon. All the parameters showed a positive effect after application of silver nanoparticles, except the soil microbial count which was seen decreased after application of silver nanoparticles in soil.

Study on sterility mosaic disease of pigeon pea (*Cajanus cajan* L.) with reference to symptom development, transmission behaviour and varietal reaction

Bhaskar Talukdar

The experiment entitled "Study on sterility mosaic disease of Pigeon pea (*Cajanus cajan* L.) with reference to symptom development, transmission behaviour and varietal reaction" was carried out in the Instructional cum Research Farm, Assam Agricultural University, Jorhat (Assam) during 2016-17. A roving survey was carried out in 5 districts of Assam *viz.* Biswanath, Nagaon, Barpeta, Kokrajhar and Jorhat. The highest incidence of pigeon pea sterility mosaic disease was observed in Nagaon (24.00%) followed by Biswanath (16.60%), Barpeta (12.25%), Jorhat (8.16%) and Kokrajhar (0.00%). Sterility mosaic disease of pigeon pea produced symptoms like yellowish green appearance of leaves, patches of light and dark green color in leaves, reduced leaf size and excessive growth without production of pods. Transmission of pigeon pea sterility mosaic virus (PPSMV) using leaf stapling method yielded positive results in *Cajanus cajan* with a disease incidence of 40%. The experiment was however successful in transfer of mites on *Oxalis corniculta* and *Cannabis sativa*. On the other hand transmission of pigeon pea sterility mosaic virus by mechanical sap transmission showed negative results. Jorhat Local showed lowest mite population density with a mean of 0.266 mite eggs/cm^2 and ICPH-2740 showed the highest mite population with 2.198 mite eggs/cm^2.

Screening of pigeon pea genotypes against pigeon pea sterility mosaic disease was done using a susceptible check *viz.* ICP-8863. Natural application of disease pressure resulted in production of symptoms in all the grown genotypes. Disease incidence was recorded at 30, 60 and 90 days after sowing. Biswanath Local, Jorhat Local, MAL13, Maruti, ASHA, BAHAR and Pathsala Local were found to be moderately resistant. On the other hand ICPL 88039, ICP 8863, ICPL 11305, ICPL 11330, ICPH 2671, ICPH 2740, TS 3R, Bhawanipur Local, Howli Local were found to be susceptible to pigeon pea sterility mosaic disease. ICPH 2740 showed highest disease incidence with 38.09% and Jorhat local showed lowest disease incidence with 19.04%.

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Department : Plant Pathology
Major Advisor : Dr. P. Nath

Artificial production of *Cordyceps bassiana* a teleomorph of *Beauveria bassiana* (Bals.) Vuill

Boppa Linggi

An attempt was made to produce *Cordyceps bassiana* (Li *et al.,* 2001) from its anamorph *Beauveria bassiana* (Bals) Vuill. in artificial condition. Sixteen (16) isolates of *B. bassiana* were collected from the Mycology Laboratory, Department of Plant Pathology, AAU, Jorhat. Compatibility between the different isolates of *B. bassiana* were tested in half strength Sabouraud's dextrose agar yeast extract (SDAY) and brown rice media in different combinations of the isolates were conducted by inoculating two isolates on opposite sides of petriplate containing media for mating and were incubated at 20°C, 80~90% RH, and 1000 lux of illumination under standard fluorescent lamps. After regular observations until 60 days of incubation, the plates were kept in refrigerator temperature (4°C) for 30 days. Only four combinations (Bb1×Bb1, Bb2×Bb6, Bb6×Bb14 and Bb14×Bb14) produced perithecial stromata. They were determined as *C. bassiana* by observing the stromatal characters and other relevant taxonomical keys for identification. This vegetative compatibility of the anamorphs (*B. bassiana*) by using indigenous isolates for the formation of teleomorphs (*C. bassiana*) may lead for its mass multiplication in laboratory condition.

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Department : Plant Pathology
Major Advisor : Dr. K.C. Puzari

Standardization of mass culture technique of *Phaeoacremonium* spp. responsible for oleoresin deposition in *Aquillaria malaccensis*

Le Thi Kim Loan

Phaeoacremonium parasiticum has been found to be associated with oleoresin deposition in *Aquialaria malaccensis* (Agar plant). Mass culture of *P. parasiticum* needs to be done for its economic and large scale production of Agarwood oil. *P. parasiticum* cultured on PDA petriplate at 30±1°C, showed very slow growth rate. At 30 days after inoculation, the radial growth reached 6 cm to 7 cm, and showed a grey to greenish-grey colour, typical radial furrows were seen prominently form the back side of PDA plate. The Agar-agar slide culture of *P. parasiticum* under microscopic examination showed that at 5 days after inoculation, mycelium and circular mycelium were coloured, with septate hyphae, bearing branched or unbranched conidiophores. Conidiophores were approximately 10 μm to 65 μm in length, septate or aseptate, bearing the phialide. At 10 to 15 days after inoculation the hyaline, aseptate conidia aggregated in groups on the phialides of conidiophores with various shapes *viz*., oblong, ellipsoidal, obovoid or broadly oblong. The typical characteristic warts like droplets of *P. parasiticum* were also seen on mycelium. To find out the favourable material for mass culture of *P. parasiticum*, five different media including the liquid media *viz.,* Potato Dextrose Broth (PDB), Host Extract (50%) + Potato Dextrose Broth (50%) (HE+PDB), and the solid media *viz.,* Rice Bran (RB), Maize Meal (MM) and Wheat Bran (WB) were tested. Solid media were added with water at the rate of 70 ml/100g of solid substrate. The media were adjusted at pH of 6.5 and incubated at a temperature of 30±1°C. The colony forming unit (cfu) counted (after 30 days of inoculation) showed that, the population density of *P. parasiticum* in liquid media like PDB was 7.23 log cfu/ml, and HE+PDB was 4.85 log cfu/ml. In solid media, the highest population density was in MM media with 9.56 log cfu/g, followed by WB media (9.50 log cfu/g) and RB media (9.38 log cfu/g). Artificial inoculation by tree drill method with the inoculum produced in MM media

showed 100% success in development of typical symptoms of infection on *A. malaccensis* trees. After burning the woody disease samples on the flame, the emission of a light pleasant aroma was observed. It proved the pathogencity of the fungus cultured in MM. Hence, Maize Meal media (MM : Water = 100g : 70 ml) at pH of 6.5, incubation temperature: 30±1°C for 30 days would be the standard technique for mass production of *P. parasiticum*. The inoculum (9.56 log cfu/g) can directly be used for artificial inoculation by Tree drill method for artificial oleoresin deposition in *A. malaccensis*.

Management of root rot of patchouli (*Pogostemon cablin* Benth)

Monuj Gogoi

Patchouli is an important aromatic plant from Lamiaceae family, well known for its essential oil properties. Root rot disease of patchouli is caused by *Fusarium solani* (Mart.) Sacc., a severe and wide spread disease in India. A roving survey was conducted on root rot incidence based on the occurrences of disease in major patchouli growing areas of Nagaon, Biswanath, Golaghat and Jorhat districts of Assam. Highest percentage of the disease incidence was recorded in the districts of Nagaon (69.01%).

Different isolates were collected from patchouli growing areas of Assam to study the cultural and morphological characteristics of *F. solani*. Among eight isolates studied, the fastest radial growth (90 mm) were observed in isolates JFS_1, JFS_2 and NFS_4 whereas minimum colony diameter was observed in isolate BFS_7 (81.55 mm). All the isolates produced micro, macro conidia and chlamydospores. All the conidia were hyaline and macro conidia were sickle shaped with blunt end, micro conidia was cylindrical and chlamydospores were intercalary, terminal, globose to oval shaped in all the isolates.

Pot and field experiment was conducted to study the effect of fungicide, bio-formulation (*Biofor-pf-2*) and oilcake for the management of root rot disease of patchouli caused by *F. solani*. A separate set of natural and sterilized soil pot experiments were maintained under net house. In natural soil experiment, Among the treatments, root dipping + soil drenching with Carbendazim @ 0.1% + MOC @ 50 g/pot (T_5) was found best management practices in reducing the disease incidence in comparison to inoculated control. Root dipping and soil drenching with Carbendazim @ 0.1% (T_1) was found highest per cent disease incidence (44.40%). In sterilized soil experiment, the PDI ranged between 22.22 to 44.40 per cent in various treatment combinations compared to the inoculated control (100%). Among them, MOC @ 50 g/pot (T_3), Root dipping and soil drenching with Carbendazim @ 0.1% + MOC @ 50 g/pot (T_5) and *Biofor-pf-2* @ 100 g/pot + MOC @ 50 g/pot (T_6) respectively was best with minimum disease incidence (22.22%) over control. Root dipping and soil drenching with Carbendazim @ 0.1% (T_1) and *Biofor-pf-2* @ 100 g/pot (T_2)

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respectively was found less effective with higher per cent disease incidence (44.40%), respectively.

In field trial, all the treatments were found significantly superior over inoculated control in reducing disease incidence. Integration of seedling root dipping and soil drenching with Carbendazim @ 0.1% and soil application of *Biofor-pf-2* @ 100g/plant and MOC @ 50 g/plant (T_7) recorded least percent disease incidence (5.58%) and maximum herbage yield compared to inoculated control (88.88%). It was followed by soil application of *Biofor-pf-2* @ 100 g/plant and MOC @ 50 g/plant (T_6), seedling root dip and soil drenching with Carbendazim @ 0.1% and soil application of MOC @ 50 g/plant (T_5) recorded 8.33% and 11.11% PDI, respectively. The integration of *Biofor-pf-2* @ 100 g/plant with Carbendazim @ 0.1% (T_4) recorded maximum disease incidence (33.33%) compared to the inoculated control.

Biological Control of Plant viruses

Namrata Baruah

A novel approaches comprising of biological control by the use of plant growth promoting rhizobacteria (PGPR) can be an useful strategy for containment of diseases, as PGPR are well known for their proficiency in growth promotion and protection from diseases in crops. It is known that the control of viruses is difficult to achieve, an efficient way of management of these can be with the use of PGPR or their products, which is basically strenghtening the immune system which refers to the induction of systemic resistance. The impact of such induced systemic resistance with the modulation of antioxidant enzymes and â-1,3-glucanases with the induction of pathogenesis related proteins (PR-Ps) are found to be the background of biocontrol. Thus, in this study, use of two PGPR strains, *Burkholderia* sp. R8 and *Pantoea agglomerans* 255-7 against viruses like CMV, PVX, PVY and TSWV with their various traits like colonization, plant growth promotion as well as their biocontrol activites are described in reference to different laboratory and greenhouse trials and techniques.

In terms of colonization, it was found that the strain R8 of *Burkholderia* sp. could colonize better in a diverse range of host plants including beans, zucchini, cucumber, tomato, chilli, *N.benthamiana*, as compared to the 255-7 strain of *Pantoea agglomerans*. Also, the plant growth promotion trials when conducted both *in vitro* as well as *in vivo* gave positive results for a number of tests conducted including measurement in heights, biomass and root lenght in plants inoculated with PGPR against the non-inoculated control plants. Moreover, for the biocontrol traits imparted by the bacteria, it was found both phenotypically as well as through molecular assays, that the R8 strain could effeciently protect the plants from virus infections giving delayed symptoms in plants inoculated with PGPR even in higher virus concentration, which can be employed in order to provide better fitness to the plants. This gives an explanation to the fact that application of PGPR might have provided the plants with regulation in certain enzymes like â-1,3-glucanases, whose down-regulation restrict the movement of the virus in the plants and thus reducing the severity of the diseases, as observed in case of the gene PR2b which codes for â-1,3-glucanases in case of R8 treated PVX infected *N.benthamiana* plants.

Bio-intensive management of Late blight and Red ant on potato

Nipom Jyoti Dutta

In the present investigation, efforts have been made to evaluate the comparative efficacy of three different forms of copper fungicides *viz*., copper sulphate, copper oxychloride, copper hydroxide and three bio-formulations *viz.,* Bioveer, Biotime and Biogreen-5 against late blight of potato incited by *Phytophthora infestans* (Mont.) de Bary under the same spray schedule (one prophylactic spray at canopy closure followed by two more sprays after appearance of late blight) with a view to select the most effective control measure for bio-intensive management of the disease. Field experiment performed during 2015-16 revealed that all the fungicides and bio-formulations could control late blight to a varying extent. Among the all treatments, copper hydroxide proved to be the best in reducing the incidence of late blight. This treatment not only gave highest tuber yield (4.75t/ha) with a corresponding minimum (10.87%) tuber infection but also provided highest protection (22.78%) against late blight and provided maximum net return of Rs. 43,818.00 along with a corresponding incremental benefit-cost ratio of 4.64:1.

The second investigation was carried out during 2016-2017 to evaluate the comparative efficacy of three different forms of bio-formulations *viz.,* Bioveer, Biotime and Biogreen-5 against Red ant (*Dorylus orientalis* Westwood) on potato under the given mode of application (Seed treatment @ 2kg/100kg seed tuber and spray application @ 0.2% at 30, 60 and 90 DAS). However, bio-formulations Biogreen-5 gave highest tuber yield of 5.63t/ha with a minimum infestation rate of 14.62% tuber damage and highest protection of tuber (56.50%) against red ant and also gave a satisfactory profit of Rs. 28020.00 with a B:C ratio of 2.14:1.

Molecular characterization of isolated bacteriophages of *pseudomonas savastanoi* pv. *savastanoi*

Parinda Barua

The olive knot disease, caused by *Pseudomonas savastanoi* pv. *savastanoi* is one of the most significant bacterial diseases of olive (*Olea europaea* L.) in all the olive growing countries of the world. Although the use of copper compounds (copper hydroxide, copper oxychloride etc.) along with integrated control programme have been reported to be effective against control of olive knot disease, the disease is unable to be controlled once established in the fields. Moreover, there are several drawbacks of copper like phyto-toxicity, environmentally unsafe, cost intensiveness etc. The management of the disease by bio-control agents (BCA) is a promising and sustainable alternative. Use of bacteriophages as BCA has been reported to found effective against several bacterial pathogens belonging to the species of *Erwinia*, *Xanthomonas* and *Streptomyces* etc. However, no report have so far been found regarding the use of bacteriophages against olive knot causing pathogen, *P. savastanoi* pv. *savastanoi*. In the present study, 11 bacteriophages infecting *Pseudomonas savastanoi* pv. *savastanoi* were isolated from an olive knot infected field in Agria, Volos, Greece. Three rounds of purification were carried out to obtain phages having one genetic clone. Morphological characterization by transmission electron microscopy (TEM) has shown that all the samples had an icosahedral head along with a tail suggesting that they belong to the Order *Caudovirales*. Study of the tail morphology revealed that the samples had a long, flexible and non-contractile tail with its breadth ranging from 9.43±1.19 nm to 12.75±2.83 nm suggesting that the sample phages had more affinity to the phage family *Siphoviridae* than *Myoviridae* and *Podoviridae* under the Order *Caudovirales*. Molecular investigation of the bacteriophages revealed that they contain DNA genomes of about 10kb in size. Next generation sequencing (NGS) and bioinformatics analysis of the sequences suggested that the genomes of the sample phages were more homologous to the genomes of „Proteus phage vB_PmiS-TH , „Caulobacter phage Ccr29 and „Staphylococcus phage Andhra than

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the Pseudomonas phages which showed „hits‟ in BLAST analysis. Although the „Proteus phage vB_PmiS-TH‟ is still unclassified, however, „Caulobacter phage Ccr29‟ belonged to the family *Siphoviridae* and „Staphylococcus phage Andhra‟ belonged to the family *Podoviridae* of the order *Caudovirales* hence correlating with the TEM results. It was also observed that the sample phage genomes had a similarity of only up to 24% with already identified phage genomes indicating the presence of some novel bacteriophages that are yet to be characterized.

PGPM formulation mediated biochemical changes and defense response of tea (*Camellia sinensis* (L) O. Kuntze) against major diseases and pests

Rituraj Deb

Tea is a perennial plantation crop grown under monoculture providing favourable conditions for a variety of pests. In recent years there has been a greater dependence on the use of pesticides for management of tea pests, due to which, the tea pests are showing higher tolerance/resistance status as well as higher accumulation of pesticide residues in made tea (DDT-10.4 to 47.1%; endosulfan - 41.1 to 98.0%; dicofol - 0.0 to 82.4%; ethion - 0.0 to 36.2%; cypermethrin - 6.0 to 45.1%). In our study we tried a environment friendly green approach of tea pests and disease management using four different PGPM based bioformulations, *viz.*, *Beauveria bassiana* based (*Biosona*)*,* consortia of *Trichoderma harzianum*, *Pseudomonas fluorescens* and *Metarhizium anisopliae* based (*Biotime*)*,* consortia of *T. viride, P. fluorescens, Bacillus thuringiensis, B. bassiana* and *M. anisopliae* based powder formulation (*Biogreen-5*) and consortia of *T. viride, P. fluorescens, B. thuringiensis, B. bassiana* and *M. anisopliae* based liquid formulation *Biogreen-L*). The efficacy of these bioformulations was tested against tea mosquito bug, looper caterpillar, red spider mites, tea aphid and grey blight disease under field conditions during summer '2016. The bioformulations were applied as foliar spray at an interval of 15 days during May to September of 2016. Bioformulation *Biogreen-5* was found to be most effective in controlling the insect pests and disease followed by *Biotime, Biosona and Biogreen-L*. Significantly highest reduction of tea mosquito bug (89.06%), red spider mite (92.04%), looper caterpillar (91.47%), aphid (92.53%) and grey blight (91.20%) was recorded along with increase in the green leaf yield (10.40q/ha) due to application of *Biogreen-5* which was significantly *at par* with the standard chemical check. The UV-spectrophotometric analysis of leaf samples revealed manifold increase in caffeine (4.11%) and total phenol (22.77%) content in the tea plants treated with *Biogreen-5*. The investigation indicated

direct correlation between application of PGPM formulation and tea quality. The study also updated the usefulness of current strategies based on biological control agents for effective management of tea pests to achieve optimum effects in terms of lowering production costs, reducing environmental contamination, loss of biodiversity, delaying the development of resistant pest biotypes and above all minimizing the pesticide residues in tea to enhance potential of export business.

Keywords: Bioformulation, biogreen-5, management, pest, tea

Management of fruit rot of brinjal with botanicals

Sukanya Gogoi

Fruit rot of brinjal is one of the most destructive disease causing severe damage to the fruits in the field and considerable losses during storage, transit and marketing. The commercial cultivation of the crop is under serious threat in Assam due to the disease. The incitant fungus of fruit rot of brinjal was identified and confirmed as *Phoma exigua* (Id No. - 8221.16) of the National Centre of Fungal Taxonomy, New Delhi). The present investigation aimed at management of the disease by using few botanicals *in vitro*. The aqueous extracts of fifteen botanicals were evaluated at 25 per cent concentration *in vitro* for their efficacy against the fruit rot pathogen of 'brinjal'- *Phoma exigua.* Out of these fifteen botanicals tested, *Allium sativum* (90.24%), *Allamanda cathertica* (87.80%), *Lawsonia inermis* (79.67%), *Laurus nobilis* (73.28%) and *Lasia spinosa* (70.15%), which exhibited considerably higher inhibition (above 70%) on mycelial growth of the pathogen were further tested against *P. exigua* at 5, 10 and 15 per cent concentration. *A. sativum* at 15 per cent concentration showed significantly highest inhibitory effect (88.03%) on the mycelial growth of the pathogen, over the control. This was followed by 10 and 5 per cent concentration of *A. sativum* (78.51 and 74.33%, respectively). Next was *A. cathertica* (73.51%) and *L. inermis* (73.28%) at 15 per cent concentration, the effect of which were statistically *at par* with *A. sativum* at 5 per cent. Least inhibition was recorded with 5 per cent concentration of *L. spinosa* (57.14%). These five botanicals were also evaluated for their effect on seed germination, root length, shoot length and seedling vigour of brinjal. At 15 per cent concentration, *A. cathertica* resulted highest values in all the parameters over rest of the botanicals at different concentration, which was followed by *A. sativum, L. inermis*, *L. nobilis* and *L. spinosa*, respectively. The phytotoxic effect of these botanicals at 5, 10 and 15 per cent concentration (if any) were tested on 30 days old seedlings of brinjal. It was observed that the botanicals did not show any phytotoxic effect at all the concentrations tested. The total alkaloid, total phenol content and antioxidant activity profiles of these five botanicals were also estimated. Results revealed significantly higher alkaloid and phenol content in case of *A. cathertica* followed by *L. inermis, A. sativum, L. nobilis* and *L. spinosa.* The highest antioxidant activity was found in *L. inermis* followed by *L. nobilis, A. cathertica, A. sativum* and *L. spinosa.*

Enhancement of potentiality of a bio-control agent through protoplast fusion

Tingneinem Linda Suantak

Investigations were carried out to know the biocontrol potential of *Trichoderma asperellum, Trichoderma harzianum* and *Metarhizium anisopliae* through protoplast fusion. Protoplasts from fungal antagonists *T. asperellum* (ITCC-8886.12), *T. harzianum* (ITCC- 8887.12) and *M. anisopliae* (ITCC - 8882.12) were isolated using lysing enzyme and fused. The fused protoplasts were regenerated and 9 fusant isolates were used to study their antagonistic activity against *Rhizoctonia solani* and *Colletotrichum capsici.* Among the nine isolates fusant$_1$ (*T. harzianum + T. asperellum*) showed maximum mycelial growth inhibition of both the pathogens. All the tested fusants isolates exhibited increased antagonistic activity against both the pathogens than the non-fusant isolates of the parent strains except for fusant$_3$ (*T. asperellum + M. anisopliae*) against *R. solani*. Studies on management of *R. solani* and *C. capsici* under pot condition revealed that T_5 sprayed with fusant$_1$ showed minimum *R. solani* incidence (0%) and both T_3 (25%) sprayed with non-fusant strain of *T. harzianum* and T_5 (25%) showed minimum incidence of *C. capsici* incidence. Results of the present study suggested that the protoplast fusion technique is useful for developing the superior hybrid strains and enhance antagonistic activity of fungal antagonists against tested pathogenic fungi.

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Incidence and etiology of sugarcane grassy shoot disease in Assam

Trishna Mipun

Field surveys were carried in sugarcane growing districts of Assam *viz.,* Biswanath, Golaghat, Nagaon and Sonitpur during 2015 August to June 2017, for the presence of sugarcane grassy shoot disease.

Highest disease incidence was observed (up to 22.48%) in Biswanath district of Assam which was followed by (up to 18.44%) in Sonitpur, (up to 16.65%) in Nagaon and the lowest (up to 11.07 %) in Golaghat district. Among different varieties highest incidence was observed in Khagori (22.48 %) at Biswanath district and lowest in Kolong (9.48%) in Golaghat district. The association of phytoplasma with symptomatic sugarcane was confirmed by direct and nested PCR amplification of phytoplasma ribosomal gene.

The most characteristic symptoms of the disease as observed in the study were proliferation of vegetative buds from the base of the infected cane giving rise to crowded bunch of tillers bearing narrow grass like leaves, pale yellow to completely white chlorotic leaves in the newly developed shoots, soft textured leaf with chlorotic streaks, production of dwarf and thin canes with short internodes not fit for milling. Sprouting of eye on the above ground portion of the infected cane was observed. The disease symptoms were more pronounced in the ratoon crops.

Sugarcane grassy shoot resulted in the reduction of the yield parameters namely, cane height (m), cane weight (kg), number of internodes (No), Length of internodes (cm) and cane diameter (mm) over healthy, which varied from 48.72-56.56 per cent, 49.28-54.46 per cent, 25.00-38.88 per cent, 55.63- 69.76 per cent and 59.66-63.46 per cent respectively among the sugarcane variety Co-997, Dhansiri and Nambor. The presence of SCGS phytoplasma were also confirmed through nested PCRs by using phytoplasma specific primer (P1/P6 and R16F2n/ R16R2n) through PCR amplification of 16Sr RNA gene. SCGS infected plant samples produced size of ~1.2 kb phytoplasma DNA.

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Sugarcane grassy shoot disease also reduced the sugarcane juice quality *viz.* Juice weight (kg/lit), Brix (%), Sucrose content (%) and purity of juice (%) varied from 44.75-47.60 per cent, 25.15 -41.04 per cent, 40.45 -53.35 per cent and 20.45 - 24.58 per cent respectively over juice of healthy canes of the three sugarcane varieties under study *viz.*, Co-997, Dhansiri and Nambor.

Five different types of leafhoppers viz. *Orosius albicinctus* Dist., *Hishimonus phycitis* Dist., *Exitianus indicus* Dist., *Cofana unimaculata* Dist. and *Nephotettix nigropictus* Stal. were collected and identified during the survey with average population of 4.25, 4.5, 3.75, 6.75 and 3.0 no./ five net sweep respectively.

The sugarcane grassy shoot disease was successfully transmitted by setts collected from infected cane with 100 per cent transmission efficiency. It took 67-90 days for expression of disease symptoms after planting of the setts.

The leafhopper *Exitianus indicus* (Dist.) could successfully transmit the disease in artificial inoculation with a transmission efficiency of 100 per cent. It took 87 days for the first appearance of the disease after giving 7 days acquisition and 7 days inoculation feeding period. Insect DNA PCR confirmed the phytoplasma association with the insect vectors.

Transmission with dodder was also successful with 40 per cent transmission efficiency. The dodder inoculated plants took 43-50 days for first appearance of the SCGS disease symptom.

The transmission of the sugarcane grassy shoot disease to the healthy canes was confirmed by detection of the sugarcane grassy shoot phytoplasma in the inoculated plants through PCR assays.

Characterisation of suppressor genes for development of gene construct against *Citrus Tristeza Virus*

Urmil Barthakur

Among the fruit crops, citrus is one of the most widely cultivated and economically important crops which is grown in around 142 countries in the world. Citrus cultivation is facing decline caused by both biotic and abiotic factors from centuries. *Citrus tristeza virus* (CTV) is one of the biggest oppressions to the citrus industry globally and a major contributor of citrus decline. In this study, for the detection of the three CTV suppressor genes namely p25, p23 and p20, specific primers were designed using the Jorhat isolate of virus JRT1. After extraction of RNA from infected leaf samples, one-step Reverse-Transcriptase PCR protocol for each of the specific primers was standardized by manipulating the annealing temperature for each primer pair. Amplification of the three suppressor gene could be visualized through agarose gel electrophoresis and bands were observed at 422bp, 420bp and 368bp for gene p25, p23 and p20, respectively. The PCR products thus obtained were purified from the gel using proper protocol and ligated into pGEM-T Easy vector using appropriate ligation reaction mixture and the ligated products were grown in competent *E. coli* JM 109 cells on ampicillin treated LB agar media plates. Transformed colonies were confirmed to be carrying the gene of interest by performing colony PCR. These three suppressor genes were sequenced and their sequence similarity was analysed among themselves and also with other known CTV isolates of India and the world. The three genes showed very little sequence similarity among themselves. Results showed p25 gene to be highly conserved as it has high sequence similarity with local isolates of CTV. On the other hand, p23 gene showed variation when its sequence was aligned and analysed with other local isolates of CTV. Phylogenetic analysis of the three genes was performed with known isolates of India and the world and the relationship was shown in the form of a phylogenetic tree prepared using MEGA software.

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Effect of plant extracts on larval growth and economic cocoon parameters of Eri silkworm, *Samia ricini* Boisd. (Lepidoptera: Saturniidae)

C. Lalmuankimi

An investigation on larval growth and economic cocoon parameters of eri silkworm, *Samia ricini* Boisd. fed on castor leaves fortified with three plant extracts viz., *Mikania micrantha* (Japanese weed), *Murraya koeniigi* (Curry patta) and *Pongamia glabra* (Karanj) extracts with different concentrations *viz.,* 5, 10 and 15 per cent was carried out in the Department of Sericulture, Assam Agricultural University, Jorhat in the year 2015-16. Results revealed that treatments as a whole when compared over control showed significant result in larval and cocoon parameters like mature larval weight, effective rate of rearing, larval mortality, silk gland weight, cocoon weight, shell weight and shell ratio. Fortification of castor leaves with plant extracts significantly improved larval growth and economic cocoon characters of eri silkworm. Castor leaves fortified with *Mikania micrantha* leaf extracts revealed maximum increment in respect of larval and cocoon parameters like larval weight (both mature and full grown), silk gland weight, silk gland tissue somatic index, cocoon weight, shell weight, shell ratio and pupal weight. However, maximum improvement in respect of effective rate of rearing and lowest larval mortality were observed when larvae were allowed to feed on castor leaves fortified with *Murraya koeniigi* leaf extracts. Shortest larval duration was recorded on eri silkworms fed on *Pongamia glabra* leaf extracts fortified castor leaves, however this was statistically non-significant. It was also observed that the plant extracts at different concentrations had no significant effect on larval duration of eri silkworm.

The concentrations were found to be statistically significant in shell weight. The 10 per cent of all plant extracts exhibited better performance in both larval and cocoon parameters *viz.,* larval weight (both mature and full grown), silk gland weight, silk gland tissue somatic index, effective rate of rearing, larval mortality, cocoon weight, shell weight, shell ratio and pupal weight. Whereas larval duration was found shortest at 5 per cent in all plant extracts.

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Major Advisor : Dr. (Mrs) I. Gogoi

Hence, from the present investigation, it was revealed that the plant extracts have effect over control on mature larval weight, effective rate of rearing, larval mortality, silk gland weight, cocoon weight, shell weight and shell ratio which is a major concern in sericulture industry. *Mikania micrantha* extracts exhibited better performance on majority of the parameters at 10 per cent concentration. Therefore, fortification of castor leaves with *Mikania micrantha* leaf extracts at moderate concentrations can be adopted for better performance of larval growth and cocoon characters.

Effect of coupling devices and mating durations on reproductive parameters of muga silkworm (*Antheraea assama* Ww)

Dipankar Saikia

An investigation on effect of coupling devices and mating durations on reproductive parameters of muga silkworm (*Antheraea assama* Ww) was carried out in the Department of Sericulture, Assam Agricultural University, Jorhat, in spring and autumn season during the year 2016-17. Results revealed that coupling device had significant effect on fecundity as well as hatching percentage of eggs of muga silk moth while oviposition period, incubation period and hatching period of eggs did not vary significantly in different coupling devices. The paper made coupling device was found to be better in terms of fecundity while the thatch grass device was observed to be better in hatching percentage. The fecundity of muga silk moth had an increasing trend with the prolongation of the mating duration. However, duration of mating had no significant effect on oviposition period, incubation period and hatching period of eggs. Mating duration found to have significant effect on fecundity and hatching percentage of eggs. Hatching percentage of eggs was registered highest for the eggs laid by the moths after 3 hours of mating duration on thatch grass made coupling devices. The fecundity of muga moth was recorded better after 5 hours of mating duration and found to be *at par* with 4 hours of mating duration while the hatching percentage of egg was registered better after 3 hours of mating duration and found to be *at par* with 4 hours of mating duration. The coupling devices and duration of mating did not have significant effect on incubation period of the eggs. Season had significant effect on fecundity, incubation period and hatching percentage of eggs except oviposition period and hatching period of the eggs. The fecundity was registered better in autumn while hatching percentage of eggs was registered better in spring season.

Thus, from the present investigation it is imperative to infer that a period of 3-5 hours mating duration is optimum for maximum egg laying of muga silk moth. In addition to

common practices of egg laying preparation of muga silk moth on *Kharika*, the bio-degradable news paper, tree twig and rice straw made coupling devices could be effectively used for quality egg (seed) production of muga silkworm. Though the fecundity was registered better in autumn, with shorter incubation period and hatching percentage of eggs the silk moth performed better in spring season.

Effect of foliar supplementation of ascorbic acid on larval growth and economic traits of Muga silkworm (*Antheraea assamensis* Helfer.)

Manas Jyoti Deori

Muga silk is the product of the silkworm *Antheraea assamensis* Helfer. endemic to North Eastern India which is prevalent in the Brahmaputra valley and adjoining hills by virtue of its typical agro-climatic condition. Muga silkworm is polyphagous and feeds on the leaves of different plant species. The silkworm is semi-domesticated and multivoltine in nature having 5 to 6 generation in a year. Supplementation or fortification of silkworm host plant leaves is a technique of recent application in sericulture research. A variety of fortification agents such as, proteins, carbohydrates, amino acids, sugars, vitamins, minerals, sterols, hormones, antibiotics, salts and other chemicals have been tested on silkworm larvae (Sundar Raj *et al*., 2000). The dietary supplements like proteins, vitamins, lipids etc. evincing their specificity at specific dose for various metabolic activities of silkworm (Horie and Watanabe, 1980). Ascorbic acid has many important functions in the animal body (Balasundaram *et al*., 2013). The present investigation is aimed to study the effect of foliar supplementation of ascorbic acid on larval growth and economic parameters of muga silkworm, *Antheraea assamensis* Helfer. in the Department of Sericulture, Assam Agricultural University, Jorhat during the year 2016-17.

The study revealed that supplementation of som leaves with ascorbic acid does not have much impact on the larval growth and cocoon characters of muga silkworm. Application of ascorbic acid in 4th instar larval period with 1.5 % to 3.0% concentration of ascorbic acid increases the larval weight with decrease of larval duration compared to control, while effective rate of rearing was found to be more in 3.0-4.5% concentration of ascorbic acid supplementation during 3rd, 4th and 5th instar larval period. The silk gland weight was 1.8g in control batch and at variation from 1.75g to 2.10g in the treated batches of the silkworm with different concentration of ascorbic acid. The cocoon weight, shell weight, shell ratio, length and size (denier) of cocoon filament found to be increases with application of ascorbic acid with 1.5% concentration at 4th instar larval growth period.

Thus, from the present investigation it could be inferred that fortification of host leaves with ascorbic acid does not have much impact on larval growth and economic characters of muga silkworm. However, supplementation of host leaves with lower concentrations of ascorbic acid during 3rd and 4th instar rearing period may be effective at certain levels, for improvement of larval growth and economic traits of muga silkworm.

Effect of nitrogen level on productivity of mulberry (*Morus* spp.) based intercropping system

Nilkamal Bora

A field experiment was conducted at the Instructional cum Research (ICR) Farm of Assam Agricultural University; Jorhat during 2016-2017 to study the effect of nitrogen level on productivity of mulberry based intercropping system. The treatment comprises of three levels of nitrogen (75kg, 100kg and 125kg N/ha) and five cropping system (sole mulberry, sole setaria, sole cowpea, mulberry + setaria and mulberry + cowpea intercropping system). The experiment was conducted in split plot design taking cropping system as main plot treatment and nitrogen level allotted to sub plot treatment replicated thrice. Experimental results showed that mulberry intercropped with cowpea (C_5) recorded significantly higher plant height, maximum number of leaves, leaf area, leaf area index, leaf yield, dry matter percentage, dry matter yield and crude protein yield as compared to rest of the treatments. However, the sole mulberry recorded significantly higher growth and yield parameters as compared to mulberry planted in intercropping system with Setaria (C_4). Crude protein, Crude fibre, Crude fat content (%) in mulberry intercropped with cowpea and Setaria varied significantly with respect to nitrogen levels. Results showed that Mulberry +cowpea (C5) intercropping system recorded significantly better leaf quality parameters compared to rest of the treatments. The growth and yield attributes of component crop (Setaria and Cowpea) were studied and the component crop planted/ sown as intercropped with mulberry recorded significantly higher plant height, tiller/tussack of Setaria, leaf stem-ratio of cowpea, dry matter percentage. The green forage yield of sole Setaria and sole Cowpea were found to be significantly higher than their green forage yield as a component crop in intercropping system with mulberry. In terms of quality parameters of both Setaria and cowpea in respect of crude protein, crude fibre and crude fat content recorded significantly higher in the Setaria when intercropped with mulberry. Same trend has also been observed in cowpea when intercropped with mulberry. As far as the interaction effect of cropping system with nitrogen levels are concerned only the green forage yield of cowpea was found to be significant. On dry matter yield of cowpea in the first and second crop were found to be significant. Considering the cropping system as whole mulberry + cowpea intercropping system was found to be better among all the cropping system which resulted in the highest land equivalent ratio (1.67), higher gross return (Rs. 145638.00) , net return (Rs 74536.63) and B: C ratio (3.65).

Boron status and its critical limit for cauliflower in soils of Assam

Biplab Choudhari

A study was undertaken to assess the available boron status and its critical limits for cauliflower in soils of Assam. Two hundred surface soil samples representing four agro-climatic zones of Assam were collected covering fifty locations in each zone and analysed for hot water soluble boron (HWS-B) and some important soil physico-chemical properties. A wide variation was observed in HWS-B and physico-chemical properties among the four agro-climatic zones of Assam. Soils from Upper Brahmaputra Valley Zone recorded higher mean value of HWS-B, clay, organic carbon, CEC, available nitrogen and phosphorus than that of other three agro-climatic zones. HWS-B exhibited a significant positive correlation with organic carbon, CEC, available nitrogen and available sulphur indicating their dominant influence on boron status of these soils. Among the zones, soils from Lower Brahmaputra Valley Zone showed the highest deficiency in HWS-B with 36 per cent and the lowest deficiency was found in Upper Brahmaputra Valley Zone with 28 per cent.

A pot experiment was conducted during 2015-2016 with twenty two number of soils of varying soil characters for selecting the most suitable chemical extractant for determination of available boron and evaluation of critical limits of boron for cauliflower. The soils were extracted with hot water, hot 0.01M calcium chloride, 0, 01M tartaric acid, 1.0M ammonium acetate, 0.5M potassium dihydrogen phosphate and 0.1M salicylic acid. The availability of boron was found to be vary with chemical extractants used. In terms of the efficiency of B extraction, the extractants followed the order in decreasing trend as hot 0.01M calcium chloride(HCC) > hot water (HW) > 0.1M salicylic acid(SA) >0.5M potassium dihydrogen phosphate (PDP) > 0.01 M tartaric acid (TA) >1.0M ammonium acetate(AA). Critical limits of extractable boron as determined by graphical procedure were **0.50, 0.66, 0.45, 0.38, 0.47, 0.50 mg kg^{-1}** and by statistical procedure were 0.53, 0.66, 0.47, 0.38 0.47 and 0.50 mg kg^{-1} for h**ot water,** hot 0.01M calcium chloride**,** 0.01 M tartaric acid**,** 1.0M ammonium acetate**,** 0.5M potassium dihydrogen phosphate and 0.1M salicylic acid**,**

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respectively. Both the methods showed very closer values of critical soil boron concentration. Among the extractants, 0.1M salicylic acid recorded the highest correlation with Bray's percent yield, yield at control, B concentration at control and B uptake at control. Therefore, in view of high degree of correlation of soil test values with plant response parameters, 0.1M salicyclic acid was found to be the best extractant for assessing the available boron in soils of Assam. The critical level of boron concentration established by graphical and statistical procedures were 24.87 and 25.78 mg kg^{-1}, respectively grown in soils of Assam in cauliflower plant on dry weight basis at 60 days growth period.

Land evaluation for crop intensification in Bumnoi-mornoi watershed of Kokrajhar district of Assam using remote sensing and GIS techniques

Danswrang   Basumatary

The present study was undertaken in Bumnoi-mornoi watershed of Kokrajhar district of Assam in order to characterize and prepare soil resource maps, to study soil site suitability and to find out the related constraints for crop production. Altogether six profiles and twenty two surface samples were collected from two different physiographic units *viz.,* alluvial plain and flood plain. The samples were analyzed for various morphological and physic-chemical properties. The dominant hue of soil colour was 10YR, except in sub surface C horizon of P1 (AP) where it was 7.5YR. Colour value ranged from 3 to 6 and chroma from 1 to 6. Yellowish red (2.5YR 4/6) to reddish yellow (7.5YR 7/6) mottles were observed in the soils. Wide variations were observed in soil textural class varying from sand to clay loam. The structure of the soil varied from medium, weak to moderate sub angular blocky at the surface to very fine to medium, week to moderate sub angular blocky, massive and single grain structure. Organic matter content in the soil varied from 0.07 to 3.13 g kg^{-1}, the highest being observed in the surface Ap horizon of P3. Soil pH varied from 4.7 to 6.2. Sand, silt and clay contents in these soils varied from 23.3 to 89.2, 9.9 to 60, and 1.8 to 22.1 per cent, respectively. Among the exchangeable cations, Ca^{2+} was the dominant cation followed by Mg^{2+}, Na^{+} and K^{+}. CEC of the soils varied from 3.5 to 10.2 cmol (p^{+}) kg^{-1}. Available N varied from 13.44 to 448.0 kg ha^{-1}, available P$_2$O$_5$ varied from 0.92 to 55.70 kg ha^{-1} and available K$_2$O varied from 137.2 to 451.0 kg ha^{-1}, respectively. The studied soils were classified as Aquic Dystrudepts (P1), Oxyaquic Dystrudepts (P2, P4), Typic Dystrudepts (P3), Aquic Udorthents (P5) and Fluvaquentic Epiaquepts (P6). The productivity of the soils for crop production varied from poor to good in alluvial plain, and poor to average in flood plain. Potential productivity varied from average to good in alluvial plain and flood plain, respectively. The co-efficient of improvement (CI) values indicated that the productivity

of the alluvial plain and flood plain soils can be increased to maximum extend of 2.22 to 1.88, respectively. Soil site suitability assessment showed that the soils were moderately suitable (S2) to permanently unsuitable (N2) for *Sali* rice, *Ahu* rice, Potato and Maize. Soils were found to be very suitable (S1) to permanently not suitable (N2) for Banana. For pineapple, the soils were found to be very suitable (S1) to moderately suitable (S3). Various thematic and soil site suitability maps along with potential productivity maps of the study area were prepared using remote sensing and GIS techniques.

Soil properties and summer moongbean yield under winter rice stubble management

Kashyap Porag Bezbaruah

A field experiment was conducted in the Instructional-cum-Research Farm of the University to evaluate the effect of spraying cellulose degrading microbes (CDM) or commercial yogurt culture as mixture with glyphosate on *in situ* decomposition of rice stubbles left after the harvest of the crop, and on soil properties and crop yield in the succeeding summer moong bean. Rice stubbles were sprayed with glyphosate solution (0.205%), as mixture of glyphosate+CDM (0.205%+0.1%) or glyphosate+yogurt (0.205%+0.5%), or kept untreated in the field in three sets. The stubbles in two sets of the treatment were incorporated at forty five days after spray, and the plots of one set were grown with summer moong bean (variety – Pratap). The treatments were assigned to plots in the field with complete randomization and the samples or observations were taken with required replications for statistical analysis. Compared to the untreated or spraying glyphosate alone, CDM or yogurt commercial culture with glyphosate significantly decreased dry weight, total organic carbon content, cellulose content and C:N ratio of the rice stubble sixty days after the treatments, but did not affect total nitrogen content. The per cent decreases in dry weight, total organic carbon content, cellulose content and C:N ratio of the rice stubble due to treatment with microbial cultures varied from 31.1 to 33.5, 25.3 to 26.6, 45.5 to 48.8 and 16.8 to 17.9, respectively relative to the values before the treatments. Except for mean weight diameter (MWD) and exchangeable K^+ none of the soil properties *viz.* bulk density, total porosity, saturated hydraulic conductivity, water holding capacity, pH, exchange acidity, exchangeable cations showed significant change due to the treatments before sowing of moong bean (80 days after spray). The MWD of soil increased due to incorporation of rice stubbles treated with microbial cultures compared to the other treatments. The plant density and number of seeds per pod of moong bean grown after incorporation of rice stubble were not affected due to spraying glyphosate alone or as mixture with microbial culture after harvest of rice. But, the average nodule number, nodule dry weight, number of pods

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per plant and seed yield of moong bean were significantly increased due to incorporation of stubbles treated with glyphosate-microbial culture compared to the untreated plot. The moisture content of surface soil (0-15 cm) in the crop field significantly increased at 20 and 40 days after stubble incorporation compared to without incorporation. Available nitrogen and organic carbon content of soil did not very due to the treatments after harvest of moong bean. The available phosphorous content of soil increased significantly due to growing moong bean following incorporation of stubble treated with glyphosate-microbial culture after crop harvest, compared to others. The available potassium content of soil decreased in rice stubble incorporated plots without moong bean compared to that with moong bean or plots without stubble incorporation, irrespective of the treatments. Incorporation of the rice stubble significantly increased NH_4-N up to four weeks of moong bean sowing, while in case of NO_3-N it continued to increase compared to the control (without incorporation), irrespective of the treatments. In rice stubble incorporated plots no significant difference among the treatments was observed for NH_4-N and NO_3-N in soil, except for significantly higher NO_3-N in crop field than that in incorporated but fallow in glyphosate-microbe culture treated stubble at eight weeks after sowing. The total contents of N, P and K in soil were unaffected by the treatments.

Integrated fertilizer prescription equation for recommendations of fertilizers in hybrid rice on Alluvial soils of Assam

Namrata Kashyap

A field experiment was conducted at the Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during the year 2016-17 to study Integrated fertilizer prescription equations for recommendations of fertilizers in hybrid rice on Alluvial soils of Assam. In order to develop fertilizer prescription equations, fertility gradient experiment was conducted taking *kharif* rice (cv. Ranjit) as exhaust crop by creating three fertility gradient strips. After harvest of gradient crop, test crop experiment was conducted in the same field with hybrid rice (cv. US- 382) by superimposing 24 treatment combinations consisting of five levels of N (0, 30, 60, 90 and 120 kg ha^{-1}), four levels of P$_2$O$_5$ (0, 20, 40 and 80 kg ha^{-1}), three levels of K$_2$O (0, 40 and 80 kg ha^{-1}) and three levels of vermicompost (0, 2 and 3 t ha^{-1}) in each of these fertility gradient strips.

Integrated nutrient management approach brought about a positive influence on organic carbon, soil available nutrient status, crop yield and uptake of nutrients by hybrid rice. Combined application of 120 kg N, 80 kg P$_2$O$_5$ and 80 kg K$_2$O per hectare along with 3 tonnes of vermicompost per hectare resulted the highest available N , P and K as compared to other treatments. The highest crop yield and uptake of nitrogen, phosphorus and potassium by rice was obtained with combined application of 120 kg N, 80 kg P$_2$O$_5$ and 80 kg K$_2$O along with 3 tonnes of vermicompost per hectare.

Fertilizer prescription equations were formulated for hybrid rice by following Ramamoorthy's Inductive- cum-targeted yield model. Based on experiment, the nutrient requirement (NR) for producing one quintal of hybrid rice was found to be 2.00 kg, 0.31 kg and 2.35 kg of N, P$_2$O$_5$ and K$_2$O, respectively. The percent contribution of nutrients from soil (CS), fertilizer (CF) and vermicompost (CO) were found to be 35.15, 48.65, 26.50 for N, 47.17, 23.06, 12.08 for P and 60.32, 55.68, 28.69 for K, respectively. Based on NR, CS, CF and CO, the fertilizer prescription equations were developed for hybrid rice (cv. US-382) and an estimate of fertilizer doses were formulated for a range of soil test values and desired yield targets under NPK alone and NPK plus organics.

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Dissolved Organic Matter and Soil Enzyme Activity in Organic Cultivation of Rice

Purabi Buragohain

The dissolved organic carbon (DOC), dissolved organic nitrogen (DON), reducing sugars(hexose and pentose), soluble phenols, protein, amino acids,key enzymes [arylsulfatase(ARS), phosphomonoesterase (PME), fluorescein di-acetate (FDA) â-glucosidaseand urease] contained indissolved organic matter (DOM) and biodegradability of DOM were assessed as influenced by application of organic inputs in organic rice (*variety: Joha*)after five years of experiment. Two extractants*viz*:1.0MKCl(salt extractable organic matter, SEOM) and 5.0mM CaCl$_2$(water extractable organic matter, WEOM) were used for extraction of DOM from the rhizosphere soils. The results indicated the significant variations of DOM under the organic inputs. Significantly highest DOC of 83.41(mg/kg) and 31.32(mg/kg) were obtained by the extractants SEOM and WEOM on application of enriched compost (EC) (@5t/ha) and compost(5t/ha) respectively. Significantly highest DON of 54.33 and 47.54(mg/kg) were obtained in the extractant SEOM and WEOM under the application of EC@5t/ha and 2.5t/ha respectively. The phenol, protein, amino acids and reducing sugars were also exhibited the significant variation under different organic inputs following the utilization of two extractants. Among the organic inputs, EC @ 5.0t/ha, @2.5t/ha and compost @5.0t/ha with biofertilizer consortium contributed significantly higher amount of enzymes in DOM. Application of EC either @ 5.0t/ha or @2.5t/ha continuously for five years could resulted significantly highest amount of PME, FDA and ARS activity while application of compost @5.0t/ha with or without biofertilizers could resulted higher content of urease and â-glucosidase activity respectively. The total organic carbon (TOC) and total nitrogen (TN) were significantly highest (12.53 g/kg and 8.60g/kg respectively) in soil under the application of EC @5.0t/ha while soil organic carbon (SOC), was significantly highest (10.60g/kg) under the application of compost@5t/ha. Likewise the fractions (F1, F2, F3 and F4) of TOC were influenced significantly by different organic inputs.

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The correlation matrix illustrated the significant correlation between the two extractant for ARS (0.787**),PME (0.490*) ,â-glucosidase (606**),hexose (756**), protein (0.736**) and biodegradable DOM(0.595**). DON of DOM also established significant correlations in between the two extractant but in a different way. The SOC, TOC, fraction 1 and fraction 2 of TOC illustrated significant correlation with the DOC ofSEOM while TN could show the significant correlations with DON of both the extractants. However, varied significant correlations between the SOC, TOC, fractions of TOC and TN with different components of DOM were observed under the two extractants.The biodegradability of DOM were also significantly influenced by DOC, DON,SOC, fractions of TOC, TOC and TN at varying degree under the two extractants.

Isolation and characterization of Plant Growth Promoting (PGP) associative Diazotroph from Lowland Rice Ecosystem

Rasinja Englengpi

Rice crop harbours diverse communities of beneficial plant growth promoting diazotrophs which mostly plays a significant role in supplementing not only N fertilizer but also gives indirect benefit to the crops by improving their productivity and immunity. Considering all the benefits from PGP diazotrophs, the investigation was carried out from lowland rice rhizosphere of Jorhat district of Assam. Altogether, 53 rhizobacterial cultures were isolated in non-selective TSA media. Further, 30 pure culture isolates were grown in selective media to select the organisms having different PGP traits. The results of investigation revealed 10 pure cultures that showed PGPR as five phosphate solubilizers, three *Azospirillum*, one *Azotobacter* and one *Pseudomonas*. The selected rhizobacterial cultures were morphologically characterized and biochemically tested to identify the homology among the test isolates. The results indicated that none of the culture was identical to each other. The cultures were evaluated for different PGP activities both qualitative and quantitatively. The results showed all selected cultures produced ammonia, IAA and HCN. All isolates also showed urease activity. However P-solubilization, Proteolytic activity and Antimicrobial activity were limited to few cultures. On quantitative investigation, the test cultures enhanced seed germination ranging from 60-100%, nitrogenase activity from 5 to 12.6 μmol C_2H_4 ml^{-1}hr^{-1}, ammonia production from 112.34 -310.05 mgl^{-1}, IAA production from 15.8 to 22.6 mg l^{-1} and P-solubilization from 0.3-3.1 percent. The results also indicated direct relationship of drop in pH (6.57 to 4.01) to extent of P-solubilized with days of incubation. A Pot culture experiment was conducted during November, 2016 to evaluate 7 screened cultures of PGP on growth characters of brinjal (*Solanum melongena*) and post harvest parameters. Results indicated that, among the test organisms, culture P 20 (*Azospirillium*) recorded significantly highest percent increased in root length (21.6%),

plant height (40.6%), root dry weight (120.6%), shoot dry weight (84.82%), total biomass (86.86%), root shoot ratio (19.45%), number of leaves (144.4%) and number of branches (200%) over uninoculated control. On post harvest parameters, the microbial population was evaluated and that ranged from 1.7 to 3.5 cfu $10^6 ml^{-1}$, dehydrogenase activity ranged from 107.2 to 140.4 µg TPF g^{-1}, hydrolysis of Fluorescein diacetate ranged from 64.1 to 80.4 µg FDA $g^{-1} hr^{-1}$ and phosphomonoesterase activity ranged from 75.0 to 94.2 µg p-nitrophenol $g^{-1} h^{-1}$. Cultures P 20 recorded the highest *Azospirillium* population, and microbial activities. Thus, from the above investigation, P 20 was found as the most efficient and superior culture among the test isolates followed by P 49 in respect of PGP activities likes biofertilizers, phytostimulators and bio-control properties.

Soil acidity components under organic and conventional tea cultivation of Assam

Samikhya Bhuyan

An investigation was carried out to study soil acidity components under organic and conventional tea cultivation of Assam. Sixty numbers of soil samples were collected from two tea gardens of Golaghat district of Assam, soil sample were analysed for important soil physico-chemical properties and different forms of acidity components using standard procedures. Conventional system was found to be more acidic than organic system although the pH was maintained at a favourable range for tea production. The Organic system was found to maintain higher levels of organic carbon than conventional system. The pH of the soil increased with depth and organic carbon decreased with depth in both the management systems. Lower bulk density under organic system improved the water holding capacity of the soil within a range of 30.00 to 34.12 per cent compared to conventional system where WHC ranged from 27.0 to 31.4 per cent. Available nitrogen was found to be at a higher range in conventional system although available phosphorus improved under organic system. Higher level of calcium and magnesium under organic system justifies favourable pH range for the availability of these cations. Lower level of micronutrients under organic system indicated slow rate of mineralization of nutrients under organic system. The Total potential acidity was higher in both the management system. The value of total acidity was lower as compared to total potential acidity. Irrespective of depth all the acidity component were higher in conventional management system as compared to organic management, except pH dependent acidity which was higher in organic management. All the acidity components were found to decrease with depth and increase with age of plantations. pH was negatively correlated with exchange acidity (r=-0.502**) under organic system and (r=0.301**) under conventional system indicating that most of the exchange acidity is responsible for lowering the soil pH. Exchangeable Al was positively correlated with organic carbon (r=0.340**) under organic and (r=0.283*) under conventional. Exchangeable acidity showed highly significant positive correlation with exchangeable Al both in organic (r=0.983**) and conventional (r=0.990. Highly significant positive correlation was found in between total potential acidity and pH dependant acidity under organic (r= 0.856**) and conventional (r=0.730**) management. The study showed that variation of acidity components were higher under conventional management which may be due to the dominant role of Al in these soils.

Profile distribution of phosphorus in relation to pedogenesis of alluvium derived soils of the Brahmaputra valley of Assam

Samiron Dutta

A study was carried out to investigate the profile distribution of phosphorus and its relation with pedogenesis of some alluvium derived soils of the Brahmaputra Valley of Assam. Three different locations of Jorhat district starting fromBorholla at the extreme South of the District, at Koronga in mid point and Alengmora locatednear the bank ofBrahmaputra were selected for the purpose. From each area, two profiles were exposed, one from rice-ecosystem and another from adjacent non-rice ecosystem. Soil samples were collected from six profiles with twenty seven numbers of horizons. The soils are dark brown to brownish yellow in colour and varied widely in texture (sandy loam to clay), structure (single grain to moderately strong sub-angular blocky), clay content (7.5-44.5%), pH (4.3-6.9), OC (0.1-1.81%), CEC (4.7-12.3), and PBS (27.1-76.5%) and different acidity components. Based on the morphological and physico-chemical properties, the studied soils were classified as *Oxyaquic Hapludalfs* (rice soil of Borholla), *Typic Hapludalf* (non-rice soil Borholla), *Oxyaquic Dystrudepts* (rice soil of Koronga), *Typic Dystrudepts* (non-rice soil of Koronga), *Oxyaquic Udifluvents* (rice soil of Alengmora) and *Typic Udifluvents* (non rice soil of Alengmora).Among the different fractions, Phosphorus bound to particulate organic matter (extracted by 0.1 M NaOH) found to be the most dominant fraction of the soil. The order of abundance of different fractions of Phosphorus followed a trend of NaOH-Po(170.35 mg kg^{-1}) > NaOH-Pi (113.83 mg kg^{-1}) > Residual-P (44.85 mg kg^{-1}) >NaHCO$_3$-Po(33.4 mgkg^{-1}>Dil HCl-P (24.13mg kg^{-1}), NaHCO$_3$Pi(23.9 mg kg^{-1}) > Conc.HCl-Po(19.2 mg kg^{-1})>Conc.HCl-Pi(18.3mg kg^{-1})>Resin-P(5.93 mg kg^{-1}). The contribution of inorganic P fraction towards total P of the soil was observed to be 51% and the rest is contributed by organic fractions. The NaOH extracted inorganic fraction was found dominant in Alfisols under both rice and non rice soils while in Inceptisols and Entisols NaOH extracted organic fraction was dominant throughout the depth of the profile. In respect of availability, moderately

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labile pool (NaOH-Pi +NaOH-Po + Dillute HCl-P) was the dominant fraction and contributed 66-72% to the total P followed by 14-21% contribution from unavailable fraction (conc.HCl-Pi + conc.HCl-Po + Residual-P)and Labile P (Resin-P +NaHCO$_3$-Pi+NaHCO$_3$-Pi) with contribution of 13-15%. A highly dynamic relationship was observed between the resin P and NaHCO$_3$ extracted inorganic and organic P and in between labile and moderately labile P. Significant variation in the content of various fraction of P was observed among the different soil orders except in NaHCO$_3$ extracted organic P and Dilute HCl extracted P. Labile P was significantly higher in inceptisols while entisols and Alfisols were recorded for the highest amount of moderately labile and unavailable P respectively. Significant variation between rice and non rice soils was observed only in dilute HCl, conc. HCl extracted inorganic P and unavailable P. Principal Component Analysis revealed that oxides of Fe and Al is the major contributing factor of phosphorus availability in these soils followed by acidity components, organic carbon and exchangeable calcium.

Guwahati Tea Auction Centre – A case study

Abdul Sukur

This study is an attempt to examine the overall performance of Guwahati Tea Auction Centre (GTAC) with respect to organizational and functional status, volume of transaction, trends of arrival of tea, price realisation, market structure, storage capacity etc. The study was conducted based on primary data collected from GTAC and its stakeholders and also secondary data on various aspects of tea published in different sources of relevant authorities from the tea industry for the period between 2007and 2016. The investigation intends to examine the fluctuation as well as growth and stability of quantity and price of tea at GTAC, buyers – sellers concentration at GTAC, stability of quantity arrival and storage capacity at existing warehouses etc to gain the significant insight and knowledge about GTAC. Various statistical and functional analytical tools and models were used for the analysis of data and interpretation of results.

The study reveals that fluctuation and growth in quantity and price was more for orthodox tea as against CTC tea. Quantity sold in private sale was growing at a much faster rate than auction sale while private sale was found to be highly irregular than auction sale. Average price in private sale was observed to be much higher with high growth rate as against auction sale.

Quantity arrival of orthodox tea was very highly irregular than CTC tea while arrival of orthodox tea was found to be growing at 5.5 per cent as against only 1.49 per cent for CTC tea.

Quantity arrival of CTC tea found to be highest in the month of October while it was July for orthodox tea. Arrival of CTC tea was found to be highly irregular in the month of March while it was more stable in June to August and October to December. On the other hand arrival of orthodox tea was highly irregular in the month of July to August and much stable in December to January.

The investigation revealed that GTAC have enough storage space in its warehouses as against arrival of tea.

The magnitude of concentration of sellers and buyers through Gini concentration ratio was estimated at 0.14 and 0.50 respectively indicating that GTAC market was near oligopsony in competition. Higher sense of unequal distribution was observed among the buyers while relatively buyers concentration ratio indicated that market efficiency at GTAC was determine more by buyers rather than sellers.

Attempt was made to identify the factors that influences the price in auction market and found that unit price of tea at export market have very high positive effect in average price realisation in auction market.

Cytological and Anatomical Assessment of Few Planting Materials of Tea

Alija Burhagohain

Tea is one of the oldest, most widely consumed and least expensive natural beverage, know to the world over for its heritage brew, with various flavours and antioxidant properties. Tea [Camellia sinensis (L.) O. Kuntz] plant is highly self- incompatible and cross pollinated crop resulting in the the extremely heterozygous in nature (Kingdon-Ward, 1995). Due to the development of high yielding clones and seed stocks, the productivity of Tea in India has been raised but the genetic base of the existing diversity of the crop is rapidly narrowing down. Therefore, identification and screening of excellent tea germplasm become particularly important especially for preserving and utilizing the genetic resources in future plant improvement.

In the present investigation, an effort was made to characterize and estimate the variation of 20 tea germplasm (coded as THT1 to THT20) growing in the Experimental Garden for Plantation Crops, AAU, Jorhat on the basis of cytological, anatomical characters, growth parameters and abiotic tress tolerance.

In this experiment all the germplasm showed highly significant difference amongst them in all the parameters except the ploidy level. In the experiment all the germplasm were observed to be diploid having 2n=30 no. of chromosome. From the anatomical parameters it was observed that THT8 followed by THT5, THT7, THT13 showed characteristic more likely towards cambod type also recorded with higer phloem index. Banerjee (1992) observed that intermediates generally have the highest phloem index. The clones noted with higher phloem index in the present study can be considered as hybrid population which may be a good parent material for breeding programme.

THT1, THT10, THT3, contained higher total chlorophyll whereas THT4, THT10, THT20, showed high carotene content. In case of growth parameters THT11, THT7, THT5 showed higher plucking point density whereas THT11, THT17, THT7 showed good abiotic stress tolerance with high value of proline content, relative turgidity, water saturation deficit and epicuticular was content.

When clustering was done based on abiotic stress tolerance, pigment and growth parameters respectively, THT11 and THT17 are found to form a discriminated cluster when distribution was done by dendrogram. The parameters taken especially for abiotic stress tolerance study may be subjected to environmental factors for which more elaborated field trial may be required for these clones to assess their yield and quality parameters.

Chemical Pruning as a tool for Frame Formation Pruning in young Tea

Jadumoni Rajkhowa

An experimental entitled "Chemical Pruning as a for Frame Formation Pruning in young Tea" was carried out in Section No 13 of Experimental Garden for plantation Crops, Assam Agricultural University, Jorhat during 2016-2017 with the objective to evaluation of chemical pruning as an alternative for cessation of top growth and promotion of laterals. The experiment was laid out in ten treatments with three replications in randomized Block Design (RBD). In the experiments the applied chemical was chlormequat chloride in various concentrations i.e. 1000ppm, 1500ppm and 2000ppm.

Treatments which were treated with chlormequat chloride showing better result in number of laterals, length of laterals, number of leaves and plant, days required to initiation of laterals, chlorophyll content, specific leaf weight, fresh and dry weight of shoot and root, root: shoot ratio as compared to conventional method.

The treatment T9 (CMC) @ 1500ppm three times at 30 DAP, 45 DAP and 120 DAP) at 60 days, 90 days and 120 days after application was observed to be the most favourable treatment in relation to in number of leaves per lateral, number of leaves per plant, length of laterals and minimum requirement of days for initiation of laterals. At the end of end of the experiment the chlorophyll content, volume of shoot and root, fresh weight and dry weight of shoot and root showed highest results in T9 (CMC @ 1500ppm three times at 30 DAP, 45 DAP and 120 DAP) compared to order treatments. The application of CMC as an alternative to frame formation prune is found to be viable over the conventional method of frame formation operation in young tea plants. No phytotoxic effect was observed at all concentrations of CMC when applied as foliar spray on one year old young tea plants in the field.

Effect of machine vs manual plucking on quantitative and qualitative traits of tea shoots

Jyotishman Saikia

A study on effect of machine vs manual plucking on quantitative and qualitative traits of tea shoot was undertaken during March-November, 2016 in Experimental Garden for Plantation Crops of the department of Tea Husbandry and Technology, AAU, Jorhat-13, Assam. The study was conducted with Randomised Block Design accommodating seven treatment combinations *viz*. Hand plucking from March to November (T_1), One man operated machine plucking from March-November (T_2), Two men operated machine plucking from March to November (T_3), Hand plucking once from March-June and again from October to November and with one man operated machine plucking in between July-September (T_4), Hand plucking from once March-June and again from October to November and two men operated machine plucking in between July-September (T_5), Hand plucking from March-June followed by one man operated machine plucking from July to November (T_6) and Hand plucking from March-June followed by two men operated machine plucking from July-November(T_7).

The plucking machine used in the study were Tea Leaf Harvester, Kisan Kraft KK-TH-525 as one man operated and Ochiai Hamono Kogyo 133-100 as two men operated machine. The result of the data on quantitative and qualitative traits including some economic important parameters were grouped into four flushing season. *viz*. first flush, second flush, rain flush, autumn flush.

Quantitatively hand plucking from March-November (full season) gave significantly highest number of plucking round and also recorded the highest green leaf yield. On the other hand the lowest number of plucking round and hence the lowest green leaf yield observed in full season machine plucking of both the make studied.

In case of quality parameters the two categories of plucked shoots considered were fine and coarse tea shoots. The highest percentage of fine tea shoots plucked throughout the full cropping season came from hand plucking modes. Two men operated machine when used for full season recorded the lowest fine shoots. The coarse plucked tea shoots

which indicate poor quality accounted for the highest percentage in case of machine plucking for the full season irrespective of the number of operators involved.

With regard to dormancy index both manual plucking and machine plucking did not influence it significantly during first flush and second flush cropping season. However the later recorded higher value of dormancy index compared to the former ones as the cropping season advanced to rain flush and autumn flush.

The machine plucking varied significantly the time required to complete the operation to the lowest value while the manual hand plucking took the highest time, Morever one man operated machine plucking involved the lowest man day throughout the full season of plucking. In respect the cost of plucking for full season the one man operated machine accounted for 50.24% of full season manual plucking. The two men operated machine incurred higher percentage of cost compared to the one man operated ones accounted for 71.37% of full season manual plucking.

Growth of young tea plants as influenced by biofertilizer consortia

Priyanka Behera

An experiment entitled "Growth of young tea plants as influenced by biofertilizer consortia" was carried out in Section No 13 of Experimental Garden for Plantation Crops, Assam Agricultural University, Jorhat during 2016-2017 with the objectives to find out the effect of biofertilizer consortia on young tea growth and soil health. The experiment was laid out with five treatments in Randomized Block Design (RBD). The treatments that the plant received were T_1: Conventional (30g SSP+ 30g Rock Phosphate + 125g Compost per pit), T_2: Azospirillum + PSB +Compost, T_3: Azotobacter + PSB +Compost, T_4: Azospirillum +Azotobacter +PSB +Compost, T_5: Compost @ 125g/ plant.

The mean performance of young tea plants and growth parameters revealed that in Treatment T_4, number of leaves, number of branches, thickness of secondary branches per plant were more at the end of the season whereas fresh and dry weight of pluckable shoots, collar girth, bush spread and root volume were higher in Treatment T_3. At the end of the experiment leaf nitrogen and chlorophyll content was higher in the application of only compost. Proline content was higher in the conventional plot as compared to the other treatments.

Soil characters were significantly influenced by the treatments in respect of soil moisture content, available nitrogen, available potash and available phosphorus. Highest soil moisture content both in surface soil and sub-soil were obtained in the treatment T_2. The treatment T_3 showed better performance in availability of N, P_2O_5, K_2O and total microbial population in both the soil.

Treatments with bio-fertilizer consortia performed better as compared to the treatments without consortia. In case of growth parameters of young tea, growth of tea plants in the bio-fertilizer treated plots was at par to the plants under conventional application. The nutrient status of soil decreased with the advance of time. As one time application of all the treatments were done only at the time of planting, so it showed reducing effect with the advancement of time. Increasing the number of applications to twice or thrice a year may help in sustaining the availability of nutrients for uptake and assimilation.

Abstract of M. Sc. Thesis
Department : Tea Husbandry and Technology
Major Advisor : Dr. R.P. Bhuyan

Master of Veterinary Science

- Animal Biotechnology
- Animal Genetic and Breeding
- Animal Nutrition
- Anatomy and Histology
- Animal Reproduction, Gynaecology and Obstetrics
- Veterinary Extension Education
- Veterinary Epidemiology and Preventive Medicine
- Veterinary Livestock Production and Management
- Livestock Products Technology
- Veterinary Microbiology
- Veterinary Pathology
- Veterinary Parasiotology
- Poultry Science
- Veterinary Biochemistry
- Veterinary Clinical Medicine, Ethics and Jurisprudence
- Veterinary Surgery and Radiology
- Veterinary Public Health
- Veterinary Phomocology and Toxicology

Blank

Molecular characterization of bifidobacteria from animal sources and *in-vitro* assessment of their probiotic potential

Dr. Bedanta Pathak

The present study was undertaken with a view to isolate bifidobacteria from various sources, *viz.* fresh bovine milk, faeces of calves and piglets, ruminal content of slaughtered bovines and intestinal/caecal content of chicken and to characterize the isolates by random amplified polymorphic DNA (RAPD) analysis and sequencing of amplified 16S rRNA gene fragments.

A total of 12 (2.52%) out of 477 samples from various sources examined were found positive for *Bifidobacterium* spp. yielding the same number of isolates. All of these isolates were recovered from faecal samples of young piglets (6.12%), while samples from other sources examined did not reveal the presence of bifidobacteria. The isolates were characterized and identified by biochemical tests and phosphoketolase (F6PPK) enzyme assay, which showed characteristic features of *Bifidobacterium* spp. All the 12 isolates were also confirmed by genus-specific PCR based on amplification of 16S rRNA gene. Sequencing of the amplified products and subsequent sequence analysis by NCBI-BLAST revealed that out of the 12 isolates, 3 (25%) belonged to *B. breve,* 1 (8.33%) to *B. pseudolongum*, 6 (50%) to *B. animalis* subsp. *lactis* and 1 (8.33%) to *B. thermacidophilum* subsp. *porcinum.* However in respect of one isolate, the species could not be ascertained by 16S rRNA sequencing due to poor sequence data, although it was confirmed as belonging to *Bifidobacterium* spp. by genus-specific PCR. RAPD analysis could not clearly differentiate the strains belonging to different species. Phylogenetic analysis based on the bandings patterns also failed to differentiate the isolates belonging to different species of *Bifidobacterium*.

In-vitro assessment of their antibacterial effect of the isolates revealed that two isolates of *B. animalis* subsp. *lactis* had higher inhibitory activity compared to the other isolates. Based on higher inhibitory effect on selected pathogens, five isolates were selected for

further characterization in respect of their probiotic potential *in vitro.*The inhibitory effect of all these five isolateson the selected pathogens persisted even after heat-treatment at 100°C for 5 min. However, the inhibitory effect didn't persist after treatment with pronase-E and proteinase-K. All the five isolates tested were able to grow at a minimal pH at 4.0. Two of the tested isolates belonging to*B. animalis* subsp.*lactis*species exhibited comparatively higher acid tolerance even after 180 min of exposure and showed the lowest percentage of mortality of 16.21 and 21.79 per cent, and 13.40 and 17.32 per cent, respectively on exposure to lysozyme (0.5 mg/ml) and ox bile salts @ 0.3% (w/v).

In antibiotic resistant test, all the five isolates showed almost uniform susceptibility to different antimicrobial agents tested, except tetracycline. The present studysuggestedthat the two isolates from faeces of piglets obtained in the present studyof *B. animalis* subsp.*lactis* possess promising probiotic potentialand further *in vivo* study is required to be donefor validation of their probiotic activity.

Development of *pasteurella multocida* bivalent outer membrane protein based vaccine entrapped in aluminium hydroxide nanoparticles and evaluation of its immune response in mice

Dr.Haladhar Pegu

Swine pasteurellosis is one of the most economically important diseases of pig caused by *Pasteurella multocida* (*P. multocida*) capsular types A and D and these organisms are commensals and opportunistic pathogens in the upper respiratory tract in pig. The vaccine prepared from P52 stain of serotype B:2 of *P. multocida* is effective only in controlling bovine pasteurellosis but not swine pasteurellosis due to antigenic variation among capsular types A and D. In the present study, an attempt was made to develop a bivalent vaccine that could elicit immunity against both the capsular types of *P. multocida.*

Whole outer-membrane proteins (OMP) were extracted from *P. multocida* capsular types A and D, and were mixed together in the ratio of 1:1 forming bivalent outer-membrane proteins. The bivalent OMP was adsorbed onto aluminum hydroxide nanoparticles. The size of aluminum hydroxide nanoparticles adsorbed outer-membrane protein was found to be in the range of 120 to 130 nm.

The aluminum hydroxide nanoparticles adjuvanted bivalent OMP based vaccine has shown quickest immune kinetics in terms of IgG response as compared to aluminum hydroxide microparticles adjuvanted bivalent bacterin vaccine against *Pasteurella multocida* capsular type A. However, the IgG response against *P. multocida* capsular type A stimulated by aluminum hydroxide nanoparticles adjuvanted bivalent OMP based vaccine could not last longer compared to aluminum hydroxide microparticle adjuvanted bivalent bacterin. The immune kinetics in terms of IgG response against *P. multocida* capsular type D stimulated by aluminum hydroxide nanoparticles adjuvanted OMP was found to be similar to aluminum hydroxide microparticles adjuvanted bivalent bacterin vaccine. The aluminum hydroxide nanoparticles adjuvanted bivalent OMP was efficient in stimulating IgG response in initial level against *P. multocida* capsular type A that may be helpful in use of vaccine formulation during the outbreak of the disease.

Finally, the local inflammation induced by aluminum hydroxide nanoparticles in the injection sites was found to be milder than that induced by aluminum hydroxide microparticles.

Abstract of M. V. Sc. Thesis
Department : Animal Biotechnology
Major Advisor : Dr. S. Tamuly

Effects of cryoprotactants on vitrification of goat oocytes

Dr. Kabita Majumdar

A total of 1243 ovaries were obtained from local abattoirs and processed for recovery of oocytes by aspiration and slicing techniques from follicles within 2-3 hours of slaughter. A total of 621 and 1124 oocytes were recovered from 545 and 698 ovaries by aspiration and slicing techniques respectively and graded on the basis of cumulus cell layer adhered to the zona pellucida. The mean recovery rate differed significantly between grades of oocytes in both the techniques and interaction between technique and grades of oocytes differed significantly.

A total of 1745 immature good quality goat oocytes were vitrified by using cryoprotectants *viz.,* Ethylene Glycol (EG), Propylene Glycol (PG) and DMSO and their combinations i.e., EG+PG, EG+DMSO and PG+DMSO @ 6M, 8M, 10M and 12M concentrations in the vitrification solution with the addition of 0.5M sucrose in basic solution that contained DPBS and FBS (4:1) and Gentamicin (50µg/ml). The equilibration solution was prepared by adding the cryoprotectant at the rate of half of the concentration used for vitrification and 0.25M sucrose in basic solution. The vitrification solution contained 0.5M sucrose and half of the total concentration for each cryoprotectant when vitrification of oocytes was done by combining two cryoprotectants. The mean rate of recovery of morphologically normal oocytes after vitrification differed significantly between concentrations in PG, EG and EG+PG. The highest mean recovery rate of morphologically normal vitrified oocytes was 74.16±4.44 per cent which was obtained in 10M EG+PG (1:1). The mean rate of recovery of morphologically normal vitrified oocytes was the highest (71.82±5.21%) in 0.5M sucrose contained in 5M EG+5M PG, although it did not differ significantly from concentrations of 0.25M, 0.75M and 1M sucrose.

The mean percentages of *in vitro* matured oocytes following vitrification revealing expanded cumulus cells (61.67±2.54) and polar body extrusion (47.04±2.70) were significantly lower for vitrified oocytes as compared to the corresponding values (70.91±1.98% and 63.51±2.83 %) in non-vitrified oocytes.

Polymorphism of prolactin (prl) and prolactin receptor (prlr) genes in indigenous ducks of Assam

Dr. Keleson Basumatary

The present study was conducted to investigate the polymorphism of *Prolactin* (*PRL*) and *Prolactin receptor* (*PRLR*) genes in 101 indigenous ducks of Assam. PCR-RFLP analysis of *PRL* gene using restriction enzyme *Dra*I revealed three genotypes, arbitrarily designated as AA, AB and BB. Following digestion, the AA genotype yielded two fragments (141 and 316 bp), the AB genotype yielded three fragments (141, 316 and 457 bp), and the BB genotype yielded one fragment (457 bp). The frequencies of A and B alleles were found to be 0.847 and 0.154 respectively and the genotype frequencies for AA, AB and BB genotypes were found to be 0.812, 0.069 and 0.119, respectively.

The PCR-RFLP analysis of *PRLR* gene using restriction enzyme *Pci*I revealed two genotypes, arbitrarily designated as AA and AB. The AA genotype yielded two fragments (108 and 259 bp) and the AB genotype yielded three fragments (108, 259 and 367 bp). The frequencies of A and B alleles were found to be 0.956 and 0.045, respectively and the genotype frequencies for AA and AB genotypes were found to be 0.911 and 0.089, respectively.

On the basis of the present study, it was found that the A variant of *PRL* gene was predominant in the indigenous ducks of Assam with the highest frequency of AA genotype followed by BB genotype (AA>BB>AB). For *PRLR* gene, the frequency of allele A was higher than that of allele B with a higher frequency of AA genotype (AA>AB). Chi-square (x^2) test revealed that the population under study was not in Hardy-Weinberg Equilibrium for *PRL* gene, while for *PRLR* gene, the population was in Hardy-Weinberg equilibrium.

Molecular characterization and genotyping of staphylococci associated with bovine mastitis

Dr. Madhusmita Dutta

Mastitis is an important disease of dairy cows and buffaloes causing huge economic losses in the form of reduced milk production. It is an inflammation of the mammary gland (udder) that causes physical and chemical changes in milk, and leads to pathological condition of the glandular tissue. It is generally associated with poor hygienic and husbandry practices. The present study was undertaken with a view to isolate and identify *Staphylococcus aureus* from both mastitic and apparently normal bovine milk samples. The study also included molecular typing of representative isolates and detection of important virulence-associated genes by PCR.

A total of 204 milk samples comprising both clinically affected (14) and apparently normal (190) milk were used for this study. The apparently normal milk samples were subjected to California mastitis test, of which 85.79 % tested positive for sub-clinical mastitis. Bacteriological and biochemical examinations were performed to isolate and identify staphylococci associated with mastitis. A total of 60 (33.8%) out of 177 milk samples yielded *Staphylococcus aureus*, which were confirmed by polymerase chain reaction (PCR) amplification of conserved sequences of *aro*A gene. All the isolates (100 %) were found to possess three virulence-associated genes, namely surface protein A (*spa*), thermonuclease (*nuc*) and coagulase (*coa*) genes, while 58 (96.6%) of the isolates showed the presence of clumping factor A (*clf*A) gene. Antimicrobial susceptibility testing revealed that all the 60 isolates were resistant to Ampicillin and Cotrimoxazole, while the highest susceptibility (100%) was shown to Gentamicin, Kanamycin and Chloramphenicol followed by Streptomycin (80%). On the other hand, significantly lower susceptibility was shown to Ceftriaxone (13.33%), Tetracycline (8.33%) and Cefapime (1.67%). Out of the total 60 isolates, seven were subjected to PCR-RFLP of the coagulase (*coa*) gene. Polymorphism was shown by all the isolates (100%) with four different restriction patterns. Ten isolates were subjected to staphylococcal protein A (Spa) typing and PFGE. Spa typing revealed two different types, t165 and t1611. On the basis of phylogenetic analyses based on spa typing and PFGE, it was concluded that isolate number 9 of Spa type t165 is the ancestral strain, the clonal descendents of which are endemic in the study area causing subclinical bovine mastitis.

Abstract of M. V. Sc. Thesis
Department : Animal Biotechnology
Major Advisor : Dr. P. Borah

Characterization and quality evaluation of pig fibroblast cells at different subcultures

Dr. Priya Dhar

Fibroblast cells are the most common cells of connective tissue. In the present study, porcine fibroblast cells were isolated, cultured and subcultured upto six passages from adult and fetal skin samples. The time required to attain 70% confluence in primary culture of fetal fibroblast cells was found to be 26.40±2.40 hours, which was significantly lower (pd"0.01) than 67±4.80 hours of adult fibroblasts culture. The cells were maintained upto six passages which was 38.8 days for adult and 26 days for fetal fibroblast cells. The fetal fibroblast cells (days) required significantly lower (pd"0.01) time to subculture than adult fibroblast cells. Morphologically the isolated cells had fibroblastic character like typical fusiform shape, turgor vitalis cytoplasm, centrally located nuclei and flame like migration pattern upto sixth passage. The subculture time and cell viability (%) was significantly (pd"0.01) better from third subculture onwards upto sixth subculture as compare to primary and secondary cultures. TUNEL assay revealed a decreasing trend of apoptotic index from primary culture onwards to sixth subculture for both adult and fetal fibroblast cells. Fetal fibroblast cells maintained a lower apoptotic index than adult fibroblast in each of the subcultures. Therefore, fibroblast cells were found to be better from third subculture onwards to sixth subculture in regards to subculture time, viability (%), apoptotic index and in maintaining its normal morphological characteristics. ALP is considered as important marker for identification of pluripotent embryonic stem cells as well as multipotent mesenchymal stem cells. Isolated fibroblast cells of all the subcultures showed activity for ALP test indicating their progressive and undifferentiated quality and may be of multipotent in nature.

Development and evaluation of immunopotency of outer membrane vesicles vaccine of *salmonella* typhimurium adjuvanted with chitosan nanoparticles

Dr. Rakesh Kumar Sarmah

During the past two decades, *Salmonella* Typhimurium has emerged as a leading cause of human infections in many countries and the *Salmonella* spp has a broad host range and can infect broad array of animals causing diseases ranging from gastroenteritis to life threatening systemic infections. *Salmonella enterica* serovar Typhimurium is most frequently isolated serovar causing global food born outbreaks. The control of Salmonellosis can be accomplished either by vaccination or medication. Antibiotic resistance and antibiotic residue is a major hurdle in medication. The present study was conducted to study the efficacy of the chitosan nanoparticle adjuvanted outer-membrane vesicle based vaccine candidate against *Salmonella* Typhimurium.

The OMV was extracted from *Salmonella* Typhimurium (MTCC-98) strain and confirmed by SDS-PAGE. The (ChNP-OMV) vaccine was synthesized by standard method and nanometer size was confirmed by TEM studies. In the immunization study three vaccine formulation were compared and injected in the 7th day and followed by booster dose on the 14th day. The humoral immune response of the target vaccine was compared with OMV based vaccine with or without booster dose and oil adjuvanted bacterin vaccine with or without booster dose by indirect ELISA. Collection of serum was done on 0th day just before vaccination, and thereafter 7, 14, 28, 45 and 60 days post primary vaccination. Humoral immune response in mice of all the experimental groups determined by using indirect ELISA. The (ChNP-OMV) vaccine was able to elicit quick and higher antibody response in the 14th day followed by steady decline up to 60th day. All the vaccine formulation elicited similar IgG response on 7th day PPI, however chitosan nanoparticle adjuvanted outer-membrane vesicle based vaccine elicited highest IgG response on 14th days PPI (with or without booster dose) with statistical significance of 95 % confidence level.

Abstract of M. V. Sc. Thesis
Department : Animal Biotechnology
Major Advisor : Dr. S. Tamuly

Serum enzymatic test revealed that the significantly lower serum creatine kinase level in 7th and 14th day in the group of mice that was administered chitosan nanoparticle adjuvanted outer-membrane vesicle based vaccine as compared to the group of mice that was injected oil adjuvanted bacterin vaccine on 14th days PPI.

However a significant decrease in antibody response was observed for the groups containing (ChNP-OMV) complex. From this study, it can be concluded that the ChNP-OMV (*S.* Typhimurium) vaccine was indicative of quick immune response for immediate vaccination in outbreaks against salmonellosis.

Toxin gene profiling of *clostridium difficile* in food and food products of animal origin

Dr. Ritam Hazarika

The present work was undertaken with a view to investigate the presence of *Clostridium difficile* in food and food products of animal origin and profiling of toxin genes. A total of 235 samples were collected from different sources including raw meat (beef, pork, chicken and chevon), meat products (dry beef, dry pork, cooked chicken, chicken sausage and chicken salami), raw cow milk, milk product (Indian paneer) and fish products (dry fish and canned fish). Out of the total 235 samples, initially 56 (23.83%) samples revealed suspected colonies of *C. difficile*. All the suspected colonies exhibited the typical colony morphology with horse manure odour and typical Gram-positive rod shaped cell with sub-terminal spores. Among 56 tentative isolates, 17 (7.23%) could be confirmed as *C. difficile*, based on the detection of species specific *gluD* (GDH) and *tpi* (triose phosphate isomerase) genes. The 17 confirmed *C. difficile* isolates comprised of 15 (8.24%) from raw meat and meat product samples and remaining two (11.11%) from fish product samples. None of the samples from cooked chicken, raw chevon, chicken sausage, chicken salami, canned fish, cow milk and paneer yielded any *C. difficile* isolates. All the 17 *C. difficile* isolates were screened for detection of glutamate dehydrogenase (GDH) protein and toxin A and /or toxin B by enzyme immuno assay (EIA), out of which all isolates were found positive for GDH protein and six were found to be phenotypically positive for toxin production. The *C. difficile* isolates were characterized by PCR for detection of toxin genes (*tcdA*, *tcd B* and binary toxin) and PaLoc region. Antimicrobial resistance pattern was also tested against nine different antimicrobial agents by E-test. Altogether, six *C. difficile* isolates were found to be toxigenic. Out of which two were from chicken samples and four from pork samples. All the toxigenic isolates from chicken (2) samples possessed both *tcdA* and *tcdB* (A+ B+), while all the pork isolates (4) carried variant toxin genes (A-B+). All the (A-B+) isolates from pork were found to harbour the binary toxin genes (*cdtA* and *cdtB*). Based on the detection of PaLoc region comprising regulatory genes *tcdC*, *tcdR* and *tcdE*

revealed that the two toxigenic chicken isolates (A+ B+) possessed *tcdC* and *tcdE* ,while the remaining four toxigenic pork isolates (A-B+) carry *tcdR* and *tcdE*, respectively. All the 17 *C. difficile* isolates showed higher resistance pattern to ciprofloxacin (70.59%), followed by cefotaxime (58.82%), clindamycin (29.41%) and tetracycline (17.64%) but 100 per cent sensitive to chloramphenicol, moxifloxacin, tigecycline, metronidazole and vancomycin. All the beef isolates were clindamycin- resistant with an MIC of 96 - 128 mg/ml. While, all *C. difficile* isolates from pork and dry fish were sensitive to the antimicrobials tested except ciprofloxacin and cefotaxime, the four chicken isolates were sensitive to the antimicrobials except ciprofloxacin.

Type characterization of indigenous cattle (*bos indicus*) of Arunachal Pradesh

Dr. Marpi Kakki

A total of 404 animals for body measurement, 810 lactation records for performance traits, 71 birth weight records and 140 milk samples for estimation of milk constituents from indigenous cattle of Arunachal Pradesh were utilized in the present study. The data obtained were classified according to location, age group, lactation order, sex and stage of lactation. The least-squares means for head length, eye to eye space, breadth of forehead, neck length, neck circumference, horn length, horn circumference at base, horn circumference at middle, horn circumference at tip, distance between two horns at base, distance between two horns at middle, distance between two horns at tip, ear length, body length, height at withers, heart girth, pouch girth, length of arm, elbow length, fore shank length, thigh length, hind shank length, length of pes, length of tail, length of switch, length of udder, width of udder, depth of udder, teat length and teat diameter were 32.269 ± 0.112, 12.749 ± 0.048, 13.239 ± 0.040, 27.718 ± 0.085, 56.551 ± 0.237, 10.348 ± 0.087, 10.517 ± 0.035, 7.898 ± 0.037, 3.715 ± 0.020, 12.615 ± 0.038, 16.854 ± 0.044, 17.419 ± 0.046, 16.975 ± 0.032, 98.475 ± 0.155, 97.123 ± 0.153, 117.582 ± 0.241, 122.462 ± 0.243, 24.448 ± 0.048, 25.599 ± 0.043, 24.970 ± 0.041, 26.426 ± 0.052, 27.598 ± 0.054, 29.206 ± 0.061, 50.498 ± 0.160, 26.628 ± 0.072, 30.940 ± 0.105, 21.506 ± 0.069, 9.923 ± 0.037, 4.459 ± 0.024 and 2.762 ± 0.025cm respectively. Age, sex and location had significant effect on various measurements under head and neck, body, legs, feet and tail and udder. The most predominant horn orientation was curved upward (37.30 per cent) with black (55.14 per cent) and grey (44.86 per cent) horn colours and horizontal type of ear orientation. Among the 8 (eight) types of coat colours recorded, brown (30.69 per cent) was predominant, while common colours of muzzle, hoof and switch were black with a frequency of 73.76 per cent, 73.02 per cent and 65.59 per cent respectively. The least-squares means for age at first calving, lactation milk yield, lactation length, peak yield, days to attain peak yield, dry period, gestation period, inter calving period and birth weight of indigenous cattle of Arunachal Pradesh were found to be

44.553 ± 0.138 months, 296.710 ± 0.803 kg, 239.513 ± 0.483 days, 1.820 ± 0.005 kg, 35.974 ± 0.076 days, 209.957 ± 0.742 days, 272.557 ± 0.073 days, 447.085 ± 0.702 days and 14.554 ± 0.103 kg respectively. Location had significant effect on all the productive and reproductive traits except peak yield, days to attain peak yield, dry period and gestation period whereas the effect of lactation order was non-significant for gestation period. Farmers followed semi-intensive type of management system. The least-squares means for fat, solids-not-fat, protein and total solids per cent of milk in indigenous cows of Arunachal Pradesh were 5.895 ± 0.032 per cent, 8.582 ± 0.027 per cent, 2.790 ± 0.017 per cent and 14.483 ± 0.048 per cent respectively. Location and lactation order showed non-significant effect on all the milk constituents viz., fat, solids-not-fat, protein and total solids percentage however, stage of lactation showed significant effect on fat and total solids percentage.

Studies on body conformation, performance and expression of certain genes related to prolificacy in sirohi goats under farm condition in Assam

Dr. Sangeeta Sarmah

The present study was conducted for performance evaluation of certain traits of growth and reproduction in Sirohi goats as well as to study the expression profile of *GDF 9* gene related to prolificacy in Sirohi and Assam Hill goats. Data on 250 Sirohi goats for the study of growth and morphometric traits and 310 Sirohi goats for the study of reproductive traits maintained at the Sheep and Goat Breeding Farm, Silonijan, Karbi Anglong, Assam were utilized for the study. The least square means for body weight, body length, heart girth and height at wither were 2.500±0.012 kg, 25.060±0.135 cm, 25.988±0.172 cm and 25.846±0.181cm at birth; 5.607±0.041kg, 41.442±0.232 cm, 45.378±0.391cm, 41.750±0.248 cm at 3 month; 11.734±0.107 kg, 50.527±0.220 cm, 55.390±0.368 cm and 51.915±0.290 cm at 6 month; 16.778±0.177 kg, 60.864±0.212 cm, 62.978±0.323 cm and 62.173±0.272 cm in 9 month; 22.864±0.196 kg, 71.107±0.217 cm, 71.613±0.227 cm and 71.851±0.239 cm at 12 month of age respectively. Parity and period of birth exerted significant ($P<0.01$) effect on body length, heart girth and height at wither 12 month of age. Season of birth had significant effect ($P<0.01$) on body weight, body length, heart girth and height at wither. Body weight, body length and heart girth also differed significantly ($P<0.01$) due to kidding type and single born kids had higher values than the twins. Significant effect of sex was observed on body weight, body length, heart girth and height at wither at all age groups. The male goats were superior to the females in respect of all these traits.

The least square means for age at first kidding, gestation period, service period and interkidding period pertaining to first parity were 701.710±2.267 days, 148.895±0.321 days, 195.545 ±1.513 days and 343.898±1.584 days, respectively. The overall mean for gestation period, service period and interkidding period pertaining to all parities were 147.800±0.429 days, 188.553±1.201 days and 336.662±1.102 days, respectively. Period of kidding exerted significant effect on age at first kidding, service period and interkidding

period. Kidding order also exerted significant effect on service period and interkidding period and lowest values were obtained in 5th parity.

The growth pattern of Sirohi goats from birth to one year of age was found to be little slower from birth to 3 month, faster from 3 to 6 month, again slower from 6 to 9 month and then accelerated from 9 to 12 month of age. Linear and multiple regression equations were developed for prediction of 1 year body weight from the body weight at birth, 3, 6 and 9 month of age and observed that prediction of 1 year body weight could be done from the body weight at earlier ages. The phenotypic correlations among the body weight at different ages were found to be high and positive. Expression of *GDF9* gene in Sirohi and Assam Hill goat did not differ significantly as revealed by paired *t-test*.

Performance of growing pigs on corn based diet supplemented with phytase and non- phytate phosphorus

Dr. Konkona Dutta

An experiment was conducted to study the performance of growing pigs on corn based diet supplemented with phytase and non-phytate phosphorus with twenty four castrated crossbred (Hampshire × Assam local) pigs weaned at 42 days of age. The average initial body weight of the animals ranged from 14.84±1.19 to 15.12±1.13 kg. They were divided into four different groups of 6 animals each viz. T , T, , Tf and T,, and allotted to four nutritional treatments following randomized block design. Pigs in each group were offered *ad libitum* grower ration containing 18.26% CP and 3.17 Mcal ME/kg diet by using conventional feed ingredients viz. maize, wheat bran, soya bean, and de-oiled groundnut cake as per BIS (2001) specification of nutrient requirements. All the 4 experimental diet were supplemented with 0.2% non-phytate phosphorus (NPP) in the form of dicalcium phosphate (DCP) along with different levels of phytase enzyme. T ration was devoid of phytase enzyme where as T, , Tf and T,, ration was supplemented with 250, 500 and 750 unit of phytase per kg diet, respectively. Feeding trial was conducted for 6 fortnights followed by 5 days of metabolism trial with 3 animals in each group. The addition of phytase enzyme increased feed consumption in all the experimental groups with the progress of age of the pigs with highest increased rate in phytase supplemented group @750 unit/kg diet. It was observed that there was significant effect (P<0.05) in the dry matter intake per 100 kg body weight and per kg $W^{0.75}$. During the entire growth period, the average body weight and rate of mean daily gain was significantly higher (P<0.05) in T,, group. The rate of mean daily gain was 355.04±7.72, 389.56±13.45, 425.95±17.43 and 470.12±11.63 g in T , T, , Tf and T,, groups, respectively. The feed conversion efficiency improved in phytase supplemented group and was found to be significantly better (P<0.05) in T,, amongst all the groups. There was significant difference among the groups in respect of digestibility of DM, OM, CP, CF,

EE, NFE and total carbohydrate. When the availability of crude protein and digestible energy was calculated against the NRC requirement, it was observed that animals received 104.32, 126.15, 143.0 and 148.68 percent CP and 145.04, 150.83, 172.31 and 180.99 percent DE in T , T, , Tf and T,, groups respectively. No significant effects (P>0.05) of phytase addition were observed on blood biochemical constituents like glucose, total protein, calcium, inorganic phosphorus, glutathione peroxidase and lipid peroxidase. Feed cost per kg gain was Rs. 112.45, Rs. 112.57, Rs. 114.85 and Rs. 108.95 for T , T, , Tf and T,, group, respectively. It is concluded that supplementation of phytase @ 750 unit/kg feed along with 0.2% NPP in the form of DCP is advantageous for growing pigs in terms of growth and economic return.

Comparative efficacy of probiotics (swine and dairy origin) on growth and nutrients utilization in growing pigs

Dr. Mamata Joysowal

An experiment was conducted to investigate the comparative efficacy of probiotics of dairy origin (*Lactobacillus acidophilus* NCDC15) and swine origin (*Pediococcus acidilactici* FT28) on growth, feed conversion efficiency, nutrient utilization and intestinal microflora and carcass yield of (HD-K 75 (75%H) crossbred pigs.

Twenty four weaned crossbred piglets of above two months of age having average body weight 18.33 ± 0.98 kg randomly divided into three groups i.e. C, T_1 and T_2. A pig grower ration was prepared as per ICAR (2013) (for medium to high growth rate). In the control ration (grower ration) probiotics of dairy origin (*L. acidophilus* NCDC 15) and probiotics of swine origin (P. acidilactici FT28) were added as feed additives and designated as T_1 and T_2 ration. The feeding trial was conducted for the entire growing period (84 days). The dry matter intake per 100 kg body weight did not differ significantly (P>0.05) among the treatment groups. The rate of mean daily gain in body weight and feed conversion efficiency of pigs were 358.6 ± 12.3, 418 ± 8.61, 429.4 ± 13.1 and 4.06 ± 0.09, 3.51 ± 0.14 and 3.48 ± 0.66 in control, T_1 (probiotics of dairy origin) and T_2 (probiotics of swine origin) respectively. Significantly highest average daily gain in body weight and best fed conversion efficiency were found in T_1 and T_2 group. The digestibility coefficient of DM, OM, EE CF and NFE did not differ (P>0.05) significantly between the control and treatment group. But the digestibility coefficient of crude protein of T_2 (probiotic of swine origin) group and T_1 (probiotic of dairy origin) differed significantly (<0.05) from control. Similarly, in case of percent retention of intake nitrogen was highest in T_2 (Probiotic of swine origin) group followed by T_1 (probiotic of dairy origin) group. In respect of faecal microbial count, *Lactobacillus* was significantly increased in T_1 (probiotic of dairy origin) followed by T_2 (probiotic of swine origin) group and E. coli count was decreased in T_1 and T_2 group. Highest (P<0.05) villi length ($700.3\pm2.57\mu m$) and crypt depth (123.70 ± 81.52 µm) was

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observed in T_2 group. Highest carcass weight was found in T_2 group followed by T_1 group but average vital organ weight was found to be higher T_1 group followed by T_2 group. Highest dressing percentage was observed in T_2 group followed by T_1 group. In respect of average pH value, water holding capacity and ERV, there was no significant (P>0.05) difference between the treatment groups.

The concentration of blood glucose and cholesterol was found lowest (P<0.05) in T_2 group followed by T_1 group. There was no significant (P>0.05) difference in respect of serum protein, serum albumin level between the treatment groups.

The cost of production per kg body weight gain was found lowest in T_1 group (Rs. 97.69) (Probiotic of dairy origin followed by T_2 (Rs. 98.94) group (probiotics swine origin). This it is revealed that supplementation of probiotic of dairy and swine origin is beneficial in growing stage in respect of growth, feed conversion efficiency and digestibility of nutrients. The supplementation of probiotic of dairy and swine origin also improves blood biochemical profile, intestinal morphology and enhances faecal microbial count in respect of *lactobacillus*. Hence, it may be recommended that probiotic dairy origin (*Lactobacillus acdidophillus* NCDC 15, 1-2 x10^9 cfu/g) and swine origin (*Pediococcus acidilactici* FT28, 1-2 x 10^9 cfu/g) may be used as feed additives in growing pigs as probiotic.

Postnatal development of thymus of Assam hill goat (*capra hircus*)

Dr. Banajit Kumar Medhi

Goat is one of the most important species in livestock industry. Literature pertaining to the thymus of goat are very scanty in general and almost not available in Assam hill goat in particular, hence the present investigation was carried out to establish a baseline on the anatomical aspect of the thymus gland of Assam hill goat at various age groups viz. day old, 3 month and 6 month.

Eighteen (18) numbers of goats divided into 3 (three) groups, consisting of 6 animals in each group according to their age were utilized for the present study. Detailed anatomical study on gross, histomorphological and histochemical aspect of thymus gland along with some hematological, biochemical and hormonal parameters of Assam hill goat at different stages of development were performed with these animals.

In the present investigation, the morphometrical parameters of the thymus gland in Assam hill goat showed an increased value at 3 month of age group in compared to day old kids while it showed a decreased value at 6 month age group. The average weight of the thymus gland in Assam hill goat was found to be increased in 3 month of age group in compared to day old kids and the study also revealed a decrease value in 6 month old age group. The percentage of thymus weight to body weight decreased with advancement of age. The average length, width and thickness of thoracic, isthmus, and cervical parts of thymus gland in Assam hill goat increased in 3 month age group in compared to day old kids and thereafter showed a decrease value in 6 month age group.

Histology of the thymus gland of Assam hill goat found to be observed that the gland was covered by a thin capsule enclosing numerous lobules demarcating the gland in all the age groups. The capsule was made up of mainly collagen fiber besides a few amount of reticular and elastic fiber. The connective tissue septa arising from the capsule divided the gland into numerous lobes and lobules which were oval to polyhedral in shape. The connective tissue septa were predominantly consisted of collagen fiber with a few amount of reticular

fibers. The presence of elastic fiber in all age groups of goats were found to be very scanty. Nerve fibers were observed in all the three age groups. Each lobule were composed of outer dark cortex and inner pale medulla. The cortex predominantly consisted of densely packed small round or ovoid thymocytes with dark stained nuclei. The medulla consisted of relatively loosely packed larger thymocytes and more fibrous stroma containing some spheroid to oval eosinophilic body called Hassall's corpuscle . The sub capsular and the interlobular connective tissue were found to be replaced by fatty tissue which was observed in 6 month old age group indicating the involutionary changes. The micrometry of different parameters of the thymus gland revealed that the thickness of the capsule increased with advancement of age .The size of the lobules were found to be increased in 3 month of age and thereafter it showed a decreased value in 6 month age group. The thickness of cortex was increased in 3 months age group in compared to day old kids and thereafter it showed a decreased value in 6 month age group, while the thickness of the medulla was found to be increased with advancement of age. The numbers of Hassall's corpuscle per lobule increased with advancement of age while the diameter of the same decreased with advancement of age.

Histochemical study revealed that the alkaline phosphatase showed strong reactivity in day old age group while it showed a moderate activity in 3 month and 6 month old age group .However the acid phosphatase showed a moderate activity in day old age group while the same showed a strong activity in 3 month and 6 month age group.

Biochemically, the average serum alkaline phosphatase level was observed to be declined with advancement of age from day old kids to 6 month old age group with significant difference between day old and 3 month old age group and also between day old and 6 month, while there was no significant difference found between 3 month and 6 month age groups. However there was no significant difference found in serum acid phosphatase level among different age groups.

The average serum triiodothyronine (T_3) and thyroxine (T_4) hormone level was found to be decreased in 3 month old age group in compared to day old kids and after that it showed an increased value in 6 months old age group.

The hematological parameters showed that the hemoglobin level decreased from day old to 6 month age groups. The TLC level increased from day old to 3 month and thereafter it showed a decreased value in 6 month age group. However, the TEC level showed increased value from day old to 6 month age group. The PCV level was found to be decreased from day old to 3 month age groups and thereafter it showed an increased value at 6 month age group.

From the present investigation it might be concluded that most of the parameters under study showed a remarkably differed value between the various age groups of Assam hill goat. This might be due to the various anatomical, biochemical, physiological, immunological and adaptive changes in body pertaining to the advancement of age in Assam hill goat.

Technology validation of semen preservation, synchronization of oestrus and artificial insemination in pig

Dr. Biraj Kumar Bania

A total of 36 ejaculates from six boars (three Hampshire and three Rani) aged one and half to two years and maintained at National Research Centre on Pig, ICAR, Rani, Guwahati, collected twice in a week by gloved hand method, were used to study the efficacy of three extenders *viz.*: GEPS, Modena and Androheps for preservation of boar semen at liquid state. The ejaculates were split into three parts and extended in GEPS (Glucose-sodium salt of EDTA-Potassium sodium tartrate-Sodium citrate dehydrate), Modena and Androheps extenders for preservation upto 168 hours at 15p C and evaluated per cent sperm motility, live sperm and live intact acrosome at 24 hours of interval. The mean sperm motility live sperm and live intact acrosome differed significantly (P<0.01) between extenders and between preservation periods. The interaction between extender and preservation period was found to be significant (P<0.05) only for sperm motility. A total of 90 female pigs (thirty for each extender) were inseminated with a dose of 80 ml (20 ml semen + 60 ml extender) of semen preserved for 72 to 120 hours at 15p C with GEPS, Modena and Androheps extenders. The percentage of conception rates were 81.8 in gilts and 84.2 in sows, 64.2 in gilts and 68.76 in sows and 84.62 in gilts and 82.36 in sows for the three extenders respectively. GEPS and Androheps were found to be superior to Modena based on sperm motility, live sperm, live intact acrosome and conception rate (on non return basis). Thirty apparently normal and healthy cyclic Hampshire Crossbred gilts and sows (aged 10 months to 2 years) maintained at villages near to NRC on Pig Rani, Guwahati were used for the synchronization of oestrus by feeding 10 mg progesterone orally daily for 7 days in empty stomach. Animals at synchronized oestrus were artificially inseminated with semen extended in GEPS extender irrespective of preservation periods. The percentage of synchronized oestrus were 57.14 in gilts and 62.50 in sows. The mean interval from treatment to onset of synchronized oestrus

was 7.36 ± 0.78 days in gilts and 8.40 ± 0.37 days in sows. The difference having significant (P<0.05).The mean duration of oestrus was 78 ± 2.98 and 85.20 ± 3.32 hours in synchronized gilts and sows respectively, the difference being not significant. Most frequent behavioural signs of synchronized oestrus were nervousness, frequent grunting, seeking male, stance reflex and inappetance; the frequencies were 100.00, 75.00, 75.00, 62.50 and 62.51 per cent respectively in gilts and 100.00, 80.00, 80.00, 70.00 and 60.00 per cent respectively in sows. Swelling of vulva and pinkish vulva were the most common physical signs of synchronized oestrus exhibited and the intensity of signs was more in gilts than in sows. The conception rate in gilts and sows was 87.50 and 80.00 per cent respectively.

Biochemical characterization of fresh and frozen semen of swamp buffalo

Dr. Manna Baruti

Four Swamp buffalo bulls aged 5 to 8 years were used to study the biochemical characteristics of fresh and frozen semen and the effect of freezing on biochemical characteristics. The semen was subjected to protein profiling through SDS-PAGE in both fresh and frozen semen and their correlations with fresh and frozen semen characteristics were analyzed. A total of 60 ejaculates comprising 15 from each bull and a total of 40 ejaculates comprising 10 from each bull were used for evaluation and biochemical characterization in fresh and frozen semen respectively.

For studying the effect of freezing on biochemical constituents of semen the AST and ALT activities, total protein, total cholesterol and total lipid concentration were estimated in seminal plasma of fresh semen and extracellular fluid of frozen semen. The overall mean values of the AST and ALT activities and total protein, total cholesterol and total lipid concentration were 26.05±0.74 U/L, 49.14±1.72 U/L, 3.44±0.02 mg/ml, 23.12±0.65 mg/dl and 2.20±0.07 mg/ml respectively in seminal plasma of fresh semen. The corresponding values in extracellular fluid of frozen semen were 124.95±1.66 U/L, 87.80±2.29 U/L, 1.66±0.06 mg/ml, and 82.07±1.63 mg/dl and 32.70±0.74 mg/ml.

The mean value of AST and ALT activities and total cholesterol and total lipid concentration increased significantly (P ≤ 0.01) and the total protein concentration was decreased significantly (P ≤ 0.01) in extracellular fluid of frozen semen comparison with that in seminal plasma of fresh semen.

The proteins of Triton X-100-treated sperm membrane extract of fresh and frozen semen, seminal plasma of fresh semen and extracellular fluid of frozen semen were characterized by SDS-PAGE. Seven protein bands in seminal plasma and ten protein bands in extracellular fluid were identified. A total of eight and five protein bands were identified in sperm membrane extract of fresh and frozen semen respectively. The relative densities of sperm membrane proteins of different molecular weights as determined by Integrated

Density Value were correlated with semen characteristics. The per cent initially motile sperm, live sperm percentage and intact acrosome of fresh and frozen semen were significantly correlated (PÂ 0.01) with sperm membrane proteins of different molecular weight in fresh and frozen semen. The study revealed that the 42, 55 and 104 kDa proteins of sperm membrane had significant correlation with semen characteristics and could be considered as potential marker in screening of swamp buffalo bulls.

Management of postpartum anoestrus using heatsynch protocol with nutritional supplementation in crossbred cows

Dr. Mrinal Kalita

The present study was conducted to find out the efficacy of Heatsynch protocol with nutritional supplementation on postpartum anoestrous crossbred cows. Forty postpartum anoestrous crossbred cows were selected based on the history and rectal palpation in Kamrup district of Assam. The animals were divided into four groups (n=10) *viz.*, A, B and C and treated with Heatsynch + mineral mixture, Heatsynch + mineral mixture + bypass fat and Heatsynch respectively and AI was done at induced oestrus. Ten postpartum anoestrous crossbred cows were kept as untreated control (group D). Blood samples were collected from cows on day 0, 7, 8 and 9 of Heatsynch protocol for estimation of serum estrogen, progesterone, cortisol, cholesterol, total protein, calcium, phosphorus and zinc profile. The use of Heatsynch + mineral mixture, Heatsynch + mineral mixture + bypass fat and Heatsynch protocol resulted in 100.00, 100.00 and 90.00 per cent oestrus induction with mean interval of 34.65 ± 1.56, 32.60 ± 1.54 and 45.65 ± 1.91 hours and conception rate at induced oestrus was 50.00, 60.00 and 44.44 per cent, respectively. The mean serum progesterone concentration on day 0, 7, 8 and 9 revealed that the values on 7 day (2.75 ± 0.01, 2.69 ± 0.01, 2.81 ± 0.02 ng/ml) were significantly higher (P<0.01) than the values obtained on day 0, 8 and 9 with the lowest concentration on day 9 (0.43 ± 0.01, 0.39 ± 0.01, 0.46 ± 0.02 ng/ml) in group A, B and C, respectively. Serum oestrogen concentration was significantly higher (P<0.01) on day 9 in all the three treatment groups than the values obtained on day 0, 7 and 8 of treatment. Serum cortisol level showed non-significant (P>0.05) difference between the treatment groups, however, varied significantly from the control group. The highest cortisol level was observed on day 9 of treatment (6.81 ± 0.02, 6.78 ± 0.07 and 6.84 ± 0.06 ng/ml in group A, B and C, respectively). Serum cholesterol and total protein concentrations were the highest in group B and varied significantly (P<0.01) from the other groups. Serum calcium, phosphorus and zinc concentrations revealed that the values obtained in group A and B were significantly higher (P<0.01) than that in group C and D. It could be concluded that Heatsynch with nutritional supplementation resulted in effective induction of oestrus with satisfactory conception rate in postpartum anoestrous crossbred cows.

Study on prolonged oestrus in crossbred cattle

Dr. Nilotpal Das

The study was conducted in crossbred cows maintained in Instructional Livestock Farm (Cattle), College of Veterinary Science, Khanapara, Guwahati and in the private dairy farms located around Guwahati to record the incidence of prolonged oestrus, signs of oestrus, hormonal profiles and blood biochemical constituents, and to evolve a suitable treatment of prolonged oestrus.

The incidence of prolonged oestrus in crossbred cows was 14.24 per cent comprising 7.60, 5.04 and 1.60 per cent of 2, 3 and 4 days durations respectively.

The different behavioural signs of oestrus exhibited by prolonged oestrous crossbred cows were mounting, bellowing, decreased appetite, restlessness and sniffing of genitalia with a percentage frequency of 60.00, 66.66, 26.66, 100.00 and 20.00 respectively on 1st day of oestrus. The percentage frequency of different behavioural signs of oestrus decreased during subsequent days. The percentage of cows exhibiting mounting, decreased appetite and restlessness signs was 3.33, 5.00 and 10.00 respectively on 4th and 0.00, 1.66 and 3.33 respectively on 5th day. Out of different physical signs of oestrus, the most conspicuous signs were swelling of vulva, pink colour of vaginal mucous membrane, free flowing vaginal mucus, thin consistency of vaginal mucus and clear vaginal mucus. These signs were observed in 68.33 to 100.00 per cent of animals on 1st day of oestrus. Except clear colour of vaginal mucus, the percentage of animal showing other physical signs decrease on subsequent days and no animal showed free flowing and thin consistency of vaginal mucus on 4th day of oestrus. The frequency of occurrence of clinico-gynaecological changes in the genital organs *viz.,* relaxed cervix, opened cervix, good uterine tone, palpable large follicle on right ovary, palpable large follicle on left ovary and tense follicular wall was 100.00, 100.00, 66.66 66.66, 33.33 and 100.00 per cent on 1st day of oestrus. The frequency of occurrence of these signs gradually decreased in subsequent days of oestrus upto 4th day.

Statistical analysis showed that level of serum estradiol, progesterone, cortisol, calcium, phosphorus, zinc and cholesterol did not differ significantly between crossbred cows of 2, 3 and 4 days prolonged oestrus groups and between days within group.

The mean levels of serum calcium and phosphorus in prolonged oestrous crossbred cows with 2, 3 and 4 days durations increased significantly ($P<0.01$) after treatment with mineral mixture supplementation and anti stress therapy. However, level of serum zinc increased significantly ($P<0.01$) in prolonged oestrous cow of 2 days duration and serum cholesterol in 3 and 4 days durations.

The conception rate in prolonged oestrous crossbred cows was found to be 45.00, 55.00 and 40.00 per cent for mineral mixture supplementation and anti stress therapy, Buserelin acetate injection and for control group without treatment respectively.

Reproduction in swamp buffalo

Dr. Raju Deka

A study was conducted on 32 Swamp buffalo cows and heifers maintained at Network Project on Buffalo improvement (Swamp), College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam to accumulate data on oestrus and parturition behavior, reproductive performance, incidence of reproductive disorders and the efficacy of bypass fat with or without minerals and vitamins fortification in the treatment of anoestrus. Oestrus and parturition behaviour were studied based on direct observations on 17 oestrus and 5 parturient cows. Reproductive performance was studied from records maintained in the farm. Incidence of reproductive disorders was studied by clinico-gynaecological examination of the animals and analyzing their breeding records maintained for the period from 2013 to 2016. Efficacy of bypass fat in the treatment of anoestrus was studied on the basis of oestrus response, genital changes and level of some of the blood biochemical constituents.

The study revealed that behavioural signs of oestrus were not prominent in Swamp buffalo cows. Oedematous vulva and hyperemia of vaginal mucous membrane were the two clinically detectable external signs exhibited by all animals during oestrus. Relaxation of cervix, moderate uterine tone and presence of palpable ovarian follicle were the common genital changes detectable on rectal palpation of the genital organs in all animals during oestrus.

Restlessness, reduced interest in food and water, lying down and getting up, abdominal straining with arching of the back and frequent urination were the behavioural signs exhibited by all Swamp buffalo cows at first stage of parturition, which continued in the second stage. Licking of the new born and interest in food and water were exhibited by all cows at third stage of parturition. Appearance of water bag at vulva was not observed. Total time required for expulsion of the foetus was 29.00 ± 4.06 minutes. Lochial discharge was free flowing in quantity and dark yellow in colour and ceased from 9 days of parturition

Weight of placenta, total number of cotyledons and time of involution of the uterus in Swamp buffalo averaged 4.20 ± 0.10 kg, 111.60 ± 2.77 and 28 days respectively.

Average age at first calving, post partum oestrus interval, service period, gestation period and intercalving period were 1841.75 ± 95.18, 262.90 ± 30.27, 331.63 ± 65.51, 304.18 ± 2.05 and 795.39 ± 104.53 days respectively. Number of services per conception and birth weight in Swamp buffalo averaged 2.09 ± 0.27 and 26.34 ± 0.88 kg respectively.
Anoestrus was the most common reproductive disorder in Swamp buffalo occurring in 45.83 per cent cows and 87.50 per cent heifers.

Bypass fat with minerals and vitamins was more effective than bypass fat alone for the treatment of anoestrus in Swamp buffalo cows and heifers resulting in higher oestrus response rate of 75 per cent. Genital changes were apparent in greater proportion of animals from 30 days of treatment with bypass fat fortified with minerals and vitamins and from 60 days of treatment with bypass fat alone. Level of serum leptin, calcium, phosphorus and cholesterol increased and that of ghrelin decreased with the period of treatment. It was concluded that bypass fat fortified with minerals and vitamins could be effectively used for treatment of anoestrus in Swamp buffalo cows and heifers.

Effect of soybean lecithin based extender on quality of frozen semen in beetal, sirohi and Assam hill goat

Dr. Upen Kakati

A total of 135 ejaculates, 15 from each of nine bucks comprising three Beetal, three Sirohi and three Assam Hill Goat maintained at Goat Research Station, AAU, Burnihat, collected by artificial vagina were used in the study. Immediately after collection each ejaculate was evaluated for volume, mass activity and initial sperm motility and the ejaculates having volume 0.3 ml or more, mass activity (0 to 4+ scale) 3+ or more and initial sperm motility 70 per cent or more were pooled separately for Beetal, Sirohi and Assam Hill Goat. A total of 45 pooled ejaculates, comprising 15 from each breed were evaluated for live sperm, sperm concentration, cold shock resistance index, intact acrosome and sperm abnormalities. Each pooled ejaculate was split into three parts and then extended in three extenders *i.e.*, Tris extender containing 20 per cent egg yolk, Tris extender containing 1.5 per cent soya lecithin and Ovixcell, and frozen using liquid nitrogen vapour. Each semen sample was evaluated for sperm motility, live sperm, intact acrosome and HOST-reacted sperm after equilibration and after freezing. Semen after freezing was also evaluated for extracellular release of Alanine Aminotransferase (ALT) and Aspartate Aminotransferase (AST). The fertility rate of semen frozen using three extenders was recorded.

In Beetal, Sirohi and Assam Hill Goat bucks all the seminal attributes studied immediately after collection and after pooling were within normal ranges. The seminal attributes did not differ significantly between breeds, except for initial motility and live sperm (P<0.01). The differences between bucks within the breed was significant (P<0.05) only for ejaculate volume.

The mean post-thaw sperm motility, live sperm, intact acrosome, HOST-reacted sperm, extracellular ALT and AST irrespective of breed in Tris extender containing 20 per cent egg yolk, 1.5 per cent soya lecithin and in commercial Ovixcell extender was 62.11 ± 0.65, 57.67 ± 0.52 and 35.33 ± 0.64 per cent; 64.94 ± 0.30, 61.39 ± 0.14 and 38.77 ± 0.30 per cent; 44.60 ± 0.40, 42.84 ± 0.28 and 29.83 ± 0.28 per cent; 49.59 ± 0.32, 46.72 ± 0.38

and 30.82 ± 0.18 per cent; 41.75 ± 2.07, 45.04 ± 1.94 and 115.92 ± 12.81 U/L; and 70.56 ± 3.38, 84.07 ± 3.58 and 109.89 ± 7.11 U/L respectively. The post thaw values in Tris extender with 20 per cent egg yolk were significantly (P<0.05) higher than in that containing 1.5 per cent soya lecithin and in commercial Ovixcell extender, and also in Tris extender containing 1.5 per cent soya lecithin than that in Ovixcell extender for sperm motility, live sperm, intact acrosome and HOST-reacted sperm. The values of ALT and AST in frozen semen were significantly (P<0.05) lower in Tris extender containing 20 per cent egg yolk than that in commercial Ovixcell extender and AST activity was also significantly (P<0.05) lower in Tris extender containing 1.5 per cent soya lecithin than that in Ovixcell extender. However, the mean values of ALT and AST in frozen semen did not differ significantly between Tris extenders containing 20 per cent egg yolk and 1.5 per cent soya lecithin. The fertility rate was found to be the highest in Tris extender containing 20 per cent egg yolk.

Based on sperm parameters studied soybean lecithin-based extender was found to be comparatively inferior to conventional egg yolk-based extender.

Effect of epigallocatechin gallate and vitamin e on *in-vitro* maturation and fertilization of bovine oocytes

Dr. W. Lomen Singh

The present research was planned to study the effect of different concentrations of Epigallocatechin Gallate and Vitamin E (known concentration) and their combination in TCM-199 for *in-vitro* maturation and subsequent fertilization in TALP medium. A total of 664 and 661 oocytes were recovered from slaughterhouse ovaries of cattle by aspiration and slicing techniques, respectively. They were graded as A, B and C with the recovery rates of 62.27 ± 1.60, 23.73 ± 1.35 and 13.98 ± 1.41 per cent, respectively by aspiration technique; while 30.40 ± 1.74, 51.36 ± 2.01 and 18.23 ± 1.31 per cent, respectively by slicing technique. A total of 508 oocytes of grade A and B were used in the study. Maturation of oocytes was determined on the basis of rate of cumulus cell expansion and 1st polar body extrusion and fertilization were determined based on 2nd polar body extrusion. Epigallocatechin Gallate concentrations at 5, 10 and 15ìM levels in the maturation media resulted rate of cumulus cell expansion 54.92 ± 1.54, 70.02 ± 0.19 and 70.87 ± 2.20 per cent, respectively;1st polar body extrusion 30.29 ± 0.49, 44.41 ± 0.61 and 43.84 ± 0.32per cent, respectively; and 2nd polar body extrusion 18.24 ± 2.94, 24.91± 1.03 and 23.17± 1.03 per cent, respectively. Oocytes maturation rates both in terms of cumulus cell expansion and 1st polar body extrusion were significantly affected by levels of Epigallocatechin Gallate supplementation in the *in-vitro* maturation medium but had no significant influence on *in-vitro* fertilization.

Vitamin E supplementation at 100 ìM and combination of Epigallocatechin Gallate (10 ìM) + Vitamin E (100 ìM) levels to the *in-vitro* maturation media resulted in rate of cumulus cell expansion 1st polar body extrusion and 2nd polar body extrusion as 60.86 ± 1.25, 32.09 ± 1.23 and 18.84 ± 2.36 per cent, respectively and 69.03 ± 2.83, 34.47 ± 0.69 and 19.83 ± 5.12 per cent, respectively. Addition of combination of Epigallocatechin Gallate (10 ìM) + Vitamin E (100 ìM) in the maturation medium significantly improved the oocytes maturation rate both in terms of cumulus cell expansion as well as 1st polar body extrusion, although found not significant in subsequent fertilization.

In conclusion, incorporation of Epigallocatechin Gallate at 10 and 15 ìM concentration significantly improved *in-vitro* maturation rate and subsequent fertilization.

Morphological and functional characteristics of capacitated and liquid boar semen

Dr. Ainul Haque

A total of 24 ejaculates, collected twice in a week by simple fist method, six from each of the four trained and healthy crossbred Hampshire boars of one to two years of age maintained at ICAR-All India Coordinated Research Project (AICRP) on pig, College of Veterinary Science, AAU, Khanapara, Guwahati-22, were selected for the present study.

The ejaculates were extended with Modena extender (1:3), hold at 22°C for 4 hours and preserved up to 120 hours at 15°C.The semen samples were evaluated at 0 (i.e. immediately after extension), 24, 48, 72, 96 and 120 hours of preservation. In the present study, the overall mean sperm motility showed a decline from 85.42% to 51.04%, live intact acrosome decreased from 95.32% to 76.09%, HOST reacted spermatozoa declined from 73.53% to 46.41%, sperm membrane protein decreased from 13.68 to 6.06 mg/10^9 spermatozoa, extracellular protein level in extender increased from 1.54 mg/ml to 1.84 mg/ml and sperm cholesterol level declined from 31.84 to 16.22 mg/10^8 spermatozoa. The overall mean values were found to be differed significantly (P Â0.001) with increase in hours of preservation in the extender but no significant difference in overall mean extracellular protein level was observed between 24 hours and 48 hours as well as 72 hours and 96 hours of preservation.

Sperms were suspended in TALP medium and incubated for 5 hours at 37°C for *in vitro* capacitation and evaluation was carried out at 0, 1, 2, 3, 4 and 5 hours of incubation. In the present study, the highest hyperactivation motility was observed at 4 hours of incubation from 18.96% at 0 hour to 71.86% at 4 hour, the hyperactivated motility of spermatozoa increased significantly up to 4 hours then it decreased significantly to 54.79% at 5 hours of incubation. The overall mean live intact acrosome declined from 94.76% to 39.06%, HOST reacted spermatozoa decreased from 76.32% to 60.59%, sperm membrane protein decreased from 24.90 to 11.40 mg/10^9 spermatozoa, extracellular protein in TALP medium increased from 0.49 to 1.07 mg/ml and sperm cholesterol level declined from 31.84 to 8.57

mg/10^8 spermatozoa. The overall mean values were found to be differed significantly (P Â0.001) with increase in hours of incubation in the medium but no significant difference in overall mean extracellular protein level was observed from 1 hour to 3 hour of incubation. The aim of the present study was to determine the nature of capacitation-like changes during preservation by studying the morphological and biochemical characteristics, plasma membrane integrity of *in-vitro* capacitated and preserved boar spermatozoa. In the present study, the changes of the boar spermatozoa at 96 hours of preservation in respect of acrosomal status, plasma membrane integrity, membrane protein and cholesterol levels resembles with the changes of spermatozoa of *in vitro* capacitated for 3 hours of incubation at 37°C and maximum *in vitro* capacitation was observed at 4 hours of incubation at 37°C.

Avenues of employment and welfare from pig farming in Aizawl Mizoram

Dr. (Ms) Vanlalhmangaihi Fanai

A research study was undertaken to study on "Avenues of employment and welfare from pig farming in Aizawl, Mizoram" during January – May, 2017 with a view to study the impact of pig rearing among pig farmers considering 100 selected respondents in Aizawl District, Mizoram. Two sets of variables viz., independent and dependent variables were chosen for the study in consultation with available literature, experts from faculties in College of Veterinary Science, AAU, Khanapara, Guwahati, Assam and experienced exponents from the field.

The study was conducted in five purposively selected development group namely – Aibawk, Phullen (Thanglailung), Darlawn (Khawruhlian), Thingsulthliah, Tlangnuam (Sihphir, Chanmari) block. One village from each block were chosen for the study. From the selected villages twenty numbers of pig farmers were selected to make the sample size 100 (hundred) for the present study. As per the results, most of the respondents belonged to average age group 55.20 years. In an average family size of 5.53 numbers and majority (52.00 %) having nuclear family and were married (97.00 %). Quite a high number of respondents read up to primary school (30.00%), and had the primary occupation of Animal Husbandry (37.00%). Business Trade and commerce was their secondary occupation (22.00%) with their mean total annual income from pig farming being Rs.39805.00 and mean annual income from all sources being Rs.188575.00. The average experience in piggery farming among the farmers was of 15.73 years, majority were engaged in religious society (76.00 %) for social participation. Majority of the welfare came forth from pig farming was mainly on family health and treatment (98.00%) followed by housing (97.00%), and the future prospects of pig farming was perceived as very good (85.00%) and extremely promising (78.00%), fast growing (73.00%), it was reported as risky (63.00%), against great demand (73.00%) and highly remunerative (68.00%). The respondents felt piggery as highly profitable (65.00%) and responded as not problematic (96.00%).

In regression analysis, it was found that regression equation with R Sq. was 0.222959. The ANOVA $F_{(2,97)} = 10.39$; P<.001 in case of employment on different independent variables. Further, it indicated that welfare activities were impacted by the independent variables in pig rearing to the tune of about 23.00 per cent (Rsq. =23.61%; P<0.001). The rate of change of involvement in pig rearing with respect to share of major activity was statistically significant (b = 0.327; P<.001). In correlation analysis, independent variable *viz.* price of piglet, price of adult pig, price of pork, earning from pig sold, No. of yearly pigs sold, type of assistance, Extension contact, mass media, main purpose of pig farming, market orientation, marketing methods, leadership ability, type of farming, involvement in pig rearing showed various levels of correlation with each other. Pearson correlation matrix (Table 4.18), revealed that price of piglet was high significantly and positively correlated with price of pork (r = 0.392; P<0.001), extension contact (r = 0.415; P<0.001) and market orientation (r = 0.264; P = 0.008). While the same was negatively and high significantly correlated with share of major activities (r = -0.467; P<0.001).

It was seen that price of adult pig was positively and significantly related to extension contact (r = 0.246; P = 0.014), whereas high significantly and positively associated with earning from pig sold (r = 0.373; P<0.001), number of pigs sold (r = 0.391; P<0.001), type of assistance (r = 0.292; P = 0.003). Price of pork on other hand was associated positively and significantly with earning from pig sold (r = 0.204; P = 0.042) and mass media (r = 0.252; P = 0.011), whereas positively and high significantly with extension contact (r = 0.325; P = 0.001), while negatively and significantly with share of major activities (r = -0.241; P = 0.016), negatively and high significantly with main purpose of pig farming (r = -0.388; P<0.001), market orientation (r = -0.407; P<0.001) and motivational Factor (r = -0.488; P<0.001). Earning from pig sold was positively and high significantly correlated with yearly pigs sold (r = 0.566; P<0.001), type of assistance (r = 0.545; P<0.001), extension contact (r = 0.394; P<0.001), mass media (r = 0.334; P=0.001), and negatively and high significantly with market orientation, (r = -0.274; P = 0.006), involvement in pig rearing (r = -0.284; P = 0.004). No. of yearly pigs sold was positively and significantly related to leadership ability (r = 0.215; P = 0.031) and entrepreneurial behaviour (r = 0.212; P = 0.034) while positively and high significantly associated with type of Assistance (r = 0.341; P = 0.001) and extension contact (r = 0.311; P=0.002) and with types of Farming (r = 0.301; P = 0.002). Type of assistance was positively and high significantly associated with extension contact (r = 0.613; P<0.001), mass media (r = 0.613; P<0.001), main purpose of pig farming (r = 0.309; P = 0.002), leadership ability (r = 0.357; P<0.001) and entrepreneurial behaviour (r = 0.356; P<0.001); whereas negatively and significantly related to market orientation (r = -0.222; P = 0.026). Extension contact was positively and high significantly associated with mass media (r = 0.611; P<0.001), main purpose of pig farming (r = 0.333; P<0.001) and entrepreneurial behaviour (r = 0.277; P = 0.005) whereas negatively and significantly related to share of major activity (r = -0.214; P = 0.033). Mass Media was found to be associated positively significantly with entrepreneurial behaviour (r = 0.205; P = 0.040) and positively and high significantly correlated with main purpose of pig farming (r = 0.279; P = 0.005) and main

purpose of pig farming was positively and significantly related to leadership ability (r = 0.256; P = 0.010),whereas positively and high significantly associated with market orientation (r = 0.364; P<0.001), marketing methods (r = 0.383; P<0.001), entrepreneurial behaviour (r = 0.381; P<0.001) and motivational factor (r = 0.324; P = 0.001). Market Orientation was positively and high significantly associated with marketing methods (r = 0.348; P<0.001) and motivational factor (r = 0.267; P = 0.007) whereas negatively and significantly related to share of major activity (r = -0.242; P = 0.015). Marketing Methods was positively and significantly related to leadership ability (r = 0.215; P = 0.032) but positively and high significantly associated with entrepreneurial behaviour (r = 0.276; P = 0.005). Leadership Ability was positively and high significantly associated with entrepreneurial behaviour (r = 0.303; P = 0.002) while type of farming was positively and high significantly associated with motivational factor (r = 0.34; P = 0.001). Involvement in pig rearing was positively and high significantly associated with share of major activity (r = 0.470; P<0.001).

The in dependent variables also had significant impact on dependent variables *viz.* employment from pig farming and welfare coming forth from pig farming. They in tune had significant and positive correlation with problems.

Ethnicity in livestock rearing among the Nyishi tribes of Arunachal Pradesh

Dr. Nich Yadik

An investigation was undertaken to study the ethnicity in livestock rearing among the Nyishi Tribes of Arunachal Pradesh .Two predominantly Nyishi dominated districts namely Papum Pare and Lower Subansiri district were purposively selected. Four villages were selected and 15 respondents from each village were selected, making the sample size 120.Only the farmers having at least one animal were selected for the study in consultation with the officials of Department of Animal Husbandry, Veterinary and Dairy, Government of Arunachal Pradesh for the study purpose. Two sets of variables *viz*., independent and dependent variables were chosen for the study in consultation with available literature, faculties in college of veterinary science AAU, Khanapara, Guwahati, Assam. Data were collected by personally by interviewing the respondents.

Study revealed that majority of the respondents, 65.84 per cent belonged to middle age group, and about 62.50 per cent of them were male and 100.00 per cent were married. Majority 75.83 per cent had nuclear family type with 70.80 per cent medium family size. Almost 54.20 per cent were illiterate educational level and majority 73.30 per cent of the respondents were involved in agriculture as their main occupation. Majority of the respondents 70.00 per cent had medium herd size of livestock other than mithun,75.83 per cent had medium mithun herd size .Most of them had medium family income (rupees 90000-190000) of which majority of the respondents 79.17 per cent belonged to medium category. Majority 85.00 per cent of the respondents had medium income from livestock (rupees 60000-90000).About 55.83 per cent of the respondents had medium extension contact and 62.50 per cent of the respondents had social participation.

As regards to socio-cultural practices associated with livestock rearing, 100 per cent of the respondents used mithun and poultry during festivals, 100.00 per cent the respondents used mithun, pig and poultry during marriage, 100.00 per cent of respondents used poultry in rituals, 100.00 per cent in birth ceremony, 95.00 per cent of the respondents

used mithun in barter system and 95.00 per cent of the respondents used mithun in legal laws.

The study revealed that larger herd size enhances livelihood (89.17 per cent), more numbers of livestock increase social status (74.17 per cent), availability of transportation facilities enhances livestock rearing (77.50 per cent), animal husbandry provides supplementary income (76.66 per cent) and livestock provides social status (70.83) were the different type of assets which played major role in livelihood support of the farmers.

As per the preferred means of identification of livestock in order to avoid disputes 60.00 per cent of the respondents responds practiced ear notching, followed by 50.08 per cent of the respondents by different colour pattern and 50.08 per cent by horn. Majority of the respondents 95.83 per cent preferred means of processing of livestock meat and followed 63 per cent by drying.

In respect of ethno-veterinary practices leaves, roots and stems of different plants like garlic, guava, ginger, taro, mugorut, white seed, fern, banana etc were used by Nyishi tribe for treatment of different ailments of livestock.

Constraints such as non availability of labourers, lack of fodder and good quality seed and lack of proper marketing channel has been identified as sever constraints perceived by the Nyishis' in performing their livestock rearing practices.

Transition in ethno-cultural livestock preferences among farmers in Kamrup (r) district of Assam

Dr. Gayatri Das

India is predominantly an agrarian society where animal husbandry is an integral part of the agricultural system and as such helps forming the backbone of national economy. The scale of production in animal husbandry has been subsistent in nature and method of rearing, traditional in nature. Commercial or market oriented production systems have not developed much. The composition of livestock population of Assam consists of 63.3 percent cattle followed by goat (21 percent). Buffalo accounts for 5.8 percent while the share of pig is 8.62 percent and sheep is the lowest, i.e. 0.66 percent. Assam does not have any economically important breeds of livestock except the indigenous bullock (2.06 million) on which most of the agricultural operations depend. Because of constantly changing atmosphere in addition to many other factors, animal husbandry in the traditional society in the state has been in transition necessitating the preferences in the farmers' priorities. therefore a study entitled as "Transition in ethno-cultural livestock preferences among farmers in Kamrup (Rural) district, Assam "was taken up to study with the objectives- (i) Personal profile and the traditional livestock reared by the farmers. (ii)The ethno-cultural values the farmers endow to livestock (iii) The change in number and pattern of animals reared and the transition, if any since the time of his/her father (iv) The reasons of perceived transition among the farmers in livestock rearing (v) The relationship among the ethno-cultural values, transitions of livestock rearing and the reasons behind such a situation. The study was conducted in four selected developmental blocks of Kamrup (Rural) District of Assam situated to the East, West, North and South directions from the headquarters. These four blocks were Bejera, Hajo, Rangia and Boko. Twenty five farmers having at least one milch cow were selected randomly as respondents from each of the blocks thus making the sample size 100. A pre-tested, reliable and valid interview schedule was used for data collection by the researcher personally and the responses were collected on the interview schedule comprising of independent and dependent variables. Based on the data collected and the results obtained

the conclusions were drawn and findings were expressed. The salient findings were- Majority of the farmers belonged to middle age group (38-50 year), Majority of respondents were male (72.00 percent), Quite a high majority of the respondents were married (94.00 percent),Quite a good number of the respondents had low educational status (46.00 percent), Majority (79.00 percent) of the respondents had medium sized families (4-7 number) Majority of the respondents belonged to nuclear family type (84.00 per cent), Majority (51.00 percent) of the respondents were medium land holders (3-5 bighas), Quite a good number had agriculture as their primary occupation (43.00 percent), Majority (81.00 percent) of the respondents belonged to middle income group (Rs.48,000-217000) of family income from all source, Majority (83.00 percent) of the respondents belonged to middle income group of (Rs. 4000 to 10,000) of family income from animal husbandry or livestock sector, A good number of the respondents (49.00 per cent) had medium (Rs. 3000- to Rs. 5000/-) respondent's own monthly income, Majority of farmers (75.00 per cent) had maintained medium herd size (3-6 numbers) presently. Majority of farmers (77.00 percent) had maintained medium herd size (2-3 numbers of equivalent cattle units) 5 yrs. back. Quite a good number (47.00 percent) respondents had medium level of social participation. Majority of farmer (54.00 per cent) were categorized in medium extension contact, Among the farmers, 34.00 per cent respondents had high level of exposure to various information sources. Highest respondents (6.08 percent) reared livestock for agricultural purposes mainly for draft and manure. Cattle were highly preferred (40.83 percent) among the various farm animals, Majority (87.00 percent) of farmers had kutcha type of house, Majority of farmers (61.00 per cent) were categorized in medium risk orientation group towards animal husbandry practices. Quite a good number (49.00 percent) had medium level of attitude towards animal husbandry. Highest respondents (4.73 percent) kept animals let loose throughout the day &gave shelter at night, Highest respondents (8.90 percent) fed colostrum to the new born calves followed by regular vaccination against infectious diseases. In 't 'test mean number of livestock between the two phases of study i.e. five years back and at the time of conducting the study, significantly differed and showed increase from earlier,(6.84 p=<.01),In relational analysis age of the respondents was positively and high significantly related (r=0.29, p=<.01)to mass media exposure. Whereas it was positively and significantly correlated (r=0.20,p=<.05) with earlier (5 years back) herd size , Educational qualification had positive and high significantly related (r=0.31,p=<.01) to annual family income from all sources and mass media exposure ,Whereas it had positive and significant correlation (r=0.20,p=<.05) with earlier (5 years back) herd size. Family size was found to be positively and high significantly related(r=0.27, p=<.01) to land holding, whereas it was found to be negatively and high significantly related to mass media exposure, Land holding was positively and high significantly related to occupation and risk orientation, Annual family income from all sources was found to be positively and high significantly related to educational qualification , Annual family income from livestock was positively and high significantly related to with annual family income from all sources, Social participation was positively and high significantly (r=0.31, p=<.01) related to annual family income from all sources, herd size, preference of livestock

,Mass media exposure was positively and high significantly related to age, educational qualification and social participation, whereas it had significant correlation with respondent own income per month ,Risk orientation was positively and high significantly related (r=0.25, p=<.01)to land holding ,Purpose of livestock rearing was positively and high significantly related to respondent own income per month, Preferences of livestock was positively and highly significantly(r=0.18, p=<.01) related to annual family income from all sources and annual family income from livestock, Herd size (5 yrs. earlier) was positively and high significantly(r=0.79, p=<.01) related to herd size (at the time of data collection). Whereas it had significant correlation with Age, Educational qualification, annual family income from all sources and Social participation, In multiple regression out of 12 independent variables, family size, occupation, Extension contact, and risk orientation had positive and significant influence on purpose of livestock rearing. The coefficient of determination R square =0.98, indicating that 98.00 percent variation in the purpose of livestock rearing was explained by 12 independent variables taken together. 'F' value for R= 4.41** which is highly significant.

Epidemiological studies on theileriosis in goats of Assam

Dr. Syed Abdul Arif

A study was conducted to ascertain the prevalence of theileriosis in goats of Assam during March 2016 to May 2017. In the study a total of 543 blood samples were collected from both apparently healthy and sick goats on random basis from 11 districts of Assam irrespective of age, sex and breed. To determine the prevalence, microscopic examination based on Giemsa stain was done in order to detect the parasite in the blood smear.

Overall prevalence of *Theileria* infection was recorded to be 32.41%. District wise highest prevalence was recorded in Kamrup(R) (52.31%) followed by Golaghat (44.74%) and lowest in Dhemaji (12.00%).Age wise, prevalence of *Theileria* infection was found to be higher in goats from 12 months to 24 months of age group (43.18%) and lowest in less than 6 months of age (6.81 %).Sex wise, higher prevalence was recorded in female (79.00%) than male (21.00%).Temporal study on the occurrence of the disease pattern revealed that the highest prevalence was in the month of September (66.19%) followed by March (45.71%) and least in the month of February (12.19%).

Chi-square test showed that *Theileria* infection in associated with location, time and sex are statistically highly significant ($p < .01$), but there was no significant difference between age in *Theileria* positive cases.
Spatial distribution of the disease was studied using GIS software.

PCR was found to be highly specific and sensitive in detection of subclinical infection or carrier animal.Presence of *Theileria luwenshuni* was confirmed by sequencing. Phylogenetic tree showed distant relationship of *Theileria luwenshuni* with the isolate from Sika deer of China and isolates from cattle of Tibet and suggestive of cross species transmission.

Clinical recovery was ascertained based on microscopic examination, haemato-biochemical alteration and mean clinical score. Goats treated with combination of buparvaquone and oxytetracycline along with supportive treatment was found to be better in therapeutic management of *Theileria* infection in comparison with buparvaquone and oxytetracycline alone.

Growth performance and carcass traits of Assam local goats under intensive system of management

Dr. Jeherul Hoque

An experiment was conducted to study the growth response, efficiency of feed conversion, carcass characteristics and meat quality parameter and the cost of production of Assam local goats under different system of management.

Twenty goats of one month of age, were randomly selected in village Lachima of Nalbari district, Assam. The goats were randomly divided in two groups comprising of ten kids in each group *viz*, T_0 (Control group) Where goats were reared under extensive system of management with traditional grazing and browsing and T_1 (Experimental group) where goats were reared under intensive system of management with *ad lib*. concentrate and fodder feeding. The average initial (1 month of age) and final (6 months of age) body weight of the goats during the experimental periods under the control and treatment groups were 2.90 ± 0.03 kg and 2.89 ± 0.04 kg and 10.36 ± 0.26 kg and 16.05 ± 0.53 kg respectively. Highly significant difference (P<0.01) in body weight changes were observed between the control and treatment group from 3rd week of the experiment to the 22nd week or till the end of the experiment. The average final body length, height at wither and heart girth of the goats at 6 months of age under the control and treatment groups were 42.44 ± 0.34 and 51.31 ± 1.25, 41.29 ± 0.37 and 49.68 ± 1.06 and 48.29 ± 0.31 and 57.69 ± 1.35 centimetre respectively. Overall changed in body measurement showed highly significant difference between the groups in most of the months. The feed conversion efficiency on DM basis was recorded as 3.49 in the treatment group. No mortality was recorded in both control and treatment group during the experimental period. The average carcass weights in control and treatment groups were 4.89 ± 0.11 and 8.33 ± 0.34 kg respectively, while the dressing percentages were 44.00 and 49.95 in control and treatment group respectively. Highly significant differences (P<0.01) were observed in carcass weight and dressing percentage between control and treatment group. Highly significant difference (P<0.01) was also observed in non-carcass components (weight of heart, drainable blood, fore shank, lung and trachea and skin). Weight of prime cuts (leg, loin, rack, shoulder, breast, flank and neck)

also revealed highly significant (P <0.01) difference between control and treatment group. Following sensory assessment, there were highly significant (P<0.01) difference for tenderness, juiciness and overall acceptability. However, significant (P<0.05) differences were observed in flavour and texture between the control and treatment group. The total cost of raising the goats in control and treatment groups were Rs 535.00 and Rs 150.00 while the cost per kg live weight in control and treatment groups were Rs 14.47 and Rs 33.20 respectively. The total incomes by selling meat in control and treatment groups were Rs 1980.00 and Rs 3524.00 respectively. Thus the net income was recorded Rs 1830.00 and Rs 2989.00 in control and treatment groups, respectively.

Performance of crossbred sheep of Arunachal Pradesh under semi intensive system of management

Dr. Karmu Tsering

The present investigation was undertaken to study the performance of crossbred sheep of Arunachal Pradesh under semi intensive system of management at the Regional Sheep Breeding Farm, Sangti in the West Kameng district of Arunachal Pradesh from March 2016 to February 2017 by studying the following performance attributes: body weight at different ages, conformation traits, reproductive traits, wool traits and mortality pattern with its causes.

The average body weight of male sheep at birth, 3, 6 and 12 months was 2.74 ± 0.03, 14.78 ± 0.16, 18.87 ± 0.17 and 25.27 ± 0.49 cm. The corresponding value for female was 2.22 ± 0.04, 13.63 ± 0.11, 17.59 ± 0.15 and 22.74 ± 0.31 cm. The average body length, heart girth, height at wither, head length and tail length of male sheep at 3, 6 and 12 months was 36.26 ± 0.28, 41.53 ± 0.29 and 49.45 ± 0.27 cm; 55.13 ± 0.36, 55.97 ± 0.31 and 64.71 ± 0.40 cm; 46.60 ± 0.25, 52.91 ± 0.36 and 55.94 ± 0.35 cm; 13.56 ± 0.21, 17.28 ± 0.15 and 20.46 ± 0.15 cm and 17.28 ± 0.15, 19.06 ± 0.14 and 21.06 ± 0.18 cm respectively. The corresponding value for female sheep was 33.16 ± 0.12, 41.26 ± 0.23 and 41.99 ± 0.10 cm; 54.38 ± 0.26, 55.19 ± 0.21 and 64.07 ± 0.32 cm; 46.00 ± 0.31, 51.74 ± 0.19 and 54.24 ± 0.31 cm; 11.88 ± 0.13, 14.88 ± 0.11 and 18.27 ± 0.16 cm and 16.61 ± 0.13, 16.77 ± 0.08 and 19.36 ± 0.09 cm respectively. There was highly significant ($P<0.01$) difference between male and female sheep in respect to body and head length at 3 months. At the age of 6 months, highly significant difference between sexes was observed in height at wither and head length while it was significant in heart girth. On the other hand at 12 months of age highly significant difference was observed in body length, height at wither, head length and tail length due to sex.

The average age of puberty for male and female sheep was found to be 192 ± 6.17 and 329.8 ± 5.55 days respectively and the difference between the sexes was highly significant ($P<0.01$). The average age at first fertile service, gestation period, service period, duration of estrus, length of the oestrous cycle were 469.32 ± 10.25 days, 146.84 ± 0.48 days, 78.36

± 1.85 days, 29.28 ± 0.96 hours and 16.68 ± 0.20 days respectively. Only single type of lambing was observed. The average fibre length, staple length and fibre yield of male sheep at 12 months was 7.76 ± 0.13 cm, 5.89 ± 0.16 cm and 1.49 ± 0.04 kg and female sheep was 7.54 ± 0.12 cm, 6.07 ± 0.17 cm and 0.79 ± 0.02 kg respectively. The difference between the male and female animals was found to be highly significant for fibre yield, whereas non significant for fibre length and staple length. There was a significant (P<0.001) positive correlation of body weight with the body length, heart girth, height at withers, head length and tail length in both the male and female sheep at 3, 6 and 12 months of age.

The overall mortality of the sheep up to 6 months of age in the farm was found to be 48.91 percent which was mostly due to pneumonia (25.55%). More animals died during winter season (34.36%) at the pre weaning stage (35.24%).

Effect of thermal stress on certain productive performances of hampshire sows

Dr. M. Monish Raj

Pig husbandry plays an important role in the development of Indian meat industry**.** Pig farming is an important aspect in Northeastern region of India because pig farming mainly constitutes the livelihood of rural poor belonging to the lowest socio-economic strata and they play an important role in survival of rural and tribal people. Pigs lack proper thermoregulatory mechanism as other livestock making it difficult to rear them in hot and humid condition like Assam. Present study was undertaken to study the effect of thermal stress of both summer and winter on performance of Hampshire sows. In present study, Twelve Pregnant sows, six each in summer and in winter were taken for study under standard feeding and managemental system of the farm. The study was carried out in two phases i.e. phase I: Summer (June to August 2016) and phase II: Winter (December 2016 to February 2017).

Mean temperature, relative humidity and THI both in outdoor and indoor environment were taken into account. Results showed that ambient temperature ranged from 13.39 ± 0.28 to 30.87 ± 0.23, relative humidity ranged from 87.96 ± 0.79 to 91.90 ± 0.46 and THI from 61.81 ± 0.27 to 84.10 ± 0.30. In summer season, the mean rectal temperatures (°F) of the sows in morning and evening were 102.39 ± 0.04 and 102.54 ± 0.03 in June, 102.41 ± 0.04 and 102.61 ± 0.03 in July and 102.45 ± 0.03 and 102.65 ± 0.04 in August respectively. In winter season, the mean rectal temperature (°F) of the sows in morning and evening were 102.07 ± 0.05 and 102.18 ± 0.05 in December, 101.91 ± 0.04 and 102.15 ± 0.05 in January and 102.11 ± 0.04 and 102.29 ± 0.03 in February respectively. Statistical analysis revealed highly significant ($P < 0.01$) difference in rectal temperature between summer and winter seasons. In summer season, the mean respiration rate (breaths/min.) of the sow in morning and evening were 57.79 ± 0.63 and 62.47 ± 0.66 in June , 61.18 ± 0.52 and 65.54 ± 0.42 in July and 65.63 ± 0.45 and 68.90 ± 0.44 in August respectively. In winter season, the mean respiration rate (breaths/min.) of the sows in morning and evening were 39.5 ± 0.66

Abstract of M. V. Sc. Thesis
Department : **Livestock Production and Management**
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and 44.88 ± 0.64 in December, 42.65 ± 0.51 and 48.51 ± 0.57 in January and 39.38 ± 0.49 and 43.85 ± 0.42 in February respectively. Statistical analysis revealed highly significant (P < 0.01) difference in respiration rates between summer and winter seasons. In summer season, the mean pulse rate (beats/min.) of the sows in morning and evening were 83.40 ± 0.93 and 88.92 ± 1.02 in June, 83.06 ± 0.91 and 91.31 ± 1.22 in July and 85.11 ± 0.79 and 90.42 ± 0.81 in August respectively. In winter season, the mean pulse rates (beats/min.) of the sows in morning and evening were 78.21 ± 0.52 and 82.78 ± 0.51 in December, 78.53 ± 0.37 and 82.65 ± 0.32 in January and 78.75 ± 0.43 and 83.03 ± 0.38 in February respectively. Statistical analysis revealed that mean pulse rate was significantly (P < 0.01) higher in summer than in winter season. The overall average of serum cortisol concentration (nmol/l) in summer and winter were 284.42 ± 2.26 and 162.5 ± 2.47 respectively. On statistical analysis, it was revealed that there is highly significant (P < 0.01) difference in cortisol concentration between summer and winter season. The overall average of serum progesterone (ng/ml) concentration in summer and winter were 19.13±1.09 and 20.35±1.14 respectively. Statistical analysis revealed that there is no significant difference between serum progesterone concentration in summer and in winter seasons. Average litter size at birth was found to be 7.83 ± 0.65 and 9.53 ± 0.33 for summer and winter respectively. Average litter weight (kg) at birth was found to be 9.75 ± 0.16 and 12.5 ± 0.93 in summer and winter respectively. Statistical analysis revealed significantly higher (P < 0.05) average litter weight and average litter size at birth in winter seasons than in summer season. Average litter size at weaning was found to be 7.17 ± 0.40 and 6.83 ± 0.31 in summer and winter respectively. Statistically no significant difference was found in average litter size at weaning between summer and winter season. Average litter weight (kg) at weaning was found to be 68.43 ± 0.47 and 65.27 ± 0.62 in summer and winter respectively. Statistical analysis revealed significantly higher (P < 0.05) average litter weight in winter seasons than in summer season. The overall feed consumption (kg) and FCE of sow was recorded to be 33.39 ± 0.16 and 37.6 ± 0.24 and 5.02 ± 0.05 and 4.61 ± 0.06 for summer and winter respectively. Statistical analysis revealed that there is significantly higher (P < 0.01) feed consumption and FCE in winter seasons than in summer season.

From the present study it was concluded that the pregnant Hampshire sows experience severe heat stress in summer season which affects feed consumption and the productive performance of the sows. However, winter season is found to have no effect of thermal stress on the pregnant Hampshire sows. Further experiments on the line with more animals will be helpful to support the trial.

Performance of crossbred (jersey x local) cattle in East and West Siang districts of Arunachal Pradesh

Dr.Miken Kaye

An investigation was undertaken to study the performance of crossbred (Jersey xLocal) cattle of East and West Siang districts of Arunachal Pradesh from February 2017 toJuly 2017. One hundred twenty dairy farmers, 60 from each district headquarters, *viz.*Pasighat and Along, within a radius of 25 km were selected at random. In the present study,the data obtained from 340 crossbred cattle were analyzed for various productive andreproductive parameters and 200 fresh milk samples were collected to estimate the fat, SNF,protein per cent and specific gravity of milk. A separate diary was maintained to record thelocal fodders available at the farmers' level in different seasons.In respect of socio-economic condition of the farmers, in East Siang district,majority (50 %) of the dairy farmers belonged to middle age group (35-49 years), majority(55%) of them were having medium sized families (4-7 members), majority (43%) of them were illiterate, and majority (48%) of them had medium (Rs.2,18,235- Rs. 3,62,852) annual income. Corresponding values for West Siang district were 55, 38, 45 and 73 per cent, respectively.

In regards to housing and sanitation, majority (67%) of the cattle shed in East Siangwere semi-pucca, 30 per cent kutcha and 3 per cent were pucca. Corresponding values for West Siang were 90, 3 and 7 per cent, respectively. In East Siang district, majority (80%) of the farms were located on plain area, 12 per cent on low lying area, 8 per cent on elevated area and corresponding values for West Siang were 50, 25, 22 per cent, respectively and 3 per cent were located on hillock area. In East Siang, majority (88%) of the animal sheds were constructed below 5 meters, 2 per cent within 5-10 meters, 7 per cent within 10-20 meters and 3 per cent above 20 meters from the human dwellings and corresponding values for West Siang were 95,0, 2 and 3 per cent, respectively. In East Siang, majority (42%) of the wall of cattle shed were open type, 33 per cent closed (full wall), 23 per cent half wall without net and 2 per cent half wall with net and corresponding values for West Siang were 62, 23, 18 and 2 per cent, respectively. In East Siang, majority (67%) of the dairy

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farmers used CGI sheet as roofing material and 33 per cent used thatch, and corresponding values for West Siang were 28 and 72 per cent, respectively. In East Siang, majority (55%) of the floor of cattle shed was kutcha, 37 per cent concrete and 8 per cent wooden. The corresponding values for West Siang were 93, 3, and 0 per cent, respectively. In East Siang, majority (85%) of the cattle shed had kutcha drain, 8 per cent had concrete drain and 7 per cent had no systematic drain as such and corresponding values for West Siang were 80, 17 and 3 per cent, respectively. In East Siang, majority (95%) of the farmers disposed of the dung in open space while only 5 per cent used manure pit to dispose of the dung and corresponding values for West Siang were 95 and 5 per cent, respectively. In East Siang, majority (88%) of the dairy farmers followed stall feeding cum grazing while only 12 per cent followed stall feeding alone. Whereas, in West Siang, majority (98%) of the dairy farmers followed stall feeding, while only 2 per cent followed stall feeding cum grazing. Further, in East Siang, majority of the farmers (98%) fed their animals twice a day, while only 2 per cent of the farmers fed their animals thrice a day. Contrastingly, in West Siang, majority (85%) of the farmers fed their animals thrice a day, while only 15 per cent farmers fed their animals twice a day. Besides, those farmers who followed stall feeding cum grazing, majority (77%) of the farmers grazed their animals for 4-8 hours, 16 per grazed their animals for above 8 hours and 7 per cent of the farmers grazed their animals for 1-4 hours daily. In East Siang, farmers on an average fed 6.49±0.31 kg green fodder, 5.19±0.10 kg of dry fodder, and 4.8±0.97 kg concentrate feed per animal per day, the corresponding values for West Siang were 18.12±0.23, 5.44±0.11 and 4.55±0.15 kg, respectively. *Ad libitum w*ater was always provided to animals in both the districts throughout the day and night which was supplied from either govt. supply water, own farm tube well or well etc. In East Siang district, majority (58%) of the dairy farmers followed vaccination, while 42 per cent didn't followed vaccination, majority (52%) of the dairy farmers practiced artificial insemination, while 48 per cent didn't practiced artificial insemination and majority (63%) of the dairy farmers followed deworming, while 37 per cent didn't followed deworming. Corresponding values for West Siang were 53, 47, 65, 35, 63 and 37 per cent, respectively.

In regards to reproductive and productive traits of crossbred cows, in East Siang, the average age at first calving, inter calving period, service period, gestation period, lactation length, lactation yield, average daily milk yield and dry period were 1024.30±16.38 days, 394.41±4.03 days, 113.52±3.25 days, 280.89±0.10 days, 278.80±2.98 days, 1381.00±53.00 litres, 4.89±0.17 litres and 115.61±2.98 days, respectively. Corresponding values for West Siang were 1017.70±19.13 days, 420.40±7.17 days, 138.90±3.25 days, 281.80±0.33 days, 290.80±1.94 days, 1908.30±47.94 litres, 6.56±0.16 litres and 129.44±1.93 days, respectively.. Fat , SNF, protein and specific gravity content of milk were 4.89±0.15 per cent, 8.49±0.09 per cent, 3.101±0.04 per cent and 1.028±0.300, respectively and corresponding values for West Siang were 4.92±1.93 per cent, 8.59±0.08 per cent, 3.09±0.03 per cent and 1.038±0.003, respectively. Inter calving period, service period, lactation length, lactation yield, average daily milk yield and dry period differed significantly (P<0.01) between the two districts. On the hand, there was no significant difference with regards to age at first calving, gestation

period, fat, SNF, protein per cent and specific gravity of milk. Lactation order was found to have non-significant effect on fat, SNF, protein per cent and specific gravity of milk. Stage of lactation had highly significant effect on fat per cent of milk, whereas, it had non-significant effect on SNF, protein per cent and specific gravity of milk.

In regards to marketing of milk and milk products, producer to consumer was the most common marketing channel observed in both the districts. In East Siang district, milk was sold on an average Rs. 50.00 -60.00 per litre , majority (98%) of the farmers sold the milk to the consumer households, majority (75%) of the farmers practiced conversion of milk to other products, majority (93%) of the farmers used bicycle for transportation. Corresponding values for West Siang were Rs. 60.00-100.00, 95 , 60, 85 per cent respectively. In regards to the local fodders, the species available were more or less similar in both the districts. The species generally found and normally fed the cattle were grasses and shrubs such as *Saccharum spontaneum, Ageratum conizoid, Setaria palmifolia, Imperata cylidrica, Polygonum sp., Bidens pilosa, Manihot esculenta, Urena lobata, Pteris semipinnata, Brachiaria sp.* and tree leaves such as *Musa sp., Artocarpus heterophyllus, Castanopsis sp., Ficus auriculata, Bambusa sp., Arenga pnnata, Debregesia sp., Bauhinia purpurea, Kydia glabrescens, Alpinia sp., Ficus sp., Gmelina arborea, Trema orientalis, Ficus hirta, Ficus sp., Ficus sp..* In regards to constraints faced by the dairy farmers, East Siang district, majority (76.70%) of the farmers mentioned that shortage of green fodder during winter, price of milk (48%), disease incidence (38%), cost of feed (25%), lack of suitable land for farm (25%), problem with neighbours (23%), scarcity of water (17%), lack of grazing land (13%), availability of hired labour (10%), price and problem in collection of straw (10%) and inadequate breeding facilities (8%) as the major constraints faced by them. Corresponding values for West Siang were 52, 9, 35, 40, 50, 13, 8, 42, 12, 42 and 42 per cent respectively.

Effect of feeding solid state fermented ration on the performance of hampshire piglets

Dr. Sudei Maia L. Toi

Forty-eight Hampshire piglets of 2 weeks old were selected and were randomly assigned to two experimental groups *viz.* Group I (reared on conventional ration), and Group II (reared on solid-state fermented ration fermented with *Lactobacillus plantarum*).The final body weight of Group I and II at the end of the experiment was 13.13±0.13 and 13.30±0.13 kg respectively. The average total body weights gain of Group I and II piglets were 8.93±0.37 and 9.10±0.29 kg respectively and the average daily body weights gain of Group I and II piglets were 0.128±0.005 and 0.130±0.004 kg respectively. The body weights and body weight gains of the piglets in the control and experimental group did not differ significantly. The average feed intake per piglet was recorded as 25.16 and 25.70 kg for Group I and II respectively and the overall feed conversion efficiency of the piglets of Group I and Group II was worked out as 2.61±0.28 and 2.60±0.29 respectively. There was no significant difference in the feed conversion efficiency between the groups. The mean *E. coli* count of faecal samples of Group I and Group II at the beginning of the experiment (2nd week) was 5.90±0.02 and 5.90±0.02 log10cfu/g respectively. In the subsequent weeks the *E. coli* counts decreased in both Group I and Group II. The *E. coli* count of faecal samples of Group I and Group II at the end of the experiment was 5.77±0.02 and 5.63±0.02 log10cfu/g respectively. The results are supported by the findings of Canibe and Jensen (2003) and Hung *et al.* (2008) who reported that levels of *E. coli* in the faeces of the animals fed fermented feed is lower than the group fed conventional feed.The intestinal villi length of Group II piglet was longer than Group I. These results are in agreement with the findings of Feng *et al.* (2007) Wang *et al.* (2007) and Missotten *et al.*(2015) who reported that the group fed fermented feed showed larger villi length when compared with the piglets fed conventional feed. The economic analysis of production of Hampshire piglets of the two groups revealed that the Group I piglets could fetch a profit margin of Rs. 232.00 and Group II a margin of Rs. 240.00 per piglet. As the use of fermented feed in piglets from 2nd to 5th fortnight could not exhibit any significant influence in the growth performance the production economy has become less relevant.

Effects of different smoking methods on certain quality attributes of pork sausage

Dr. Debajit Bhuyan

Commercial liquid smoke @ 3%, 5% and 7% to produce smoked pork sausages with the best eating and keeping quality attributes. The sausages were prepared as per a predesigned programme of work. Altogether 5 batches of sausages were prepared and these were evaluated on 1st, 5th, 10th and 15th days of storage for various important quality indicating parameters including the estimation of production cost. The highest ES (ml of oil/ 100g emulsion) was recorded for the control and T1 groups (1.88±0.12) of sausages while the lowest ES (3.2±0.10) was observed in the T2C formulations. In terms of % CL, the T1 formulation recorded the highest (16.42±0.52) while the lowest values were recorded for the control formulation (5.58±0.46). Statistical analysis of the data showed highly significant differences ($p<0.01$) among the treatments for both the parameters. The control and T1 formulation recorded the lowest pH (nonsignificant) in the sausage emulsion, while finished sausages of T1 formulation recorded the lowest pH with significant difference ($p<0.05$) within the group. The mean aw recorded on the 1st day of production in the sausage emulsion and the finished sausages were almost static and did not reveal any significant difference, while there was a gradual increase in the TBARS values of the finished sausages from the beginning till the end of the experiment. The lowest TBARS values were recorded by sausages of T2A and T2C formulation (0.24±0.001) on 15th day of storage with significant difference ($p<0.01$) amongst the treatments and also within the various days of preservation. The highest % moisture, % CP, % EE and % TA was recorded for T2C (64.16±0.31), T2A (19.57±0.54), T1 (21.66±0.98) and control (1.29±0.12) group of sausages. The % moisture and % EE content of the sausages differed significantly ($p<0.01$) while no significant differences ($p>0.05$) were observed in terms of % CP and % TA content. In terms of TPA analysis, the highest scores for hardness, chewiness, cohesiveness and resilience were recorded by the sausages of T1 formulations, while the highest scores for fracturability and springiness were recorded by the sausages of control and T2B formulation. T1 formulation

also recorded highest shear force values (1.023±1.75) with significant different (p<0.05) amongst the treatments. All the sensory parameters like appearance, colour, flavour, texture, juiciness and overall acceptance of the control as well as the treated sausages exhibited a declining trend from the very 1st day till the end of the experiment. It was observed that beyond 5th day of refrigerated storage, all the sausage samples failed to earn satisfactory ratings from the panel members. However, the CS and LS treated sausages scored comparatively better than those from control group. Statistical analysis of the data on sensory parameters reveled significant differences (P<0.01) in the control as well as in the treated formulations at different periods of storage. The mean TVPC and TPC (log cfu/g) of the smoked pork sausages exhibited significant differences (P<0.01) between the treatment groups and also amongst the storage periods while in terms of Y&M counts no significant differences were observed. There was a gradual increase in the mean TVPC, TPC and Y&M counts of the sausages with the progress of the storage periods. The mean TVPC counts on 15th day of study were recorded to be 4.17±0.02, 5.43±0.06, 5.24±0.04, 5.31±0.01 and 5.23±0.01 for control, T1, T2A, T2B and T2C sausages, while the TPC and Y&M counts for T1 sausages were found to be below the countable range throughout the storage periods. The colititre count in respect of pork sausages prepared with conventional smoking as well as by 8 using liquid smoke at various concentrations did not reveal any growth for the entire period of study.

Though the smoked pork sausages were found to be within the acceptable limit from the lipid oxidation (TBARS Values) and microbiological safety point of view till 15th day of refrigerated storage; from the sensory analysis, it was evident that panel members almost rejected the sausages irrespective of any treatments employed after 5th day of storage. The cost of production of smoked pork sausages estimated on the basis of prices of raw materials, cost of smoking, other non-meat ingredients, processing and ancillary costs etc. revealed that cost of sausages prepared with conventional smoking was more expensive than those prepared with liquid smoke at various concentrations (Rs. 378.00 V/s Rs. 330.00, 332.00, 334.00 and 336.00 per 1 kg).

Development of chicken jalebi-a ready-to-eat meat snack

Dr. Preeti Doley

The study was conducted in the department of LPT, Assam Agricultural University, Khanapara. Chicken jalebis were prepared by incorporating 23% non meat ingredients (Black gram flour, Bengal gram flour, corn flour, rice flour, semolina flour) at different proportions with 55% chicken (Broiler meat) to find out the best formulation without affecting the physico-chemical, microbial and organoleptic qualities of the product.

A total of five batches of chicken jalebi comprising of three different formulations in each batch were prepared. Non meat ingredients were fermented for 24hrs with curd at room temperature. Chicken was collected from local market, deboned, minced and processed. Different formulations of chicken jalebi batter were prepared by mixing broiler minced meat with fermented non meat ingredients, spices, oil, salt and ice to form a stable emulsion. The batter is then stuffed in a conical shaped plastic packet and pressed in such a manner to give a jalebi shape and then fried in refined sunflower oil at $180\pm5^{R"}C$ for 5-10mins. One part of the chicken jalebis was immersed in tomato sauce, prepared from tomato magi sauce with little modification and other part was kept as such and then different parameters such as % cooking loss, emulsion stability, p^H, proximate composition, organoleptic qualities, bacterial quality, including cost of production were evaluated. The results of the investigation were summarised as follows:

Emulsion stability of chicken jalebi incorporated with different non meat ingredients (Black gram flour, Bengal gram flour, corn flour, rice flour, semolina flour) were found to be highly stable. Percent cooking loss was found to be highest in T_1 sample incorporated with bengal gram flour, black gram flour and corn flour and lowest in T_2 sample with black gram flour, bengal gram flour, rice flour and corn flour. The percentages of moisture, fat, protein, ash were found to decrease with addition of sauce. Percent sauce absorption was found to be highest in T_1 sample. The result with respect to pH of chicken jalebi has shown that T_2 has the lowest pH. The pH decreased with addition of tomato sauce which is acidic in nature.

The bacterial counts (TVC) at 0 hr was found to be nil in all treatments groups, however, after 24hrs of storage at room temperature, significant growth was recorded to extent of 10^1 cfu/g and the highest growth was recorded in T_1 samples with sauce. Sensory evaluation revealed that T_2 sample with sauce added was highly preferred when compared to other products. The cost of production when calculated, it was found that T_1 without sauce was the cheapest (Rs.223.00) followed by T_2 without sauce (Rs. 224.00), T_3 without sauce (Rs. 225.00), T_1 with sauce (Rs. 239.00), T_2 with sauce (Rs. 240.00) and T_3 with sauce (Rs 241.00)/Kg.

The study revealed the fact that chicken jalebi which is an innovative meat snack may be successfully prepared with right proportion of meat and non meat ingredients to fulfil the demand of the meat consumers.

Development of low calorie fat reduced fermented dairy product

Dr. Priyanka Bania

A study was carried out to develop a low calorie fat reduced fermented dairy product. The experiments were conducted in the laboratories of the Department of Livestock Products Technology and the All India Coordinated Research Project on Post-Harvest Engineering and Technology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-781 022.

Strain NCDC 263 obtained from the National Dairy Research Institute, Karnal, Haryana-132 001 was used as starter culture. Low calorie, fat reduced *misti dahi* was prepared by replacing sucrose at 25, 50, 75 and 100% with either natural sweetener – honey or with artificial sweetener - sucralose.

Effect of sugar replacement on pH and lactic acid content, proximate composition, microbiological quality, organoleptic properties and calorific value of *misti dahi* was studied.

Acid production capacity of the starter culture showed decreasing values along with a corresponding increase in pH values of the *dahi* samples in the treatment groups. Results of the study on the proximate composition of *misti dahi* with varied concentrations of sugar, honey or sucralose revealed a gradual decrease in protein and total solids contents while an increase in moisture content was noted. Fat content of the products showed variable results.

Total viable count showed an increase in honey added *misti dahi* while sucralose added products showed a gradual decrease in TVC. Yeasts and mould count was found to be below the minimum countable number of 25 per plate for all the treatment groups including the control. Coliform organisms were not detected in any of the samples.

Sensory evaluation of the low calorie, fat reduced *misti dahi* samples was done for various eating quality attributes like appearance, colour, body and texture, flavour and taste by a semi-trained panel. Results of the study showed that the *misti dahi* containing 25% honey was rated best for flavour, taste and overall acceptability. The samples of the control

group enjoyed superior ratings for appearance and body and texture. Samples of the T_8 group scored the lowest ratings for overall acceptability.

Calorific value of all the treatment groups was found to be lower than that of the control group (97.33±1.33). Among the treatment groups, the least calorific value was calculated in the samples of T_8 group (56.26±2.07) and among the treatment groups the samples of the T_1 group had the highest calorific value (94.80±3.63).

On the basis of low fat content of 2.96±0.22% and superior eating quality characteristics, treatment group T_1 containing 25% honey and 75% sucrose is recommended and a suitable protocol for commercial production of *misti dahi* has been proposed.

Epidemiology of bovine subclinical mastitis and associated important pathogens

Dr. Suruj Protim Kakati

A study was undertaken to study the epidemiology of bovine subclinical mastitis and associated important pathogens in organized and unorganized dairy farms of Kamrup (Metro) and adjoining districts of Assam. A total of 1552 quarters milk samples from 388 dairy cows were examined by California mastitis test. The prevalence of bovine subclinical mastitis was found to be 43.81% and 18.09% animal-wise and quarter-wise respectively. Higher prevalence was recorded in unorganized farms (46.78%) in comparison to organized farms (32.05%). Age wise prevalence was found to be highest in 4-6 years age group (51.95%), followed by 6-8 years (44.12%) and 2-4 years (32.39%) age group respectively. Prevalence of bovine subclinical mastitis was highest in 4th lactation (60.40%) followed by 5th lactation (44.83%). Highest prevalence was found in early stage of lactation (59.82%) followed by mid stage (45.35%) and late stage (21.50%). Left hind quarter (45.71%) and right hind quarters (31.07%) were mostly affected as compared to the other two quarters. Higher prevalence was recorded in conventional barn and in animals reared under poor hygienic condition. Prevalence of bovine subclinical mastitis was highest in winter season (58.93%), followed by summer (43.81%), spring (39.78%) and autumn (26.92%).

Risk factor analysis by chi-square revealed significant association of the factors like age, breed/genetic group, lactation number, stage of lactation, quarter-wise distribution, farm type, management system and season with prevalence of subclinical mastitis in cows. A total of 200 CMT positive quarter milk samples of representative animals of the herds screened were examined and of these175 samples were found culturally positive and 185 strains of bacteria were isolated from these samples. The most predominant isolate was found to be *Staphylococcus* spp. (143) followed by *Streptococcus* spp.(22), *Escherichia coli* (14) and *Enterococcus faecalis (6)*. Among the *Staphylococcus* spp. 117(81.82%) isolates were positive for coagulase and 65(45.45%) for haemolysin production. The staphylococcal and streptococcal species identified were *Staphylococcus aureus,*

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Staphylococcus epidermidis, Staphylococcus auricularis, Staphylococcus capitis sub spp. *capitis, Staphylococcus hominis, Staphylococcus chromogenes, Streptococcus dysgalactiae, Streptococcus uberis, Streptococcus pyogenes.* PCR based detection revealed that a total of 64 (54.0%) isolates of *Staphylococcus aureus* were found to be positive for gene encoding protein A (*spa*) at IgG binding region.

The bacterial isolates were subjected to antimicrobial sensitivity testing to determine the sensitivity pattern of the isolates to 16-18 antimicrobial agents. enrofloxacin, gentamicin and ceftriaxone followed by oxytetracycline, ciprofloxacin and amoxyclav were found to be most effective antimicrobial drugs against the isolates, while penicillin-G was least effective. Moreover among the *Stapylococcus aureus* isolates, 14 isolates (11.96%) could be detected phenotypically as methicillin resistant *Staphylococcus aureus* (MRSA) but only in 3 isolates (2.56%) could be identified genotypically as MRSA.

Molecular characterization of extended spectrum beta lactamase (esbl) producing *klebsiella pneumoniae* in poultry

Dr. Risha Saikia

The study was undertaken to isolate and identify *Klebsiella pneumoniae* from poultry with or without the history of diarrhoea and to determine the occurrence of Extended Spectrum Beta- Lactamase (ESBL) producing *Klebsiella pneumoniae* in Assam, India.

A total of 410 samples were collected randomly from poultry of Assam and were processed for isolation and identification of *Klebsiella pneumoniae* by standard bacteriological techniques which were collected from faecal samples, intestinal contents, lung and liver tissues. All the isolates were subjected to antibiotic susceptibility test and were phenotypically confirmed to be ESBL producers by Double disk synergy test (DDST) method. ESBLs producing isolates were subjected to simplex Polymerase chain reaction (PCR) for detection of ESBLs genes, $bla_{TEM,}$ bla_{CTX-M} and $bla_{SHV.}$

A total of 23 (5.61%) *Klebsiella pneumoniae* strains could be isolated. All the *Klebsiella pneumoniae* isolates showed large, pink, mucoid, convex, lactose positive colonies on MacConkey's Lactose Agar medium. The isolates were further processed in Eosin Methylene Blue Agar where the colonies formed mucoid, pink to purple colonies with no metallic green sheen. Morphologically, all the isolates were Gram negative bacilli when stained with Gram's staining technique. The bacilli showed capsule on Capsule staining when stained with Nigrosin and Methylene blue and observed under 100X light Microscope. All the 23 *Klebsiella pneumoniae* isolates exhibited similar IMViC pattern, negative for Indole and Methyl Red (MR) test and Voges-Proskauer (VP) and Citrate utilization test positive. All the isolates produced sugar fermentation and urease production. None of the isolates produced hydrogen sulphide (H_2S).

Of the 23 isolates, 16 (69.56%) isolates were phenotypically confirmed as ESBL producers based on the double disk synergy test screening method. All the phenotypically positive isolates were subjected to PCR assay for detection of bla_{TEM} (686bp), bla_{SHV}

(733bp) and bla_{CTX-M}(585bp) genes using specific oligonucleotide primers. Genomic DNA was extracted from all the isolates and was found to be positive for at least one of the target gene by PCR assay. By PCR, of the 16 ESBL producing isolates confirmed by DDST method, 14 (60.86%) isolates were found to be positive for at least one of the three resistance genes, bla_{TEM} (686bp), bla_{SHV} (733bp) and bla_{CTX-M} (585bp).

Of the 14 isolates, 6 (26.08%) were found to be positive for bla_{TEM} gene. Similarly, 3 (13.04%) were found to be positive for bla_{CTX-M} gene. 5 (21.73%) were found to be positive for bla_{SHV} gene. These results indicate that bla_{TEM} gene is the most abundant ESBL type in this region. However the importance of bla_{SHV} and bla_{CTX-M} also cannot be ignored.

Isolation and genetic characterization of swinepox virus from Assam

Dr. Puja Mech

Swinepox is an acute, often mild disease of pig characterized by typical pox lesions in the skin. It is caused by swinepox virus (SWPV), a member of the genus *suipoxvirus* of the family *Poxviridae*. India is endemic for poxvirus infection in animals and pox outbreaks in various species of animals have been reported from time to time. Although, sporadic cases of swinepox have been reported from India, a very little information is available on isolation and characterization of the virus. The north eastern region of India being a potential hub for pig husbandry harbours one fourth of the country's pig population. An increasing trend of occurrence of swine pox has been recorded among the swine population of Assam in the recent times. However many of such outbreak goes unreported or unattended. Lack of awareness among the tribal farmers, non availability of rapid diagnostic method and vaccines for controlling the disease are some of the underlying reasons. Therefore, isolation and characterization of swinepox viruses from field outbreaks along with development of a rapid, sensitive diagnostic method for swinepox is the need of the hour to formulate the strategies to be adopted for controlling the disease. The present study was undertaken to isolate the swinepox virus in established cell line, to develop a PCR methodology for rapid and specific detection and to characterize the isolated virus by molecular techniques.

A total of 71 scab samples were collected from pigs clinically affected with swinepox from different places of Assam of which 36 (50.70%) samples were found to be positive for swinepox virus by PCR targeting the *SPV18-20*, *VLTF-3* and *P42* gene. All positive samples showed clear amplification of 555bp, 524bp and 880bp as desired in case of swinepox virus. Samples were collected from only three districts of Assam, *viz*., Kamrup, Lakhimpur and Karbi Anglong, of which Karbi Anglong district showed highest percent positivity (55.55%) followed by Lakhimpur (50.00%) and Kamrup (35.71%). Representative positive samples were processed for isolation of the virus using PK-15 cell line. Virus induced cytopathic changes were observed from the 3rd passage and was initiated by day 4 post infection and progressed to 70-80% by day 6. Growth of the propagated swinepox virus at each passage

level was confirmed by conventional PCR targeting the swinepox virus specific gene *SPV18-20*, *VLTF-3* and *P42* respectively. For rapid diagnosis of swinepox, a PCR methodology was developed targeting the highly conserved *DNA Polymerase* gene of SWPV. It was found that the developed PCR methodology (Real time PCR) was specific for swinepox only and could detect SWPV in more number of samples 45 (63.33%) in comparison to conventional PCR 36 (50.70%), indicating higher sensitivity of the developed real time PCR over conventional PCR.

A total of 5 isolates (two each from Kamrup and Lakhimpur district and one from Karbi Anglong district) could be adapted to grow in the laboratory. Out of this five isolates, three isolates (one isolate from each district) were used for genetic characterization based on *VLTF-3* gene, *DNA polymerase* gene and *P42* gene sequences. Results showed that, all three isolates were very closely related to other SWPVs reported from India as well as other parts of the world with high degree of identity (96-100%).

The present study concluded that swinepox is prevalent among the pig population of Assam. Swinepox virus from the field outbreaks could be successfully isolated in PK-15 cell line and demonstrated efficiently by conventional PCR. The developed real time PCR methodology was specific to SWPV only and can efficiently be used for rapid diagnosis of swinepox infections in pigs. Genetic characterization study revealed that the swinepox viruses isolated from Assam shares 96-100% homology based on nucleotide sequences of *VLTF-3*, *P42* and *DNA polymerase* gene.

Immunogenicity of cell culture adapted duck plague virus

Dr. Nayanmoni Konwar

Duck plague is an acute, fatal viral infection of ducks, geese, swans and other species of the order Anseriformes. DPV causes considerable mortality among domestic and wild ducks, swans, geese and other waterfowl of different ages. The disease is known to have global distribution and due to high mortality, decreased egg production and hatchability, significant economic losses are associated with DPV across the world. Vaccination is the only option to prevent and control the disease during an outbreak. The chick embryo adapted live vaccine which is currently in use has many limitations. Development of cell culture adapted duck plague vaccine using a local strain of viruses is the best option. Adaptation and propagation of Duck plague virus in large quantities in some established cell line will cause a significant vaccine production cost and increase the stability of the vaccines. Since very limited research works are available on adaptation and propagation of Duck Plague Virus both in primary culture and cell lines for vaccine production, the present study was undertaken with a view to adopt in heterologous primary cells and cell lines of avian as well as mammalian origin.

During the study a wild strain of DPV (DP/As-Km/0019) which was adapted in CEF, available in the Department of Microbiology was selected on the basis of its virulence and homology with vaccine strain. The selected wild strain was used for adaptation in various cell culture systems viz. Chicken embryo fibroblast cell culture, Vero cell line, QT-35 cell line and BHK-21 cell line. It was observed that the wild strain of virus was successfully adapted in CEF, Vero cell line and QT-35 cell line but it was best adapted in CEF. In CEF distinct CPE was demonstrated within 48 hours and the presence of viral nucleic acid was confirmed by PCR and Sandwich ELISA in different passage levels. In Vero cell line the virus was adapted but characteristic CPE was not visible till 12th passage. The presence of viral antigen could be demonstrated by PCR at 5th passage level and by S-ELISA from 10th passage level. The adaptation of wild strain of DPV in QT-35 cell line was confirmed by

PCR analysis and S-ELISA. In QT-35 cell line the CPE was not prominent but there was a gradual development of CPE from 8th passage onwards which was characterized by thinning and detachment of cells.

As the wild strain of DPV was best adapted in CEF, the quantitation of virus adapted in CEF at 10th and 12th passages was done by $TCID_{50}$. The 12th passage of virus showing high $TCID_{50}$ was used for immunogenicity trial. In safety trial ducklings were vaccinated with 0.5ml of 10 doses and 100dose of $TCID_{50}$/ml of vaccine virus. All doses of vaccine were found to be safe and were used for immunogenicity trial. For trial one group of birds was vaccinated with $10^{4.37}$ $TCID_{50}$/ml of vaccine and the other group was kept as control. The trial was conducted for 30 days and the immune response of the vaccinated birds was assessed by Indirect ELISA and Virus neutralization test. There was a rise in the antibody titre and neutralizing titre in the vaccinated group along with increase in days.

The present study clearly showed that the CEF adapted local strain of DPV was comparable to the vaccine strain and it has the potential to be used as a vaccine candidate in near future. Adaptation of local strain of DPV in various cell lines indicates requirement for further passage of the virus in these cell lines for production of cell line adapted duck plague vaccine.

Development of rapid diagnostic tests for detection of duck plague virus

Dr. Kevisenuo Evalyn Vizo

Duck viral enteritis or duck plague is a highly lethal, acute and contagious disease of ducks, geese, swans and other species of the order Anseriformes . It is caused by Anatid herpesvirus-1 and exerts a serious impact on the duck industry worldwide due to high mortality and decreased egg production. Monitoring of Duck plague specific antibodies using rapid test and prevention by early diagnosis and vaccination can aid in the control of the disease. Most of the conventional diagnosis techniques commonly used are time consuming and labour intensive . Therefore a novel and rapid diagnosis is the need of the hour for early detection and control of the disease.

The present study was undertaken to develop a rapid diagnostic test for the detection of duck plague virus. In the present study, the CEF adapted duck plague vaccine virus available in the Department of Microbiology was selected for propagation of the virus from 18th to 30th passage. Presence of the virus in CEF monolayer was evident from the presence of cytopathic effect consisting of vacuolation, cell rounding, syncytia formation, thining and cell detachment. The presence of the virus was confirmed by Polymerase chain reaction (PCR) and Sandwich ELISA. All the passages were found positive in PCR and titre increased with gradual passage level.

For purification of the virus, the infected cell culture fluid was concentrated first using either Vivaspin or treating with 8% Polyethylene glycol(PEG). Both the methods proved to be efficient as ELISA titre of 1:256 and viable virus was obtained from both methods. Purification of Duck plague virus was done by single sucrose gradient or by multiple sucrose gradient centrifugation. Viable virus with better protein concentration was observed using single sucrose gradient. Therefore, treating with 8%PEG followed by 30% single sucrose gradient proved to be a reliable and feasible method for purification of large volume of viruses.

Indirect ELISA, Dot ELISA , and Sandwich ELISA method were optimized for the efficient detection of Duck plague virus antigen and antibody using polyclonal antibodies. The polyclonal antibodies were raised both in ducks and rabbits with the purified virus antigen. Lateral flow test was also attempted without much success. Comparative evaluation between Indirect ELISA and Dot ELISA revealed that Dot ELISA was more rapid and could easily carry out without the need of a well established laboratory. But on the other hand Indirect ELISA was found to be more sensitive with quantification of the titre possible. In the present investigation, various tissue samples and cell culture fluids were processed for detection of viral DNA by PCR and viral antigen by Sandwich ELISA. Both Sandwich ELISA and PCR could equally detect the viral antigen in the cell culture fluids. However, out of the 30 tissue samples, including the CAM samples, only 63.33% was found positive by ELISA in comparison to 93.33% by PCR. This study indicates that PCR could detect more number of DPV in tissue samples than that of S-ELISA .

Molecular characterization of foot and mouth disease virus isolates from Assam

Dr. Chayanika Das

Livestock is an important agriculture sector and plays a vital role in the Indian economy for which the biggest impediment is Foot and Mouth Disease (FMD). The disease is endemic in Assam, and to implement an effective control programme, it is essential to understand the complex epidemiology of the disease. The causative agent, FMD virus is antigenically diverse with seven distinct serotype (O, A, C, Asia 1 and SAT-1, 2 and 3). The present study was undertaken for isolation and identification of FMD virus involved in recent outbreaks in Assam during April, 2015 to March, 2017, followed by molecular characterization of the isolated FMD virus and their relationship with Indian vaccine strain as well as previously published sequences.

To find out the FMD endemic pockets, 1700 serum samples collected from different agro-climatic zones of Assam were screened for detection of antibodies against non structural proteins (NSP) to FMD virus using 3AB(3) indirect ELISA. The overall sero-prevalence study on NSP antibody detection revealed that FMD is endemic throughout all the six agro-climatic zones (18.53 %) of Assam. In the present study, filter paper serum sampling method was evaluated to determine the NSP antibody to FMD virus and the results obtained in the present study revealed that eluted samples from blotted serum on filter paper strips perform quite well.

To assess the spatio-temporal distribution of FMD virus serotypes in Assam, a total of 398 samples collected from clinically FMD infected (n=212), in-contact (n=88) and recovered animals (n=98) were subjected to sandwich ELISA and mRT-PCR. During the study period, serotype O and A was identified, with highest prevalence of serotype O (98.11%). The present analysis showed that epithelial tissue samples were the samples of choice from clinically infected animals for typing of the FMD virus by sandwich ELISA whereas saliva and OP fluid were the choice of samples for typing of the virus by mRT-PCR. Investigation of FMD virus in animals' in-contact revealed that the whole blood was found to be the

suitable sample for typing of the virus, whereas OP fluid was the sample of choice for detection of persistently infected cattle by mRT-PCR. During the study period, FMD was reported throughout the year; however, the highest outbreaks of the disease were recorded in winter. In the present experiment, 37 epithelial tissue samples were subjected for virus isolation in BHK-21 cell culture system. Adaptation of FMD virus in BHK-21 cell was observed as initiation of cytopathic effect (CPE) from the 1st passage (11 isolates) and the extent of CPE increased with progressive passages. Among the two types of epithelial tissue samples, the highest rate of isolation of FMD virus in BHK-21 cell line was 96.0 per cent from TE followed by FE (83.33%). On the basis of the present study, TE and FE appeared to be the first and second category samples respectively for isolation of FMD virus.

The molecular characterization of FMD virus isolates from Assam based on P1 gene revealed that the serotype O FMD virus currently circulating in Assam differed from presently used Indian vaccine strain IND R2/1975 by 12.4 to 14.3 per cent at nucleotide level at P1 genomic region. All the isolated circulating FMD virus serotype O showed 97.0 to 100.0 per cent identity with previously submitted FMD virus P1 genomic region from Bangladesh (KY077626.1), whereas, the circulating FMD virus serotype A showed close relationship with previously submitted FMD virus P1 genomic region from India (KJ146961). Thus, it may be inferred that both deletion and non deletion variants of FMD virus are co-circulating in Assam due to which regular vaccine matching of circulating FMD virus isolates and selection of new vaccine strains representing various lineages is critical for the control of FMD in the region.

Molecular and immunological characterization of wild strains of classical swine fever virus

Dr. Barnali Talukder

Classical Swine Fever (CSF) is highly contagious and economically devastating viral disease of domestic pigs and wild boar and pygmy hogs. Wild boars act as reservoir for CSF virus and possible source of infection for domestic pigs. This disease poses as a major burden and risk for growing pig industries of the world. The CSF is currently endemic in India including North Eastern States. There is shifting of historic 1.1 geno-group to 2.1 and 2.2 and even in vaccinated pigs outbreak of CSF were also recorded. In such situation it is necessary to characterize antigenic motive of circulating wild strains of CSFV and compare with existing vaccine strain. The present study was undertaken to characterize cell culture isolated field strains CSFV for their molecular alteration as well as the antigenic responses.

Post mortem tissue samples like tonsil, lymph node, kidney and spleen were collected from the tissue repository, Department of Microbiology. Presence of CSFV antigen was demonstrated by S-ELISA and RT-PCR. Although 77 samples were selected but only 55% (43) were found positive in S- ELISA and 61% (47) in RT-PCR.

In this study twenty five field samples were propagated in PK-15 cell culture upto 5th passage level. Sandwich ELISA and nested RT-PCR were used to confirm the isolation of the field virus strain in cell culture. Out of 25 propagated samples, 84%(21) were found positive in S-ELISA as well as in nRT-PCR. Presence of highest percentage of virus recorded in tonsil, lymph node and kidney. It was observed that sensitivity was more in RT-PCR than S-ELISA. Out of 21 CSFV field isolates, in S-ELISA maximum O.D value was found in AADSMC/AS/Sw/0117, AADSMC/AS/Sw/0038, AADSMC/AS/ WH/0025, CSF/PH/0025/AS, CSF/PH/0121/As at 5th passage whereas, for wild hog and pygmy hog the O.D value were 1.5 and 1.5 respectively. The quantitation (TCID$_{50}$) of passaged viruses was done using IPT.

All propagated field strains were subjected for genogrouping using sequence analysis targeting E2 partial and NS5B gene and it was observed that the E2 and NS5B gene of the

CSFV field strains were phylogenetically closely related to the CSFV sequences reported from China and India at nucleotide level. Further molecular characterization of field isolates of CSFV was done targeting E2 and E^{rns} full length gene as per the method described by Haung *et.al.,*(2006) with slight modification. The amino acid analysis was done to check whether any change in conserved immunogenic epitope during the isolation and propagation in cell line. Multiple alignment of the deduced amino acid sequence of E2 region of all the field strain under study showed some substitution of amino acid at different position.

Based on virus propagation titre, conserved immunogenic epitope (TAVSPTTLR) of field strains (domestic pig, pygmy hog and wild hog) remained intact with the established vaccine strain (viz. ALFORT/187 and IVRI), LP-IVRI CSFV vaccine strain .

Immunological characterization of CSFV field isolates was done by cross neutralization with classical swine fever vaccine virus specific antibody following the method of NPLA. Out of 8 representative field isolates, 5 showed a similar log titre of 1/158, another 2 isolates showing similar log titre of 1/125. Comparison of the neutralization titre of CSF virus isolates in NPLA using pig hyperimmune serum raised against the vaccine virus revealed that the antiserum against vaccine virus reacted equally with the homologous vaccine virus as well as with the field isolates

The study showed that wild strains of CSFV could be isolated from domestic pigs of Assam and different adjoining states of NER as well as from wild hogs and pigmy hogs. The circulating viruses during the period 2008-2017 fall in geno groups1.1, 1.2 and 2.2 and all field isolates bear homologous epitopes with that of currently using vaccine strain.

Isolation and molecular characterization of group a rota virus from bovine calves of Assam

Dr. Priyanka Doley

Rotavirus is one of the most important etiological agent causing mild to severe diarrhoea in most of the farm animal species and human infants below 8 months of age. Rotavirus is a highly infectious and contagious disease causing immunosuppression. Among different groups, group A Rota virus is the major cause of viral diarrhoea in bovine calves. The disease has great economic importance leading to high morbidity and mortality. Rotavirus classified as a genus in the family Reoviridae, are nonenveloped, double- stranded RNA virus. There are frequent reports of the occurrence of the disease from different parts of India including Assam. So the present study was aimed to assess the infection by detecting presence of antigen in the faecal samples through S- ELISA and detection of viral nucleic acid from samples by direct Reverse Transcription- Polymerase Chain Reaction (RT-PCR) and RV positive samples were processed for isolation of the virus in MA 104 cell line. Propagated virus in the cell culture was detected by RT-PCR and RNA-PAGE. A total of 175 diarrhoeic samples from 10 different districts of Assam based on different age groups were collected and screened for presence of antigen against RV using commercial DAS- ELISA kit out of which, 22(12.57%) sample were found positive. In RT-PCR used for amplification of *VP4, VP6, VP7* gene with specific set of primers 37(21.14%) samples were found positive. Samples positive in PCR were stained with DNA loading dye and run under polyacrylamide gel electrophoresis along with DNA ladder. A distinct band was observed at 876,309,304 base pair and in RNA-PAGE 14(8%) samples were found positive for RV. Representative four PCR amplicon from Lakhimpur, Barpeta, Kamrup and Bongaigaon were further sequenced via an out source and a phylogenetic tree was constructed by maximum likelihood method along with other RV isolates reported from various part of the world. Percent identities were analyzed within the isolates reported from our study, and from other parts of the world. RV can be well adapted in MA 104 cell line. A total of 10 samples were inoculated, out of which 4 isolates could be recovered. Propagated virus was confirmed by RNA-PAGE and RT-PCR

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and isolates were exhibit CPE on sixth passage. Results of the present study clearly indicated that antigen based test S-ELISA and nucleic acid based test and RNA-PAGE and RT-PCR could detect high percent of rotavirus positive sample. Present study provides important information about group A rotavirus in bovine calves of Assam. Isolation of virus also added virus isolates in the rotavirus repository in this part.

Prevalence and pathological studies of canine distemper in Guwahati city

Dr. Mridusmrita Buragohain

Present study was investigated for period of one year from March, 2016 to February, 2017, total of 167 clinically suspected cases of canine distemper (CD) were examined and 58 (34.73%) dogs were found positive. Age-wise dogs of 0-6 months old were most susceptible (55.17%).

Highest occurrence of canine distemper in the present study was found in the winter months (48.81%). The unvaccinated animals (37.50%) showed highest CD positivity percent compared to vaccinated and irregularly vaccinated animals. It was observed that the occurrence of CD had no significant effect on either sex.

The haematological alterations observed in CD infected animals were decrease total erythrocyte count (TEC), packed cell volume (PCV), haemoglobin (Hb), platelates count and mean corpuscular volume (MCV). The total leukocyte count (TLC) as well as total neutrophils and lymphocytes count were found within the normal range. In serum biochemical estimation increase level of aspartate aminotransferase (AST) and alkaline phosphates (ALP) were noticed in animals with CD.

Cytoplasmic eosinophilic inclusions were detected in the leukocytes, erythrocytes as well as in the nasal and conjunctival epithelial cells. Highest incidence of inclusions were observed in conjunctival epithelium (48.28%) compared to other cell types.

The prominent clinical signs observed in the affected animals comprising of respiratory distress, purulent oculo-nasal discharge, biphasic fever, gastroenteritis, hyperkeratosis of the digital pads and nervous disorders. Commonly noticed nervous disorders were partial to generalized seizure, chorea, paddling and cycling movement, increase salivation, ataxia, muscle tremor and paralysis.

Post-mortem examination of six dead and sacrificed animals revealed bronchopneumonia, congestion and haemorrhages over the mucosal surface of urinary bladder, stomach, intestine and in the brain. In histopathological examination, intranuclear and intracytoplasmic inclusion bodies were detected in the neuron, glial cells, epithelial cells of bronchioles, urinary bladder, kidney tubules and gastric mucosa. Congested vessels with haemorrhages were also found in brain, lungs, stomach, intestine and lymphoid organs.

Pathology of wild strain of dpv (duck plague virus) and its interference with vaccine strain

Dr. Mamta Pathak

Duck plague or duck viral enteritis is an acute, contagious and fatal viral disease of ducks, geese, swan and other waterfowl. The disease is responsible for significant economic losses in duck population due to heavy mortality and decrease in egg production. Besides clinical and postmortem findings, laboratory diagnosis is utmost necessary for confirmation of the disease in cases of outbreaks. Moreover vaccination plays a crucial role in prevention and control of the disease. The present study was undertaken to study the pathogenesis and pathology of wild strain of DPV (duck plague virus) and role of vaccine virus in interfering the pathogenesis of wild strain of DPV.

In the present study, revival, pathogenesis and pathology of wild strain of DPV (duck plague virus) were studied in 2 months old ducklings. Each duckling of the experimental group were inoculated 1ml of 10^3 $TCID_{50}$ of virulent duck plague virus and were observed for 7 days of post- inoculation (dpi) for appearance of clinical signs. The earliest clinical signs were observed from 3 days of post- inoculation onwards that includes weakness, depression, lethargy, ruffled feathers, anorexia, polydypsia, sitting on breast, restriction in gait and increased lachrymation, periorbital ring formation which appears at two dpi as a constant finding throughout the study, greenish diarrhoea associated with soiled vent was evident from 3 dpi. The gross and histopathological lesions were confined to vascular and degenerative types being prominent in lymphoid organs and liver. Diphtheritic membrane on mucosal surface and presence of infiltrating cells was recorded in oesophagus. Haemorrhage and depletion of lymphocytes were observed in spleen. Liver showed marked enlargement and haemorrhage, fatty change and coagulative necrosis of haepatocytes. Histopathologically prominent changes like haemorrhages, congestion and degeneration of cells were recorded in most of the organs. Presence of viral nucleic acid and antigen in tissues samples were detected by PCR and S-ELISA respectively. The wild strain revived in ducklings was further propagated in 9-11 days old embryonated duck eggs and prominent embryopathy like thickening

and extensive haemorrhages of CAM and haemorrhage over the body of infected embryos particularly over neck area were observed from 2nd passage onwards. Cryopreserved duck embryo fibroblast cell was used as primary cell culture for revival of the virus. Cell culture was carried out upto 5th serial passage. Clear cytopathic effects including vacuolation inside the cells, skeletal appearance, syncytia formation followed by detachment of the cells were observed from 2nd passage onwards. Reviving of wild strain in primary host followed by duck embryo and cryopreserved duck embryo fibroblast (DEF) cell culture made 100% recovery of the virus. The DEF cell culture was found to be more suitable than embryonated duck egg for revival.

On the basis of $TCID_{50}$, challenge titre was calculated. $TCID_{50}$ was found to be $10^{8.7}$. A challenge titre of 10^3 was used to study the role of vaccine virus in interfering the pathogenesis of wild strain of DPV. The study was carried out in four groups comprised of 6 ducklings in each group. by using mean clinical, pathological scores and serological assessment. The highest mean clinical (1.900 ± 0.396) and pathological (9.250 ± 1.160) scores were observed in Group III (challenged) followed by Group II (challenge followed by vaccination) (0.999 ± 0.181) and (3.916 ± 1.434) respectively. Group I (vaccinated followed by challenge) showed the lowest clinical (0.0715 ± 0.05) and pathological (0.194 ± 0.118) scores respectively. Grossly, vascular changes including necrosis, congestion and haemorrhages were present variably in visceral organs including oesophagus, heart, liver, spleen, kidneys, lungs, thymus harderian gland and brain in Group III followed by decreased intensity of severity in Group II and a mild alterations in Group I. Mean serological evaluation recorded a highest antibody titre (155 ± 1.03) in Group III (challenged) and non significant titre (16.66 ± 0.500) in Group I (vaccinated followed by challenge) respectively.

Seroprevalence, molecular detection and pathomorphology of circovirus infection in pigs in Guwahati, Assam

Dr. Karabi Phukan

PCVAD or Porcine Circovirus associated disease is a newly emerging disease caused by Porcine circo virus 2. The present study "Seroprevelance, Molecular Detection and pathomorphology of circovirus infection in pigs in Guwahati, Assam" was conducted from the period of August, 2015 to July, 2017 on both organized and unorganized farms of Kamrup Rural, Kamrup Metro, Lakhimpur and Dhemaji districts of Assam. In the investigation a total of 190 sera samples were collected from the afore said districts to ascertain the presence of PCV2 Ab. The seroprevelance rate of aforesai districts were recorded as Kamrup Rural (60.43%), Kamrup Metro (46.15%), Lakhimpur (27.27%) and Dhemaji (21.73%) respectively, with overall positivity of 48.94%. Molecular detection of PCV2 by PCR in tissue samples has visible positive results in 3 out of 40 suspected cases (7.50%).

The PCR positive cases were further undergone gross and histopathological studies. Gross study revealed, non-collapsible, emphysematous lungs, mild congestion of heart, stomach, intestine and kidneys, patchy spots on liver, and congestion and haemorrhage of mesenteric lymph nodes. The histopathological alterations in the organs lungs, heart, liver, stomach, intestines, kidneys, spleen and lymph nodes of suspected animals with presence of syncytial cells in spleen and lungs reflected the involvement of Porcine Circo virus.

Prevalence and pathology of avian colibacillosis

Dr. Suman Kumar Boro

The present investigation was carried out to establish the prevalence and pathomorphology of avian colibacillosis in and around Guwahati. The prevalence of avian colibacillosis was worked out on the basis of age of the birds, cultural characterstics, biochemical tests and gross and microscopic examination of the affected tissues.

Altogether 268 carcasses of birds were collected and examined from organized and unorganized poultry farms irrespective of age, sex and breed during the period of July2016 to June 2017. The prevalence of colibacillosis was found to be highest in the age groups of >3-6 weeks (42.50%) followed by 0-3 weeks (28.57%) and >6-12 weeks (18.75%). The overall prevalence of colibacillosis was recorded at 17.16%.

The prevalence of colibacillosis was higher in semi urban areas (18.29%) than in urban areas (16.67%)

On necropsy examination, the gross lesions observed were congestion of all visceral organs along with fibrinous pericarditis and fibrinous perihepatitis. In few cases enlargement of liver, kidneys, spleen, lungs and mottling of spleen. Severe congestion and haemorrhage of the mucosal surface of the intestine, congestion and haemorrhages of the trachea with presence of bloody exudate in the tracheal lumen were also evident in few cases. Two chicks of 0-7 days old showed swollen abdomen with presence of unabsorbed yolk materials along with congestion of liver and lungs.

Histopathological lesions were characterized by congestion, haemorrhages, degeneration and necrosis of the visceral organs. The liver showed varying degrees of degeneration with focal areas of necrosis and fatty change of the hepatocytes. In some cases infiltration of heterophils and aggregation of lymphocytes around the blood vessels forming the lymphoid nodules and thickening of the liver capsule were also observed. There was deposition of fibrinous exudate on the epicardium and infiltration of heterophils and eosinophils in the myocardium and in between the myofibres. Kidneys revealed coagulative necrosis, hypercellularity and infiltration of eosinophils in the glomeruli. Lymphocytic depletion was observed in the spleen. The lungs showed congestion and haemorrhages with infiltration

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of heterophils and thickening of alveolar walls. Trachea showed necrosis and sloughing of the mucosal epithelial cells. Necrosis and sloughing of the villus epithelium with infiltration of heterophils were observed in the intestinal villi. A total of 46 cases of colibacillosis were confirmed and 93 numbers of *Escherichia coli* were isolated from different organs as well as heart blood by using MacConkey and EMB agar. All the isolates were confirmed by biochemical tests.

Organwise distribution of isolates of *E.coli* was 93, highest number (19) was isolated from liver samples which constituted 20.43% of the total positive samples

Studies on ticks and haemoparasites of cattle in indo-bhutan border districts of Assam

Dr. Dipanjali Mushahary

Ticks and tick-borne blood parasitic diseases are recognized as a major constraint to livestock production causing clinical and subclinical parasitism and greatly hamper the health of animals worldwide including India. The present study was carried out to record the tick infestation and tick-borne blood parasitic diseases (haemoprotozoal and haemorickettsial) in crossbred and indigenous cattle of four Indo-Bhutan border districts of Assam, viz. Kokrajhar, Chirang, Baksa and Udalguri for one calendar year from April 2016 to March 2017.

A total of 533 cattle were examined of which 266 (49.90%) were found infested either with *Rhipicephalus (Boophilus) microplus* (23.45%) or *Haemaphysalis bispinosa* (15.75%) or with both the ticks (mixed infestation) (10.69%). Crossbred cattle were found having higher prevalence of tick (53.50%) compared to the indigenous (49.34%) which was statistically non-significant. Tick infestation was the highest in adult cattle of > 3 years of age (56.61%) and the lowest in calves of < 1 year of age (41.74%) while in young cattle of 1- 3 years it was 52.89 %. Higher prevalence of tick infestation was recorded in female cattle (53.57%) than the males (44.80%). Also, tick infestation was recorded higher in indigenous cattle which were free ranged (49.34%) than that of the stall fed crossbred cattle (41.55%). According to the distribution of ticks on different body parts of cattle, infestation was observed highest in inguinal region including udder and scrotum (82.70%) followed by neck (71.42%) and lowest seen in back region (22.55%).

Prevalence of haemoparasites determined by microscopic examination of Giemsa stained blood smear followed by confirmation in Polymerase Chain Reaction (PCR) revealed presence of three species, *Theileria orientalis* (62.85%), *Babesia bigemina* (1.87%) and *Anaplasma marginale* (2.62%) with an overall 67.35% haemoparasite prevalence. However, no case of *Babesia bovis*, *Theileria annulata* and *Trypanosoma evansi* was detected

during this study by microscopy and PCR. Haemoparasite infection was higher in crossbreds (77.92 %) than the indigenous animals (65.57 %). Adult cattle > 3 years age were found more susceptible to blood parasitic diseases (80.42%) than young (68.11%) and calves (54.85%). Females had higher prevalence (74.02%) compared to the male animal (58.22%). PCR amplified parasite DNA of *T. orientalis*, *B. bigemina*, *A. marginale* showed clear band at 776 bp, 1124 bp and 160 bp respectively.

Demonstration of *T. orientalis* DNA in the eggs laid by female engorged *R (B). microplus* obtained from *T. orientalis* positive case suggested the tick species as the vector of the parasite and transmitting it transovarially to the subsequent generations.

Screening of 100 sera samples by Indirect ELISA revealed presence of *Trypanosoma evansi* antibodies in 7 samples with O.D value of 0.45.

Phylogenetic analysis of MPSP gene of *Theileria orientalis* isolate revealed 99.00% similarity with the isolate reported from Thailand and Myanmar. *Anaplasma marginale* isolate in the present study bear 93.46% similarity with isolates reported from USA and Mexico while the *Babesia bigemina* isolate has been found to be very distinct molecular type in terms of 18S rRNA gene. The high level of unrelatedness could be due to lack of interaction between the present isolate reported and other isolates.

Quantification of *Babesia bigemina* organisms by Real Time PCR (RT-PCR) revealed presence of 8.01×10^{11} DNA copies μl^{-1} of *B. bigemina*.

Haematological estimation in both crossbred and indigenous cattle infected with haemoparasites revealed anaemia in terms of lowered Hb and PCV values.

This study fairly suggests that *R. (B). microplus* and *H. bispinosa* infestation are highly endemic and the blood parasitic diseases, Oriental theileriosis, babesiosis and anaplasmosis are prevalent in subclinical state in cattle in the study areas.

Ectoparasites of poultry in Kamrup district of Assam: an exploratory investigation

Dr. Sanjana Bora

A study was conducted to record the prevalence of different ectoparasites of poultry in Kamrup (rural and metro) districts of Assam from March, 2016 to February, 2017.

Out of 6514 birds; 1896 fowl (local), 4450(broilers), 108 ducks and 60 pigeons, lice infestation was 58.24% in intensive system and 64.09% in free range system, arachnids both tick and mite together was 48.61% in free range system. The lice, _Menopon gallinae_ (52.32%); _Lipeurus caponis_(45.44%); _Menacanthus stramineus_ (38.88%) and _Goniodes gigas_(3.68%) and no arachnids could be encountered in intensive system. The lice in free range system were _Menopon gallinae_ (47.21%); _Lipeurus caponis_(46.59%)and _Menacanthus stramineus_ (27.09%), mites were _Dermanyssus gallinae_(14.24%); _Cnemidocoptes mutans_ (36.38%); _Sarcoptes_ spp. (6.81%) and some other mites (8.20%) with significant differences amongst seasons and systems of rearing. A hard tick, _Haemaphysalis_ spp. could be found for the first time in India with 3.10% prevalence rate. The ectoparasites of ducks recorded were lice _Columbicola columbae_ (30.56%); _Lipeurus caponis_ (28.70%) and some other mites (30.56%). The ectoparasites encountered in pigeons were _Dermanyssus gallinae_ (20%); _Columbicola columbae_ (50%) and dipteran fly _Pseudolynchia canariensis_ (65%). Myiasis due to _Chrysomyia bezziana_ in broiler chickens of 5-7 weeks old had a prevalence rate of 1.34% in pre-monsoon and monsoon and not in the winter season, this being the first report in North East India.

Skin of fowl naturally infested with Dermanyssus gallinae revealed destruction of the superficial layer of epidermis, mild spongiosis in dermal layer characterized by vacuolation alongwith infiltration of eosinophils and heterophils histopathologically. Heavy infiltration of mononuclear cells in the dermis and areas with haemorrhages alongwith congestion were observed. Perakeratosis of stratum corneum in certain areas of the epidermis without affecting the deeper layers of the skin were noticed.

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Department : Veterinary Parasitology
Major Advisor : Dr. Manoranjan Das

Histopathologically, birds infested with Cnemidocoptes mutans, showed sloughing of the stratum corneum and cross sections of the mite in the affected areas of the epidermis, abnormal thickening of stratum granulosum indicating hyperkeratosis. Infiltration of eosinophil, heterophils and mononuclear cells and focal areas of necrosis were observed in the dermis.

Skin sections of fowl infested with Cnemidocoptes mutans showed no reaction in epidermis with Succinic dehydrogenase (SDH),intense reaction in dermis with Succinic dehydrogenase (SDH),Alkaline phosphatase (AKPase) and Acid phosphatase (ACPase) and moderate reaction with AKPase and ACPase in the dermis. Chrysomyia bezziana completes its life cycle in 13 to 18 days in room temperature (28-32°C).

The molecular characterization of Chrysomyia bezziana revealed 99% similarity with established database sequences of NCBI in BLAST analysis.

Filarial parasites in livestock with special reference to *onchocerca armillata*

Dr. Nidarsana Rabha

A study was conducted to record the prevalence of filarial nematodes in cattle, buffalo and goat in Kamrup district of Assam (Metro and Rural) in local abattoirs in and around Guwahati from January 2016 to January 2017. A total of 792 animals comprising cattle (n=430), buffalo (n=262) and goat (n=100) was examined for this study. In cattle 3 species of adult filarial parasite (*Setaria labiato-papillosa*, *S. digitata* and *O. armillata*) and in buffaloes 2 species (*S. labiato-papillosa*, *S. digitata*) of adult filarial parasite could be recorded. Light microscopic morphological studies of these parasites were conducted. Based on the presence of lesion, *Stephanofilaria assamensis* could be encountered in 16.00% cattle. *Setaria* species infection was 62.50% in buffaloes. Prevalence of *Onchocerca armillata* in cattle was 68.40%, more in female Jersey cross bred animals (83.09%). Skin nip examination of cattle revealed presence of *O. armillata* microfilariae in 28.57% cases of *O. armillata* infection-positive cases. The molecular identification of ITS1-5.8S rDNA gene of *Onchocerca* isolate of the present study revealed 95% similarity with *O. fasciata* which complemented the light microscopic identity of the parasite. The molecular identification of 16S rDNA gene of *Wolbachia* revealed 99% similarity with *O. volvulus*, *O. ochengi*, *O. cervicalis* and *O. gutturosa*. Studies on the pathology of *O. armillata* infected aortae could reveal three major lesion types viz., parasitic migratory tracts in the intimal layer, nodular lesions in both intimal and adventitial layer and umbilical cord-like lesions in the intimal layer. These three lesion types appeared in the aortae either as a single or in combinations. Generally there was mild infiltration of inflammatory cells particularly mononuclear cells admixed with polymorphs and a few giant cells with thickening and edema of intimal layer. Migratory tracts showed empty spaces lined by fibrous connective tissue and proliferation of collagen fibers. Nodular lesions consisted of necrotic parasites and microfilariae inside them and inflammatory cell infiltration predominated by eosinophils. Umbilical cord like lesions exhibited edematous and massive fibrotic areas with calcification.

Abstract of M. V. Sc. Thesis
Department : Veterinary Parasitology
Major Advisor : Dr. Saidul Islam

In the present attempt, developmental stages of larvae and pupae of *Simulium metatarsale* and *S. bhutanensis* were encountered at 12 different breeding sites, with predominance of the former species. Presence of *Wolbachia* in *Simulium metatarsale* could be detected through a molecular identification of *Wolbachia* specific 16S rDNA gene. The results revealed 99% similarity with *Wolbachia* of other species obtained from different geographical regions. The *Wolbachia* obtained from   *S. metatarsale* had 100% similarity with *Wolbachia* of *O. armillata* of the present isolate.

Investigation on parasites of duck in upper Assam with special reference to haemoprotozoa

Dr. Nanswita Borah

A survey was conducted in seven districts of upper Assam for a period of one year from June, 2016 to May, 2017 to study the prevalence of parasites of domestic ducks in upper Assam. Out of a total of 675 numbers of ducks examined, 467 ducks were found positive for different ectoparasites showing the overall prevalence of 69.19 per cent. Ducks from Gaurisagar of Sibsagar district had highest 92.86 per cent and Lahowal of Dibrugarh district had lowest 58.82 per cent prevalence for ectoparasites.

Five different lice and two different types mites were recovered from different body parts of duck, of which infestation with *Lipeurus caponis* (13.33%) was highest followed by *Menopon gallinae* (12.74%)*, Menacanthus stramineus* (10.67%)*, Columbicola columbae* (8.44%), different feather mites viz. *Dubininia melopsittaci*, *Megninia ginglymura* and *Bdellorhynchus* sp. (5.19%), *Goniodes* sp. (3.70%) and larva of Trombiculid mite (0.89%), respectively. The three feather mites, larva of the Trombiculid mite and *Columbicola columbae* were first time reported from Assam in duck.

Examination of 724 faecal samples collected from different localities of upper Assam revealed 333 samples to be positive for helminthes with overall prevalence of 45.99 per cent. Out of the positive samples, 314 samples were positive for single and 19 for mixed infection with incidence of 94.29 per cent and 5.71 per cent. Samples from Gaurisagar of Sibsagar district had highest 68.96 per cent of helminthic infection. Helminthic infections of ducks were not recorded from samples collected from Baghchung of Jorhat district and Joysagar of Sigsagar district.

Faecal samples collected from ducks reared under free range system had highest prevalence of 57.84 per cent for helminthes followed by semi intensive system of rearing (35.34%) and no helminthic infections were recorded from faecal samples of ducks reared under intensive system.

Season wise prevalence of helminths in ducks on the basis of faecal examination revealed highest during pre monsoon (73.56%) and lowest during winter (20.92%).

Out of 724 faecal samples examined, 20 samples were positive for Coccidia (*Isospora* sp.) with the overall prevalence of 2.76 per cent.

Post mortem examination of 774 carcasses of ducks from different localities of different districts in upper Assam revealed 518 carcasses to be positive for helminthic infections. The overall prevalence of helminthes was recorded as 66.93 per cent. 232 carcasses were found positive for cestodes (44.79%), 241 for trematodes (46.52%) and 45 for nematodes (8.69%). Carcasses from Demow of Sibsagar district had highest prevalence of 86.05 per cent and lowest from Kakopathar of Tinsukia district with 50.00 per cent prevalence for helminthes.

Post mortem examination of ducks reared under free range system revealed highest 78.21 per cent for helminthes followed by semi intensive system of rearing (70.33%). Helminthic infection was not recorded from ducks reared under intensive system.

Seasonal prevalence of helminthes on the basis of post mortem examination revealed highest during monsoon (72.28%) and lowest during winter season (51.43%).

On the basis of morphological studies, 7 different species of cestodes and 1 larval stage of cestode, 8 different species of trematodes and 5 different species of nematodes were identified and recorded. Highest incidence of cestodes was recorded with *Hymenolepis collaris* (35.78%) followed by *Hymenolepis carioca* (35.34%), *Fimbriaria fasciolaris* (22.41%), *Hymenolepis lanceolata* (1.74%), *Raillietina tetragona* (1.29%), *Raillietina echinobothridia* (1.29%) and *Raillietina cesticillus* (1.29%) and lowest with plerocercoid (0.86%). Highest incidence of trematodes was recorded with *Echinostoma revolutum* (24.07%), *Hypoderaeum* sp. (18.67%), *Psilorchis* sp. (18.67%), *Echinostoma paraulum* (16.60%), *Paryphostomum* sp. (10.79%), *Prosthogonimus* sp. (8.30%), *Tracheophilus cymbius* (2.07%) and *Psilochasmus* sp. (0.83%). Highest incidence of nematodes was recorded with *Tetrameres sp.* (57.78%), *Heterakis gallinarum* (17.78%), *Heterakis dispar* (17.78%), *Strongyloides avium* (4.44%) and *Porrocaecum* sp. (2.22%). *Hymenolepis carioca, Hymenolepis lanceolata, Raillietina tetragona*, *Hypoderaeum* sp., *Echinostoma paraulum, Prosthogonimus* sp., *Psilochasmus* sp. and *Heterakis dispar* were first time reported from Assam in duck.

Seasonal prevalence of helminthes according to breeds of duck revealed highest prevalence of helminthes in monsoon season (82.54%) and lowest in winter (26.67%) from Patihanh, highest in pre monsoon (85.26%) and lowest in monsoon (54.29%) from Khaki Campbell, highest in pre monsoon season (85.37%) and lowest in winter (56.52%) from Chara ducks and prevalence of helminthes in Muscovy ducks during monsoon season was 80 per cent.

Overall prevalence of helminthes was recorded highest in adults (76.73%) and lowest in young ducks (54.41%). Seasonal prevalence of helminthes according to age of ducks revealed highest prevalence of helminthic infection during pre monsoon (67.83%) and lowest during winter season (34.88%) in youngs and highest prevalence during post monsoon season (85.29%) and lowest during winter season (61.29%) in adults.

Overall prevalence was recorded highest in female (67.44%) and lowest in male (66.41%). Seasonal prevalence of helminthes according to sex revealed that males had

highest helminthic infection during monsoon (80.41%) and lowest during winter season (43.14%). Similarly, females had highest during pre monsoon season (73.88%) and lowest during winter season (57.41%).

Prevalence of haemoprotozoa in ducks revealed that, out of 300 thin blood smears prepared, only 4 showed the presence of *Haemoproteus* sp. infection in RBC. The overall prevalence of infection was 1.33 per cent.

Haematological changes observed due to helminthes and haemoprotozoan parasites of duck revealed decrease in Haemoglobin (9.38±0.13), PCV (27.98±0.36) and TEC (1.69±0.08) with increase in TLC (43.18±1.76) in infected ducks.

On post mortem examination, various pathological lesions were found associated with *Hymenolepis* sp. and *Echinostoma* sp. in intestines and *Tetrameres* sp. in proventricles of ducks. Intestines of duck showed catarrhal enteritis and congestion in the mucosal surface of the small intestine for *Hymenolepis* sp. and haemorrhages and catarrhal enteritis for *Echinostoma* sp. Microscopic examination revealed marked thickening of intestinal villi with infiltration of inflammatory cells. Some villi showed haemorrhagic patches, degeneration and necrosis. Desquamated epithelial lining of intestinal villi were found to be deposited in the lumen of the intestine. Cross section of Hymenolepid parasite was found attached to the superficial epithelium surrounded by infiltrating cells. Gross examination of infected proventiculus revealed small blackish elevated spots visible from the luminal surface. Microscopic examination revealed cut sections of female parasite inside the proventricular gland. Glandular epithelium surrounding the parasite exhibited pressure atrophy and the lumen of the gland was found dilated. Tunica muscularis around the glands was found thickened and inter glandular spaces was found enlarged and thickened with proliferation of fibrous connective tissue and was found infiltrated with monocytes and polymorphs.

The genera *Echinostoma* sp. (Identified as *Echinostoma revolutum* on the basis of morphological characteristics) and *Hypoderaeum* sp. were identified as *Echinostoma friedi* and *Hypoderaeum conoideum* on the basis of ITS2 sequence identity. The present isolate of *Echinostoma* sp. showed 100 % identity with *Echinostoma friedi* the isolate of *Hypoderaeum* sp. showed 99% identity with *Hypoderaeum conoideum*

The Molecular characterization of either *Echinostoma friedi* or *Hypoderaeum conoideum* could not be accomplished due to unavailability of more than one ITS2 sequence of these species in NCBI database. Probably it might be the first report of *Echinostoma friedi* in India. The ITS2 sequence based species identification of *Psilorchis* sp. could not be accomplished due to absence of *Psilorchis* ITS2 sequence in NCBI database. This might probably be the first report of ITS2 sequencing of *Psilorchis* sp. either in India and abroad.

Epidemiology of bladder worm diseases of pigs in arunachal pradesh with special reference to *taenia solium* taeniasis in man

Dr. Badal Biswakarma

A systematic investigation on bladder worm diseases in pig in three district of Arunachal Pradesh (West Kameng, East kameng and Papum-Pare) and adjoining border areas in Sonitpur and Lakhimpur district of Assam revealed 1.83 percent *for Cysticercus cellulosae,* 10.40 percent *Cysticercus tenuicollis* and 0.15 percent of hydatid cyst in pig on examination of 654 pig carcasses. In the entire study *C. cellulosae* infection was recorded highest in the age group of more than 18 months (2.70%), cross bred pigs showed higher infection than indigenous pig. Sex wise prevalence was non- significant. Season record of highest prevalence was recorded in winter (2.70%) specially in the month of November (4.65%). Another common bladder worm *C. tenuicollis* in pig was recorded highest infection among cross-breeds. Sex wise prevalence was non-significant and highest seasonal prevalence was observed in winter (12.22%) particularly in the month of January (14.67%). Scanty prevalence of hydatid cysts was observed (0.15%). Human *Taenia solium* taeniasis was recorded 2.98 percent with two positive cases out of 67 nos. of stool samples examined.

The cross sectional surveys were conducted to determine the pig husbandry practice and associated risk factors of *Taenia solium* cysticercosis in pigs in fourteen (14) revenue circles in three (3) districts of Arunachal Pradesh (West Kameng, East kameng and Papum-Pare) revealed that majority of the pig farmers (64.62%) were male members and belonged to middle age category (39 to 52 years of age). About 95% of them were married and had medium sized families having 6 to 10 members. The pigs were kept mostly by tethering and scavenging system, sometimes were housed in specially constructed shed called Chang Ghar (Nyishi-nam), made of raised wooden platforms. Most of the farmers reported worm infestation in pigs a serious problem in the peak monsoon season. Most of the respondents consumed pork (95.23 %) in a weekly (24.82%) or fortnightly (53.54 %) basis. The primary water source was Govt. supplied untreated surface water.

Abstract of M. V. Sc. Thesis
Department : Veterinary Parasitology
Major Advisor : Dr. Dilip Kr. Deka

A total of 38.43 percent respondents had permanent sanitary latrine but 8.16 percent farmers' had permanent sanitary latrine which drained into open fields & streams. The farmers (56.12 %) had access to Govt. water supply system (surface water) and majority of farmers (100%) used kitchen waste as main source of feed for their pigs and 48.3 percent uses rice beer waste as concentrate feed.

The SDS- PAGE study of cystic fluids of bladder worms revealed 225 and 100 kDa protein bands which are highly immunogenic. There was slight variation in the bands among the samples from various regions due to environmental and altitude variation. The molecular and phylogenetic study of *C. cellulosae* revealed that the present isolates have similarity with those the South East Asian countries and also Madagascar.

Exceptional finding of human taeniasis due to *T. solium* was also recorded. The IgE and Eosinophil count before and after treatment differ markedly in the patient. Single dose of treatment with Praziquantel 900 mg was 100 % efficacious in expelling the adult *T. solium* tape worm.

Tissue reaction of *C. Cellulosae* in skeletal muscles showed variation in the degree of inflammatory response around larval cyst with fibrous connective tissue and proliferation of the inner membrane of the cysts. Marked necrosis and atrophy of the surrounding muscles were microscopically evident. *C. tenuicollis* infected liver of pig revealed marked proliferation of fibrous connective tissue in intra-lobular septa dividing into pseudo lobules containing clusters of hepatocytes without a central vein.

Effect of dietary supplementation of turmeric (*curcuma longa*) powder on the performance of commercial broiler chicken

Dr. Dimpi Choudhury

The present study was undertaken to investigate the effect of dietary supplementation of turmeric (*Curcuma longa*) powder on the performance of commercial broiler chicken. A total of one hundred and forty four (144) day-old commercial broiler chicks (Cobb 400) from a single hatch were procured. The broiler chicks were randomly divided into four groups viz. T_0, T_1, T_2 and T_3 consisting of 36 number of birds in each group. Each group was further sub divided into 3 replicates consisting of 12 birds in each sub group. The chicks were wing banded and reared under deep litter system of management throughout the experimental period following standard and uniform managemantal practices. The birds under T_0 group (control) were offered basal diet without addition of turmeric powder. The birds under T_1, T_2 and T_3 groups were fed turmeric powder at the rate of 0.25, 0.50 and 0.75% in the feed (on dry matter basis), respectively. For preparation of turmeric powder, raw turmeric rhizomes were procured and washed. Then these were boiled in water for 30 minutes and sun dried for 15 days after slicing into thin long pieces. The dried turmeric was ground to powdered form and stored at room temperature and used in the broiler starter and finisher feed for a period of 6 weeks. All the birds under the control and treatment groups were offered *ad libitum* feed and water throughout the experimental period. The birds of all the four groups were reared separately and maintained under uniform managemental condition.

The following parameters were studied during the experimental period of 6 weeks: performance traits which included weekly feed intake and feed consumption, weekly body weight and body weight gain, Feed Conversion Ratio (FCR), Broiler Performance Efficiency Index (BPEI) and livability, economics of production, carcass traits like dressed weight, dressing percentage, giblet yield and relative organ weights including lymphoid organs,

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haematological parameters like haemoglobin, Packed Cell Volume (PCV), total RBC count, total WBC count and WBC differential count (Neutrophil, Eosinophil, Monocyte and Lymphocyte) and blood biochemical parameters like total serum cholesterol, triglycerides, HDL, LDL, serum glucose, ALT and Glutathione peroxidase.

The total feed consumption per broiler for different experimental groups was highest in T_3 group (3659.02g) and lowest in T_1 group (3561.11g). The final body weight per broiler was highest in T_3 group (2134.56 ± 25.82g) followed by T_2 group (2049.36 ± 31.07g), T_1 (1963.97 ± 39.36g) and T_0 (1900.28 ± 31.27 g). The overall FCR of the entire period of the experimental groups was best in T_3 group (1.71) followed by T_2 (1.75), T_1 (1.81) and T_0 (1.88) group.

Among the different experimental groups, T_3 showed the highest BPEI (124.82) followed by T_2 (117.09), T_1 (108.50) and T_0 (101.08). The per cent livability of all the experimental groups was cent per cent (100).

The cost of production per broiler including the additional cost of turmeric powder was highest in T_3 ('.177.50) followed by T_2 ('.174.50), T_0 ('.172.14) and T_1 ('.172.09) group. However, gross profit per broiler was found to be highest in T_3 group ('.35.96) followed by T_2 ('.30.44), T_1 ('.24.30) and T_0 ('.17.86) group.

All the carcass traits like dressed weight, dressing percentage and giblet weight except giblet yield showed non-significant (P>0.05) differences among the experimental groups. The per cent giblet yield was significantly (Pd"0.05) higher in T_0 group (4.96 ± 0.19) than T_2 (4.34 ± 0.21) and T_3 (4.25 ± 0.08) group. The per cent yield of cut-up parts such as neck, wings, back, breast, thighs and drumsticks did not differ significantly (P>0.05) among the different treatment groups.

The per cent relative organ weights on dressed weight basis did not differ significantly (P>0.05) among the different treatment groups of broiler chicken except the per cent weights of liver. The per cent weight of liver of the turmeric treated groups (T_1, T_2 and T_3) were 2.21 ± 0.04, 2.03 ± 0.08 and 1.98 ± 0.08, respectively which showed significantly (Pd"0.05) lower values than the control group (2.46 ± 0.09). All the lymphoid organs like spleen, thymus and Bursa of Fabricius showed non-significant (P>0.05) differences among the different experimental groups.

The haematological parameter like haemoglobin, PCV, total WBC count, WBC differential count did not differ significantly (P>0.05) except total RBC count which was recorded as 2.46 ± 0.02, 2.55 ± 0.03, 2.52 ± 0.04 and 2.59 ± 0.03 million/mm³ for T_0, T_1, T_2 and T_3 groups, respectively and it was found that total RBC count in the turmeric treated at the level of 0.75% showed significantly (Pd"0.05) higher value as compared to the control group. Moreover, the total lymphocyte count was significantly (Pd"0.05) higher in T_3 (93.86 ± 0.75 thousand/mm³), T_2 (93.84 ± 1.97 thousand/mm³) and T_1 (91.58 ± 3.38 thousand/mm³) group as compared to T_0 (82.98 ± 3.67 thousand/mm³) group.

The biochemical parameters (total serum cholesterol, HDL, LDL and ALT) except serum glucose, triglycerides and glutathione peroxidase differed significantly (Pd"0.05) among the experimental groups in the current study. The total serum cholesterol was found to be

significantly (Pd"0.01) lower in T_3 (140.97 ± 3.06 mg/dl) and T_2 (148.24 ± 3.62 mg/dl) group as compared to control group T_0 (158.87 ± 2.31 mg/dl). Significantly (Pd"0.01) higher HDL values were recorded in T_3 (119.22 ± 8.17 mg/dl) and T_2 (105.68 ± 8.06 mg/dl) group as compared to T_0 (82.13 ± 5.13 mg/dl) group. The LDL levels among different groups differed significantly (Pd"0.05) and all the turmeric treated groups (T_3, T_2 and T_1) showed significantly (Pd"0.05) lower values in comparison to control group (T_0). The LDL level was significantly (Pd"0.05) lowest in T_3 (20.89 ± 8.44 mg/dl) group and highest in control group (54.39 ± 5.21 mg/dl). The ALT level was significantly (Pd"0.01) lowest in T_3 (19.51 ± 0.60 U/ml) and highest in control group (29.00 ± 1.94 U/ml).

The various organoleptic parameters of broiler meat like colour, flavor, texture, juiciness and overall acceptability did not differ significantly (P>0.05) among the different experimental groups.

Thus, it is concluded that the turmeric powder can be used effectively and economically as natural feed additive at the rate of 0.75% in commercial broiler chicken feed to improve the overall performance of the birds.

Effect of feeding ginger (*zingiber officinale*) root powder on growth performance, carcass characteristics and blood biochemical parameters in broiler chickens

Dr. Pranjal Das

A total of one hundred eighty day old commercial broiler chicks (Cobb-400 Y) having similar body weight from a single hatch were procured to study the effect of feeding ginger (*Zingiber officinale*) root powder on some economic parameters in broiler chickens. The chicks were randomly divided into four groups *viz*.T_0, T_1, T_2 and T_3 containing 45 chicks in each group. Each group was further subdivided into 3 replicates of 15 chicks in each group. The birds under T_0 group were offered basal diet without addition of ginger powder, while the birds under T_1, T_2 and T_3 groups were given ginger powder with feed at the rate of 1.5, 2.0 and 2.5 % level respectively and used in the feeds of broiler chickens for a period of six (6) weeks. All the birds of four groups were offered *ad libitum* feed and water and maintained under uniform managemental condition.

The total feed consumption per broiler for different experimental groups was the highest in T_0 group (4011.11g) and was the lowest in T_3 group (3924.44g).The final body weight per broiler was the highest in T_2 group (2268.22 $\pm$ 3.02g) and was the lowest in T_0 (1890.22 $\pm$ 4.32g) group. The overall feed conversion ratio for the entire period was the best in T_2 group (1.59), followed by T_1 (1.64), T_3 (1.68) and T_0 (1.84) groups.

The broiler performance efficiency index was the highest in T_2 (142.65) group and was the lowest in T_0 (165.86). The livability per cent was 100% for the T_1 and T_2 groups, followed by T_3 (97.77%) and T_0 (95.55%).

The cost of production per broiler including the additional cost of ginger powder and gross profit were the highest in T_2 (Rs. 182.19 and Rs.32.50) and were the lowest in T_0 (Rs. 165.86 and Rs. 13.68) group.

All carcass traits (dressed weight, giblet weight and giblet yield) except dressing percentage differed significantly among different experimental groups. The dress weight (1636.40 $\pm$ 21.44 g), giblet weight (120.20 $\pm$ 1.35 g) and giblet yield (5.35 $\pm$ 0.02%) found to

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Department : Poultry Science
Major Advisor : Dr. J. K. Talukdar

be higher in T_2 group of birds. The control group of birds (T_0) had the lower values for all these carcass traits. The per cent yield of cut-up parts like wing, back, breast and drumstick except neck and thigh differ significantly among different treatment groups. The per cent weight of wings (12.75 $\pm$ 0.31), back (19.71 $\pm$ 0.49), breast (25.05 $\pm$ 0.45) and drumstick (14.92 $\pm$ 0.52) found to be higher in T_2 group of birds. The per cent weights of relative organs of broiler on dressed weight basis did not differ significantly among different treatment groups, except the per cent weight of abdominal fat. The per cent weight of abdominal fat was significantly decreased in T_3 group (0.51 $\pm$0.06) followed by T_2, T_1 and T_0 groups. Among the biochemical parameters serum glucose, total serum cholesterol, triglyceride, and LDL had significantly lower values in T_3 group, followed by T_2, T_1 and T_0 groups. The HDL values increases significantly in T_3 group, followed by T_2, T_1 and T_0 groups.

All the haematological parameters except haemoglobin and PCV recorded in the present study did not differ significantly among different treatment groups. The haemoglobin values significantly higher in T_3 and T_2 groups (11.75 $\pm$0.07 and 11.51 $\pm$ 0.20) as compared to T_1 and T_0 (10.23 $\pm$ 0.10 and 9.82 $\pm$ 0.01) groups. The PCV values increases significantly in T_3 group (28.46 $\pm$ 0.04) followed by T_2 (26.65 $\pm$ 0.06), T_1 (25.06 $\pm$ 0.29) and T_0 (22.32 $\pm$ 0.12) groups.

The result of present study indicated that the ginger powder can be used economically as a natural feed additive in broiler chicken diet at the level of 2.0% to improve the overall performance of commercial broiler chickens.

Green synthesis & characterisation of silver nanoparticles and assessment of its antioxidant & antimicrobial activity

Dr. Naba Jyoti Deka

The present study was undertaken to green synthesis of silver nanoparticles using leaves of Neem (*Azadirachta indica*) and Tulsi (*Ocimum tenuiflorum*) and to evaluate their antimicrobial & *in-vitro* antioxidant activities. The plants Neem (*Azadirachta indica*) and Black Tulsi (*Ocimum tenuiflorum*) were procured from different nearby places of Guwahati, Kamrup (metro) district, Assam. The dried leaves were pulverized and methanolic and aqueous extracts were prepared. The preliminary qualitative phytochemical analysis of Neem (*Azadirachta indica*) and Tulsi (*Ocimum tenuiflorum*) leaves showed the presence of steroid, phenol, tannin, saponin, flavonoid, alkaloid and triterpenes. The mean ± SE of total phenol of Neem and Tulsi were 0.019 ± 0.001 and 0.022 ± 0.002 (mg/ml) respectively with no significant difference (P>0.05) between the two plants. The tannin content of Neem and Tulsi were 0.61 ± 0.010 and 0.580 ± 0.000 (mg/ml), flavonoid content were 0.34 ± 0.010 and 0.240 ± 0.010 (%) alkaloid content were 2.67 ± 0.010 and 2.030 ± 0.020 (%) and saponin content were 0.52 ± 0.01 and 0.410 ± 0.01 (%) respectively. Neem showed a significantly (P<0.05) higher concentration of flavonoid, alkaloid and saponin. Though tannin content was higher in Neem than Tulsi but it was found non-significant (P>0.05). The formation of silver nanoparticles were confirmed by the colour change followed by UV-Vis spectrophotometer analysis. The zeta potential measurement of the nanoparticles using Neem and Tulsi leaf extract were found to be -48.9 mV and -18.4 mV respectively. The synthesized nanoparticle were found to be almost spherical in shape in SEM images in both cases. The synthesized nanoparticles showed sensitive response against both gram positive (*Staphylococcus aureus*) and gram negative bacteria (*Escherichia coli*) which indicates that it has antimicrobial activity. The antioxidant activity of the methanolic extract, aqueous extract and silver nanoparticles from both Neem and Tulsi were evaluated by using four different standard methods. In DPPH antioxidant assay, the aggregate percent inhibition of

Abstract of M. V. Sc. Thesis
Department : Veterinary Biochemistry
Major Advisor : Dr. Rita Nath

aqueous, methanolic and silver nanoparticle of Neem leaf extract was 80.57±0.74, 63.55±0.34 and 85.16±1.44 while that of Tulsi was 68.28±0.59, 67.42±0.26 and 77.12±0.58 respectively. In nitric oxide radical assay ,The percent inhibition of nitric oxide of AgNPs of Neem extract at 50, 80 and 110 ug/ml were 73.29±0.22, 74.32±0.13 and 75.46±0.22 and of Tulsi were 12.61±0.15, 14.67±0.07 and 16.37±0.05 respectively . The aggregate value of super oxide radical scavenging activity of methanolic extract of Neem and Tulsi at different concentration were from 58.04±1.74 and 54.60±1.15 respectively and that of aqueous extract were 72.08±2.04 and 68.98±1.29 respectively .Again, in reductive ability evaluation, both aqueous and methanolic extracts of Neem and Tulsi showed higher reducing power than the standard Butylated hydroxytoluenme .Though silver nanoparticles of both the plants showed reducing power but it was found to be weaker than the standard . It may be concluded that AgNPs derived from *Azadirachta indica* (Neem) is richer in phytochemicals, antioxidant property and antibacterial activity than AgNPs derived from *Ocimum tenuiflorum* and can be further exploited for their medicinal and industrial properties.

Metabolic profile in dairy cows and its management

Dr. Rukasen Terang

The present study was conducted in Instructional Livestock Farm (Cattle), College of Veterinary Science, Assam Agricultural University, Khanapara to study the (1) status of different metabolites in dairy cows and (2) to evolve a suitable therapeutic regime for animals showing low/high level of metabolites.

A total of 36 dairy cows were selected randomly irrespective of breed and age and divided into 3 group viz. Group I consisting Dry cows, Group II- Moderate yielding cows and Group III- High yielding cows in which each Group comprises of 12 animals. These groups were further divided into six sub-groups namely I (A), I (B), II (A), II (B), III (A) and III (B), respectively and each consisting 6 animals.

Blood and serum samples from the 36 animals were collected on day 0th, day 30th, day 45th and day 60th of study period (day 0th & day 30th: Pre-treatment and day 45th & day 60th: Post-treatment). Haemato-biochemical estimation and analysis of samples were done thereafter.

During pre-treatment serum Ca, P, Mg, Cu, Fe, K, Na, Glucose, Total Serum Protein, Albumin, Total lipid, Total Cholesterol and BUN levels were ranging from 6.96±0.15 to 7.41±0.14 mg/dl, 4.69±0.24 to 5.54±0.15 mg/dl, 2.17±0.09 to 2.42±0.04 mg/dl, 67.86±1.23 to 76.62±1.98 µg/dl, 114.36±0.35 to 143.33±1.67 µg/dl, 4.08±0.05 to 5.17±0.06 mEq/L, 115.08±0.56 to 130.20±0.75 mEq/L, 51.97±0.63 to 64.10±0.76 mg/dl, 6.97±0.05 to 7.38±0.01 g/dl, 3.16±0.03 to 3.30 ± 0.05 g/dl, 295.83±8.88 to 332.41±4.01 mg/dl, 99.10±0.68 to 111.82±0.50 mg/dl and 22.31±0.19 to 26.73±0.20 mg/dl, respectively.

The therapeutic study was conducted according to the experimental schedule. Group É (A), ÉÉ (A) and ÉÉÉ (A) was provided with specific mineral supplement (Calphos D3) and Group É (B), ÉÉ (B) and ÉÉÉ (B) was provided with commercial mineral supplement (Agrimin Forte).

During post-treatment period, all the parameters of pre-treatment period of haemato-biochemical profile reached their normal level by day 60th of observation.

During this study it was observed that both specific and commercial mineral supplement was found to be effective in improving the metabolic profile of the dairy cows.

On the basis of cost and ease of administration Agrimin Forte was found to be more suitable than Calphos D_3 in improving the metabolic status of treated cows.

Abstract of M. V. Sc. Thesis
Department : Veterinary Clinical Medicine, Ethics And Jurisprudence
Major Advisor : Dr. D. N. Kalita

Haemato-biochemical alterations in canine renal dysfunction and its therapeutic management

Dr. Habung Nakang

The present study entitled "Haemato-biochemical alterations in canine renal dysfunction and it's therapeutic management" was undertaken w.e.f. 1st August 2016 to 31st May 2017 with the objective to study the prevalence, clinical signs and haemato-biochemical alterations in dogs with renal dysfunction and to assess the efficacy of the therapy adopted in stage III and IV of renal dysfunction in dogs. The study revealed overall prevalence of 25.88% of renal dysfunction with higher occurrence in Labrador breed (38.64%) with male predominance (68.18%) and in age group of 6-10 years (72.73%). Clinical signs associated with renal dysfunction were anorexia weight loss weakness vomiting, emaciation, pale mucous membrane, polyuria, polydipsia inappetance, recumbency, anuria, halitosis, oral ulcers, epistaxis, seizure, congested mucous membrane and cataract/blindness. Haematology revealed anemia and severe protienuria with highly significant elevation in BUN, serum creatinine and phosphorous in dogs with renal dysfunction when compared with apparently healthy control dogs. A non-significant elevation of serum sodium and potassium and fall in total protein and albumin levels were also observed in dogs with renal dysfunction. Combination of rubenal and conservative treatment using supportive drugs, was found to be more effective in the therapeutic management of renal dysfunction in stages III and IV with a survivality rate of 90% when compared to prednisolone with supportive drugs and a combine therapy using both prednisolone and rubenal along with supportive drugs.

Studies on anthelmintic activity of *entada phaseoloides* and *erigeron linifolius* against gastrointestinal helminth of goat

Dr. Santosh Kumar Gupta

The present investigation was carried out with the view to study the anthelmintic activity of *Entada phaseoloides* and *Erigeron linifolius* plant extract against gastrointestinal helminth of goat. The overall prevalence of gastrointestinal nematodes in goats was found to be 82.75 per cent under the prevailing agro-climatic condition of Byrnihut during the period of October to November 2016. The different nematodes recorded in goats were *Haemonchus spp.* (82.75%), *Oesophagostomum spp.* (78.16%), *Trichostrongylus spp.* (70.11%), *Strongyloides spp.* (62.06%), *Bunostomum spp.* (48.27%), *Trichuris spp.* (39.08%) and *Cooperia spp.* (24.13%).

The EPG count in treated groups (plant extracts /drug) decreased gradually with commencement of treatment. In Group A and B treated with crude methanolic extract of *Entada phaseoloides* and crude ethanolic extract of *Erigeron linifolius,* EPG became nil on 21st day. In group C treated with combination of both plant extracts, EPG gradually reduced but was not nil on 21st day. While group D treated with fenbendzole, EPG count became nil on 7th day of post treatment. Group E was kept as untreated infected group, where the EPG count gradually increased and Group F, the animals where kept as healthy control.

During pre-treatment period, the haemato-biochemical study revealed a significant decrease in the levels of Hb (7.23 ± 0.13), PCV (25.75 ± 0.48), TEC (9.77 ± 0.17), MCV (21.73 ± 0.53), MCH (7.11 ± 0.16), Lymphocytes (42.75 ± 0.50), basophils (0.25 ± 0.04) , total serum protein (5.20 ± 0.18), serum albumin (2.34 ± 0.05), serum globulin (2.84 ± 0.19), A:G, serum sodium (127.37 ± 1.51) ,serum chloride (90.93 ± 1.00), serum potassium (3.18 ± 0.28), serum glucose (43.89 ± 0.80) , serum iron (110.41 ± 2.05) and serum zinc level (51.72

± 1.35) in the affected goats which increased gradually after treatment whereas an increase in the levels of TLC (15.75 ± 0.93), eosinophils (3.86 ± 0.14) Monocytes (1.71 ± 0.14), and neutrophils (45.78 ± 1.37) were observed in the affected goats which also decreased gradually after treatment and reached normal level.

Based on reduction of EPG count and haemato-biochemical changes, the efficacy of methanolic extract of *Entada phaseoloides* was 72.52, 89.00 and 100 % followed by ethanolic extract of *Erigeron linifolius* was 62.76, 86.17 and 100 % while in combination was 53.68, 73.68 and 89.47 % on 7th, 14th and 21st day respectively. Fenbendazole showed highest efficacy 100% on 7th day post treatment.

In-vitro studies were undertaken for which adult parasites were collected from local slaughter house. Parasites were exposed to different concentration of plant extract i.e. 50, 150, 300, 1000 and 3000 µg/ml PBS, petri dish containing fenbendazole was kept as positive control while in negative control parasite were exposed to only PBS. Both plants extract either individually or in combination were effective against adult parasite of *Paramphistome cervi, Haemonchus contortus* and *Fasciola gigantica.* Further it was revealed that dose dependent anthelminthic activity was exhibited by plant extract and highest efficacy was observed at 3000 µg/ml.

Theileriasis in cattle and its therapeutic management

Dr. Juripriya Brahma

The study was undertaken w.e.f. 1st March 2016 to 28th February 2017, to study about the theileriasis in cattle and its therapeutic management. A total of 275 out of 563 suspected animals were found positive only for *Theileria orientalis* infection and the prevalence was recorded 48.84 per cent. Season-wise prevalence of *Theileria orientalis* was recorded highest in monsoon (53.85%) in comparison to other seasons. The highest prevalence of 60.19 per cent was recorded in the age group of above 3 years. The Holstein Friesian crossbred recorded highest with prevalence of 54.04 per cent. The noted clinical signs were fever, respiratory distress, anorexia, reduced milk yield, nasal discharge, depression, pale mucous membrane, diarrhoea, icterus and changes of urine colour. Though PCR analysis was found more sensitive in detecting the *Theileria orientalis* infection, the microscopic examination was found as gold standard for diagnosis of clinical theileriasis. The level of haemato-biochemical parameters like haemoglobin, packed cell volume, monocytes, basophils, total erythrocyte count, creatinine and blood urea nitrogen were found significantly decreased ($P<0.01$), and the levels of total leucocyte count, neutrophils, eosinophils, aspartate aminotransferase, alanine aminotransferase, total bilirubin and direct bilirubin were found significantly increased ($P<0.01$). Among the different treatment regimens used, the buparvaquone was found most effective and followed by buparvaquone with immunomodulator, oxytetracycline with diminazine diaceturate, and a combination of oxytetracycline and diminazine diaceturate with immunomodulator. Considering the alteration in pre and post treatment parameters like parasitological examination, haemato-biochemical examination and therapeutic efficacy, either the combination of oxytetracycline and diaminazine diaceturate or oxytetracycline, diaminazine diaceturate with immunomodulator also can be used alternatively for the treatment of oriental theileriasis.

Dexmedetomidine and dexmedetomidine-ketamine anaesthesia in cats

Dr. Alakesh Deka

Fifteen clinical cases of cats of either sex, weighing 1.5-4 kgs and of different age group requiring surgical intervention for various conditions were considered for the study. The cats were randomly divided into three groups comprising of five cats in each group. The cats of group I injected with dexmedetomidine @ 10 µg/kg body weight intramuscularly; cats of group II were injected with dexmedetomidine @ 20 µg/kg body weight intramuscularly and the cats of group III received a combination of dexmedetomidine @ 20 µg/kg and ketamine @ 5 mg/kg body weight intramuscularly.

Induction time of 8 ± 0.71 minutes, 4.75 ± 0.48 minutes and 2.13 ± 0.31 minutes, duration of anaesthesia 11.50 ± 0.65 minutes, 22.50 ± 1.85 minutes and 42.75 ± 3.17 minutes and recovery time 40.50 ± 2.90 minutes, 73.50 ± 3.38 minutes and 131.50 ± 3.66 minutes were recorded in the cats of group I, group II and group III, respectively. Smooth induction and recovery were recorded in the cats of all the groups. Cats of group I exhibited no analgesia though they remained unconscious while animals of group II exhibited moderate analgesia with unconsciousness. The cats of group III exhibited a state of balanced anaesthesia. Little salivation was observed in all animals of group II and III. Animals of group II and III exhibited good muscle relaxation. Corneal and palpebral reflexes were present in group I and II but absent in group III. Vomiting was recorded in two animals of group I.

Heart rate and respiration rate were reduced significantly ($p<0.01$) in the cats of all the groups although in group III mostly remained stable throughout the study. Respiration rate, rectal temperature and oxygen saturation decreased significantly ($p<0.01$) in the cats of all the groups at different time interval in all the groups remained within the physiological range. Haemoglobin, PCV, TEC and TLC level decreased significantly ($p<0.01$) initially

and then increased towards the end of study. The GGT, creatinine and cortisol level increased significantly ($p<0.01$) while total protein decreased significantly ($p<0.01$) in the study period. Based on the findings of the present study, a combination of dexmedetomidine @ 20 µg/kg body weight along with ketamine @ 5 mg/kg µg/kg body weight intramuscularly produced balanced anaesthesia permitting surgical procedure. Therefore this combination could be suggested for clinical use.

Effect of Autologous Platelet-rich Plasma for Wound treatment in bovine

Dr. Basil K. G

The present study was undertaken to elucidate the effect of autologous platelet-rich plasma for wound treatment in bovine. The experiment was carried out in 10 animals in which 5 were apparently healthy male calves of 3 to 6 months of age. In this group full thickness cutaneous wounds of 3×3 cm2 were created on dorsal thoracic region on either side of vertebral column under deep sedation and one side wound treated with saline infiltration (Group A) acted as control and the other side received Platelet rich plasma infiltration (Group B). The other 5 animals were clinical cases (Group C) which were affected with cutaneous wounds. This group also received Platelet rich plasma infiltration. The recording of rate of wound contraction, macroscopic changes, bacteriological, biochemical and histopathological investigation were performed at 7th, 14th and 21st days post treatment. The macroscopic changes revealed reduction in duration of inflammatory phase and early signs of healing in wounds treated with PRP. The rate of contraction showed high significance ($P<0.01$) in comparison with control wounds during first two weeks of study. The bacteriological investigation revealed reduction in bacterial count in first week in PRP treated groups. Bacterial identification revealed presence of coagulase positive *Staphylococcus* spp. and coagulase negative *Staphylococcus* spp. on first weeks and only coagulase negative *Staphylococcus* spp. on 2nd and 3rd weeks in all the groups under investigation. The biochemical analysis of wound tissue homogenate indicated higher levels of total protein in PRP treated groups. Carbohydrate contents in all the groups was non-significant throughout the experimental period. The enzymatic investigations revealed decreasing levels of creatine kinase and aspartate aminotransferase activity in wound tissue but was found to be non-significant between all the groups. Based on histopathological results, faster rate of healing by control of haemorrhage, reduction in the duration of inflammatory phase, early maturation of granulation tissue, angiogenesis and epidermal growth with the use of PRP. The study proved that local infiltration of PRP accelerate and improve wound healing in comparison to control group.

Surveillance of equine foot diseases in north-east India

Dr. Deepjyoti Deka

The present investigation was conducted in the riding horses under a few defence establishments of north-eastern India to correlate various foot affections in relation with environmental conditions of the region. A total of 49(Forty - nine) stabled horses were surveyed in two seasons, out of which 35 (71.42%) animals were found to be affected with various foot lesions.The incidence of foot affection was found higher in summer season (60%) compared to the winter (40%). The various foot affections recordedunder the study was overgrowth of the hoof (57.14%), which was followed by hoof crack (20%), thrush (8.57%) and suppurative sole (5.71%), quittor, laminitis and bulb fibroma (2.86%) respectively. Maximum incidence rate of foot affection was found with concrete floor (94.29%) followed by sand floor (5.71%). Highest percentage of the disease was found in the fore foot (60%), while affection in the hind foot was (25.71%). Animals were found to be highly affected with foot lesions that were mostly on high concentrate (77.14%) ration compared to roughages (22.86%).Haematologicalparameters showed significant rise during both summer and winter respectively for both normal and affected animals except the Neutrophil count. Biochemical test revealed significant rise in mean values of serum Creatinine, Creatine Kinase and Aspartate Aminotransferase in affected animals except Alkaline Phosphatase in affected animals as well as normal animals bothin summer as well as in winter. Bacteriological investigation revealed both Gram positive and Gram negative organisms from infected hoof lesions. Twenty four samples out of thirty two showed*Staphylococcus* organisms and rest of the samples showed Gram negative coccobacilli and Gram positive rods in chain. Sensitivitytest of samples showed resistance to Penicillin (78.12%),Streptomycin(71.87%), Gentamicin(90.62%)   andVancomycin (81.25%) but sensitive to Ceftriaxone (84.37%) and Tetracycline (68.75%).

Anaesthetic management of pygmy hog

Dr. Prabhat Baruah

Twenty clinically healthy adult pygmy hogs within the age group of 3 to 9 years, having 2.8 to 12.1 kilograms of body weight were randomly divided into 4 groups, containing 5 animals in each group. Group I received azaperone-ketamine (2mg/kg + 10mg/kg, i.m.); Group II received dexmedetomidine-ketamine (0.02mg/kg + 10mg/kg, i.m.); Group III received xylazine-ketamine (2mg/kg + 10 mg/kg, i.m.); and group IV received tiletamine-zolazepam @ 4mg/kg i.m. respectively.

The induction time, duration of anaesthesia and recovery time were of 2.75 ± 0.48, 73.25 ± 2.02 and 122.75 ± 5.27 minutes respectively in group I; 3.00 ± 0.41, 88.25 ± 11.68 and 153 ± 10.30 minutes respectively in group II; 3.25 ± 0.63, 87.25 ± 11.90 and 153.50 ± 10.20 minutes respectively in group III and 2.25 ± 0.25, 72.25 ± 14.16 and 130.25 ± 11.24 minutes respectively in group IV. Induction and recovery were smooth in group III. Muscle relaxation and analgesia were good in both the groups, II and III. Pedal, palpebral and pin-prick reflexes were subdued to varying degrees in all the groups. Drowsiness persisted for a long time after recovery in group IV.

Heart rate, respiration rate and rectal temperature decreased significantly ($P<0.05$) in all the groups. Respiratory minute volume and SPO_2 decreased non-significantly in group I and III. Haematobiochemical parameters like Hb, PCV, glucose, total protein, GGT, LDH and creatinine showed non-significant ($P>0.05$) changes in all the groups.

Based on the findings of the study and from the score card, group III scored highest, and it can be concluded that xylazine-ketamine combination @ 2mg/kg & 10mg/kg body weight intramuscularly produced the better balanced anaesthesia in pygmy hog characterized by adequate central nervous system depression, excellent analgesia and complete muscle relaxation. This was followed by azaperone-ketamine, dexmedetomidine-ketamine and tiletamine-zolazepam respectively.

Abstract of M. V. Sc. Thesis
Department : Veterinary Surgery and Radiology
Major Advisor : Dr. Bitupona Deuri

Radiographic study on thoraco-lumbar injury in canine

Dr. Reanald D Warjri

Thoraco-lumbar injuries are a common problem in small animals and probably one of the most frequent form of trauma. The study was conducted on 10 nos. of clinical cases of spinal affections presented at the College of Veterinary Science, Assam Agricultural University, Khanapara. Neurological examination was done and such dogs with thoraco-lumbar injury mostly exhibited posterior paraesis. The purpose of this study was to compare Cervical myelography and Lumbar myelography in order to detect thoraco-lumbar injury in dogs. The animals were randomly divided into two groups, Group I and Group II. In Group I Cervical myelography was performed through cisterna magna puncture and in Group II Lumbar myelography was performed through L5 L6 intervertebral space puncture to access the sub-arachnoid space. In both the groups myelography was done after plain radiography in both lateral and ventro-dorsal views. The contrast agent used was Iohexol (300 mgI/ml) @ 0.3 ml/ kg body wt. The dogs were anaesthetized with ketamine hydrochloride @ 10 mg/ kg body wt. i.v. following premedication with diazepam @ 5 mg/ kg body wt i.v. Another control group of 5 animals (Group III) recieved the same anaesthetic drug combination for castration or panhysterectomy. The main aim of the control group was to nullify the action of anaesthesia on the animals, so that the effect of contrast agent on the body could be assessed. In all the three groups venous blood was collected at 0, 5, 30, 60 and 90 minutes and analysed for haematobiochemical parameters. The lateral and ventro-dorsal myelograms of animals in Group I and II were obtained at 5, 30, 60 and 90 minutes of injection of Iohexol. Iohexol produced good quality myelograms in dogs. In cases with partial compression there was partial impairment to the flow of the agent, while complete obstruction to the flow indicated severance of the spinal cord. Lumbar myelography was comparatively difficult to perform as compared to cisternal myelography but it was more helpful as the site of lesion in thoraco-lumbar region could be readily identified. This technique was very useful in cases where the site of lesion was in the thoraco-lumbar area. There was no significant difference between the two techniques in terms of changes of the haemato-biochemical parameters. Iohexol was thus found to be safe and effective contrast agent for both cervical and lumbar myelography for diagnosis of thoraco-lumbar injury in dogs.

Microbial quality assessment of meat contact surfaces of selected butcher shops in and around Guwahati city

Dr. Jyoti Pawan Chutia

The present study was carried out to assess the microbial quality of meat contact surfaces and the managemental practices associated with hygiene and sanitization in 36 randomly selected butcher shops in and around Guwahati city. Workers from the butcher shops were interviewed through a structured questionnaire to assess their knowledge for hygienic meat handling practices. Bacterial load was assessed by serial dilution methods and the bacterial pathogens were isolated using standard procedure. Out of 36 butcher shop workers interviewed all the workers found to be male with age ranging between 18-60 years, 80.56% received primary school education, 36.11 % received training, 16.67% did not use protective clothes and 58.33% did not cover their hair. Moreover, it was also found that 58.33% of the butcher handled money while serving meat, 77.78% worn jewellery, only 11.11% and 5.56 % had a routine health checkup after every 3 and 6 months respectively. A total of 216 of swab samples from six different sources (butcher's knives, meat chopping tables, worker's hands, weighing pans, meat wood cutting blocks and water used for cleaning of meat) were collected for enumeration of TVC and isolation of pathogenic bacteria (*viz*. *S. aureus*, *E. coli* and *Salmonella*). The mean values of TVC were found to be highest on swab samples collected from meat cutting blocks and lowest on water with 6.12 ± 0.01 log CFU/cm^2 and 5.12 ± 0.08 CFU/ml respectively. *E. coli* was the predominant isolate (37.50%) followed by *S. aureus* (34.26%) and *Salmonella* species (7.40%). Virulent *nuc* and *inv*A genes were detected from 52% and 100% of positive *S. aureus* and *Salmonella* isolates respectively and none of the isolates were found to be positive for *stx*1 gene. Results revealed poor level of personnel hygiene and poor sanitization at the butcher shops. Thus policies, regulations and procedures for hygienic meat handling should be adhered and enforced by relevant authorities in order to ensure that the meat produced is wholesome and safe for human consumption.

Surveillance of bovine tuberculosis in peri-urban dairy farms of Guwahati

Dr. Chandrani Goswami

Bovine Tuberculosis (bTB), a disease which has been considered to be of socio-economic as well as public health importance and of great significance to the international trade of animals and animal products.

The present study was envisaged to establish the burden of bTB in cattle of peri-urban dairy farms by Comparative Intradermal Tuberculin Test (CITT) and to study CITT positive reactive animals by Interferon gamma (IFN-γ) assay for confirmation of infection. The study was carried out in small holder peri- urban dairy farms for a period of 1 year (August, 2016 to July, 2017) of Guwahati city. Cross-sectional study was conducted in the peri-urban area to enumerate small holder dairy farms for sampling. A total of 33 villages were selected at random which comprised of 3 farms in each village and up to 3 lactating animals in each farm. CITT was conducted in 192 dairy cattle in 99 small holder peri-urban farms. CITT reactors comprising of positive reactors, inconclusive reactors and negative reactors were subjected to IFN-γ assay.

The burden of bTB on the basis of CITT was 5.02% whereas, 6.25% recorded inconclusive and 88.54% were negative. Farm level prevalence based on CITT was recorded to be 8.08%.

Prevalence of bTB based on IFN-γ assay was recorded as 7.29%. Farm level prevalence based on IFN-γ assay was recorded to be 11.11%. Sensitivity and specificity of CITT was found to be 71.43% (CI: 41.90% to 91.61%) and 100.00% (CI: 97.80% to 100.00%), respectively.

Abstract of M. V. Sc. Thesis
Department : Veterinary Public Health
Major Advisor : Dr. A. G. Barua

Evaluation of hepatoprotective effect of polyherbal formulation

Dr. Sushree Sangita Mohapatra

The present study was conducted to evaluate the hepatoprotective effect of polyherbal formulation against CCl4 induced hepatotoxicity. A total number of 90 Wistar albino rats were taken and divided into 4 small groups. The 4 groups were divided in 6 small sub groups. Hydroethanolic extract was prepared as per the standard procedure.

Sub-group I of Group A was given with Normal saline. Sub-group II was given with CCl4+Liq. paraffin (50%v/v 2ml kg-1body weight S/C as Vehicle). Sub-group III was treated with CCl4+Liq paraffin (50% v/v 2ml kg-1body weight S/C) + Silymarin (100 mg kg-1body weight oral). Sub-group IV was treated with CCl4+ Liq paraffin (50% v/v 2ml kg-1body weight S/C) + extract of *Alternanthera sessilis*, (100mg kg-1body weight oral). Sub group V was treated with CCl4+Liq paraffin (50% v/v 2ml kg-1body weight S/C) +extract of *Alternanthera sessilis*(300mg kg-1body weight oral). Sub-group VI was treated with CCl4+Liq paraffin (50% v/v 2ml kg-1body weight S/C) +extract of *Alternanthera sessilis*(900mg kg-1body weight oral).

Sub-group Iof Group Bwas given with Normal saline. Sub-group II was given with CCl4+Liq. paraffin (50%v/v 2ml kg-1body weight S/C as Vehicle). Sub-group III was treated with CCl4+Liq paraffin (50% v/v 2ml kg-1body weight S/C) + Silymarin (100mg kg-1body weight oral). Sub-group IV was treated with CCl4+ Liq paraffin (50% v/v 2ml kg-1body weight S/C) + extract of *Oroxylum indicum*(100mg kg-1body weight oral). Sub group V was treated with CCl4+Liq paraffin (50% v/v 2ml kg-1body weight S/C) +extract of *Oroxylum indicum*(300mg kg-1body weight oral). Sub-group VI was treated with CCl4+Liq paraffin (50% v/v 2ml kg-1body weight S/C) + extract of *Oroxylum indicum*(900mg kg-1body weight oral).

Sub-group I of Group C was given with Normal saline. Sub-group II was given with CCl4+Liq. paraffin (50%v/v 2ml kg-1body weight S/C as Vehicle). Sub-group III was treated with CCl4+Liq paraffin (50% v/v 2ml kg-1body weight S/C) + Silymarin (100mg kg-1body

weight oral). Sub-group IV was treated with CCl4+ Liq paraffin (50% v/v 2ml kg-1body weight S/C) + extract of *Oroxylum indicum*+ *Alternanthera sessilis*1:1 (100mg kg-1body weight oral). Sub group V was treated with CCl4+Liq paraffin (50% v/v 2ml kg-1body weight S/C) +extract of *Oroxylum indicum*+ *Alternanthera sessilis*1:1 (300mg kg-1body weight oral). Sub-group VI was treated with CCl4+Liq paraffin (50% v/v 2ml kg-1body weight S/C) + extract of *Oroxylum indicum*+ *Alternanthera sessilis*1:1 (900mg kg-1body weight oral)

Sub-group I of Group D was given with Normal saline. Sub-group II was given with CCl4+Liq. paraffin (50%v/v 2ml kg-1body weight S/C as Vehicle). Sub-group III was treated with CCl4+Liq paraffin (50% v/v 2 ml kg-1body weight S/C) + Silymarin (100mg kg-1body weight). Sub-group IV was treated with CCl4+Liq paraffin (50%v/v 2ml kg-1body weight S/C) +extract of *Oroxylum indicum* (33 mg kg-1body weight oral) + *Alternanthera sessilis*(33 mg kg-1body weight oral) +Silymarin (33 mg kg-1body weight oral). Sub group V was treated CCl4+Liq paraffin (50%v/v 2ml kg-1body weight S/C) ii +extract of *Oroxylum indicum*(100 mg kg-1body weight oral) + *Alternanthera sessilis*(100 mg kg-1body weight oral) +silymarin (33 mg kg-1body weight oral). Sub-group VI was treated with CCl4+Liq paraffin (50%v/v 2 ml kg-1body weight S/C) +extract of*Oroxylum indicum*(300 mg kg-1body weight oral) +*Alternanthera sessilis*(300 mg kg-1body weight oral) +silymarin (33 mg kg-1body weight oral)

Blood sample were collected on 0-day, 7th day, 14th day, 21st day and 28th day for biochemical analysis in the clot activator vial. The biochemical analysis and histopathogy was done as per the standard procedure.

From the results of present study it was found that CCl4 produced severe liver-toxicity, Hydroethanolic extract of *O. indicum* found to have hepatoprotective effect against CCl4 induced hepatotoxicity, Hydroethanolic extract of *A. sessilis* found to have hepatoprotective effect against CCl4 induced hepatotoxicity, Combination of hydroethanolic extract of *O. indicum* and *A. sessilis* offered a better hepatoprotective action against CCl4 induced hepatotoxicity and the effect was found to be better than the single plant. Moreover the dose of individual hydroethanolic extract of the plants was significantly reduced still the reduced dose extract proved hepatoprotective effect, Combination of *O. indicum, A. sessilis* and Silymarin revealed to have hepatoprotective effect better than the single plant extract or combination of the plant extract or even silymarin alone. The combined polyherbal formulation offered better hepatoprotective effect even when the dose was reduced by 2/3rd (two third) the dose that was given in single plant therapy.

Pharmacological characterization of various extracts of entada phaseoloides using isolated tissue preparation

Dr. Pranay Talukdar

In the present study, effect of various extract of seeds of *Entada phaseoloides* was studied in isolated tissues of various animals in order to characterize its activity on cholinergic, adrenergic, histaminergic and serotonergic receptors. *Entada phaseoloides* is used in various disease conditions like arthritis, gastric disorder, bronchospasm, depression, wound healing, diabetes etc. Our study shows *Entada phaseoloides* induced concentration dependent contractions on isolated rat ileum, rat vas deferens, guinea pig ileum and rat fundus that were inhibited significantly in the presence of atropine, prazosin, chlorpheniramine, and ketanserin respectively. The relaxant effect produced by *Entada phaseoloides* on rat tracheal chain was also inhibited significantly by propranolol. The contractile effect of seeds of *Entada phaseoloides* on rat ileum, rat vas deferens, guinea pig ileum and rat fundus was mediated by stimulating muscarinic, adrenergic, histaminergic and serotonergic receptors whereas, relaxant activity of *Entada phaseoloides* on rat trachea was mediated by â-adrenergic receptor. The EC_{50} (4.159×10^{-7} M) for *Entada phaseoloides* increased significantly ($P < 0.05$) to 8.907×10^{-7}M in the presence of atropine indicating that the extract interacted with muscarinic receptors. The EC_{50} ($3.077 \pm 0.146 \times 10^{-7}$ M) for *Entada phaseoloides* increased significantly ($P < 0.05$) to $6.591 \pm 0.1471 \times 10^{-7}$ in presence of propranolol indicating that the extract interacted with â-adrenergic receptor. The EC_{50} ($4.202 \pm 0.011 \times 10^{-8}$ M) for *Entada phaseoloides* increased significantly ($P < 0.05$) to $3.591 \pm 0.0174 \times 10^{-7}$ M in presence of prazosin, indicating that the extract interacted with á-adrenergic receptor. The EC_{50} (3.163×10^{-7} M) for *Entada phaseoloides* increased significantly ($P < 0.05$) to $5.311 \pm 0.085 \times 10^{-7}$M in presence of chlorpheniramine indicating that the extract interacted with histaminergic receptor. Again the EC_{50} ($5.96 \pm 0.596 \times 10^{-8}$ M) for *Entada phaseoloides* increased significantly ($P < 0.05$) to $1.4 \pm 0.872 \times 10^{-6}$ M in presence of ketanserin, indicating that the extract interacted with serotonergic receptor.

In conclusion, the observations indicate that *Entada phaseoloides* possesses agonistic activity on cholinergic, adrenergic, histaminergic and serotonergic receptors.

Abstract of M. V. Sc. Thesis
Department : Veterinary Pharmacology and Toxicology
Major Advisor : Dr.(Mrs.) C.C. Barua

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Master of Science (Home Science)

- Extension and Communication Management (H.Sc)
- Family Resource Management (H.Sc)
- Food Science and Nutrition (H.Sc)
- Human Development and Family Studies (H.Sc.)
- Textile ans Apparel Designing (H.Sc.)

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Knowledge of teachers of Jorhat district of Assam regarding diabetes Mellitus

Lalak Tatak

The present research study entitled 'Knowledge of teachers of Jorhat district of Assam regarding diabetes mellitus' was conducted in Jorhat district of Assam. The objectives of the study were i) to study the back ground profile of respondents, ii) to assess the knowledge of respondents regarding some facts of diabetes and iii) to gather information on indigenous remedial measures for diabetes. All the provincialised colleges of Jorhat subdivision were considered for the study. Fifty per cent of the total teachers of each college were the respondents of the present study, thus, totalling 204 teachers. Nearly 34 per cent of respondents belonged to age group 47-57 years. Majority of respondents (58.80 per cent) were female. Large majority of respondents (78.43 per cent) were married. Majority of respondents (58.80 per cent) belonged to arts discipline. Large majority (74.00 per cent) of respondents belonged to nuclear family. Large majority (71.60 per cent) of respondents belonged to small family. Nearly 42 per cent respondents had working experience of 1-10 years. Nearly 95 per cent respondents did not suffer from diabetes mellitus. Nearly 77 per cent of respondents checked their blood sugar level. Majority (66.18 per cent) of respondents did not have family member suffering from diabetes mellitus. Majority of respondents did not have doctor (63.20 per cent), nutritionist and dietician (91.20 per cent) in their family, friends and relatives. The study also reveals that 71.60 per cent of respondents did not attend any talk or discussion on diabetes mellitus and 83.30 per cent did not have membership in any organization. Majority of the respondents that is 64 per cent had medium level of mass media exposure. More than 69 per cent of respondents had medium level of knowledge on each aspect namely basic of diabetes, its causative factors and symptoms, diet and habits to be maintained in diabetes mellitus with higher percentage in high level on diet in diabetes mellitus. On college wise distribution of knowledge, more than 70 per cent of respondents from all the colleges had medium level of knowledge on diabetes mellitus. More than 65 per cent of respondents from all the colleges had medium level of knowledge on basic of diabetes mellitus. More than 55 per cent of respondents from all the colleges

had medium level of knowledge on causative factors and symptom of diabetes mellitus. More than 55 per cent of respondents from all the colleges had medium level of knowledge on diet in diabetes mellitus. More than 50 per cent of respondents from all the colleges had medium level of knowledge on habits to be maintained in diabetes mellitus. Both male and female respondents had nearly equal percentage in all the level that is low, medium and high level of knowledge on diabetes mellitus. According to discipline (that is Science, Arts and Commerce) more than 70 per cent of respondents had medium level of knowledge on diabetes mellitus. Respondents from science discipline had higher percentage of knowledge on diabetes mellitus. Highest percentage of respondents had medium level of knowledge on diabetes as a whole. It was also evident from the findings that there were significant association between knowledge of the respondents with age, checking of blood sugar level and presence of nutritionist/dietician in their family, friends and relatives. There was also highly significant association between knowledge of respondents with their mass media exposure. The respondents under study suggested some plants sources as remedial measures for diabetes mellitus. Higher percentage of respondents suggested neem, methi, nayantara and chirata as remedial measures for diabetes mellitus. Respondents also suggested some healthy lifestyle to be followed as remedial measures of diabetes mellitus. Higher percentage of respondents suggested 'cutting down of sugar intake', 'physical exercise', 'checking of blood sugar level' and walking as remedial measures for diabetes mellitus

Knowledge and Attitude of Teachers of selected districts of Assam Regarding Home Science Education

Mallika Saikia

The present investigation was conducted to study the "Knowledge and Attitude of teachers of selected districts of Assam regarding Home Science Education" with objectives to assess the knowledge of the respondents on Home Science education, to know the attitude of respondents towards Home Science education, to study the perception of respondents about professional opportunities of Home Science education. The study was conducted in Jorhat and Lakhimpur Districts of Assam which were purposively selected for the present study. The respondents were selected from the higher secondary schools. Total six (6) higher secondary schools were selected from each sample district using simple random sampling and 10 teachers were selected randomly from each higher secondary schools of sample district. Thus a total of 120 respondents were randomly selected for the population of the present study. The data were collected through a structured questionnaire prepared by the researcher. Collected data were analyzed by applying frequency, percentage, mean, standard deviation and chi-square test. The findings of the study revealed that majority (66.67%) of the respondents belonged to age group of 38 – 45 years and 60.83 per cent of the respondents were male. A large majority of the respondents (97.50%) were Hindu and large percentage of the respondents (57.50%) belonged to general caste. A large majority of the respondents (97.50%) had post graduate degree with B.Ed. Majority (89.17%) of the respondent were married. The findings of the present study show that 68.34 per cent of the respondents belonged to nuclear family and majority of the respondents (71.67%) had small family size. The findings indicate that a large majority (89.17%) of the respondents watched television regularly followed by 79.17 per cent of the respondents used internet browsing regularly and 70.00 per cent of the respondent had regularly read Newspaper. Respondents varied in percentage as regards to their discussion with children (91.67%), students (66.67%)

and relatives (54.17%) about their career option. A large percentage (43.33%) of the respondents showed their willingness to send their students for enrollment in Home science education. Findings also revealed that only 25.00 per cent of the respondents were willing to send their own children to choose Home science education as their career option. Majority (69.17%) of the respondents had medium level of knowledge regarding Home science education and 71.67 per cent of the respondents had favourable attitude towards Home science education. Positive and highly significant association was found between sex and age of the respondents with their attitude towards Home science education. The significant association was found between age with attitude and perception and mass media exposure with knowledge, attitude and perception of the respondents regarding Home science education.

Characterization of livelihood pattern of tribal women of Jorhat district of Assam

Monsumi Borah

The present study on "Characterization of livelihood pattern of tribal women of Jorhat district of Assam" was carried out with the following objectives 1.To find out the background profile of the tribal women of Jorhat district of Assam. 2. To characterize the tribal women in terms of participation pattern in farm and allied activities.3. To characterize the decision making pattern of tribal women in farm and allied areas. From Jorhat district two blocks namely North-West development block and Titabar development block were selected. From these two blocks two villages, one from each block was selected using simple random sampling technique. From each of the village 60 tribal women were selected through simple random sampling. Thus total numbers of respondent were 120. Data was collected using structured interview schedule and analysed using appropriate statistical techniques *viz.*, frequency, percentage, mean, standard deviation and chi-square. The data revealed that majority of the respondents belonged to the middle age group (46.16%), 52.50 per cent were from nuclear family and had education up to middle school level (26.67%). Farming was the main family occupation for 62.50 per cent of respondents with small land holding (31.76 %) and ownership was in the name of husband (50.00%). primary livelihood source of the respondents was farming (44.16%), with livestock rearing (44.57%) as additional livelihood source. No membership in any organization was recorded for 51.67% per cent of the respondents, and 27.50 per cent contacted bank personnel sometimes The findings further showed that majority of the respondents belonged to medium socio-economic status (72.00%). Findings also highlighted that respondents spent on an average 5:58 hours in household activities, 4:00 hours in farm related activities and 2:26 hrs in livestock management activities per day. Data revealed that majority of the respondents performed different household and farm activities independently such as cooking (83.33%), serving of food (80.00%), care of children (70.83%), post harvest processing (75.84%), winnowing (60.00%), harvesting (56.67%), weeding (52.50%), irrigation (50.83%). In kitchen gardening-

harvesting (66.00%), irrigation (60.00%), seed sowing (55.80%) and in livestock related activities, respondents participated independently in fodder management (60.00%) management of produce (53.33%), cleaning of shed (52.50%). With regard to decision making, independent decision making by respondents was seen in health care of children (61.67%), health care of elderly (50.33%) and spending leisure time (83.33%), post harvest processing (63.34%), transplanting (52.50%) and weeding (50.50%). In livestock rearing activities independent decisions was seen in cleaning of sheds (65.83%), fodder management (60.00%), selection of site for rearing (60.16%). In community related activities independent decision was only seen in voting in election (45.00%). Data also revealed that the respondents had medium level participation (66.67%) and decision making (70.00%) in farm & allied activities. It can be characterized from the findings that the tribal women, participated in almost all household, livestock and kitchen gardening related activities. However in case of farm related activities though their independent participation was found in selected activities only yet they participated in labour intensive activities like weeding (52.50%) and irrigation (50.83%), which were not generally seen among the rural farm women. With regard to decision making it can also be characterized from the findings that the respondents mostly participated in joint decisions in case of decision making related to household, community and farm but in case of decision making related to livestock and kitchen gardening related activities, independent decisions dominated the scenario. The decision making process was positively associated with mass media exposure, extension contact, organizational membership, livelihood source of the respondent, while participation pattern was affected by livelihood source of the respondent.

Attributes developed among students through Home Science education and their expectations for gainful employment

Nikrachi Ch. Sangma

The present investigation was conducted to study the "Attributes developed among students through Home Science education and their expectations for gainful employment" was undertaken during the period 2016-2017. The study was undertaken with the following objectives: (1) To study the background profile of the respondents, (2) To explore acquired attributes perceived by the respondents, (3) To identify the expectations of the respondents for gainful employment. The study was conducted in College of Home Science, Assam Agricultural University, Jorhat. College of Home Science was purposively selected for the present study. The respondents were selected from both under graduate and post graduate classes. Barring the first year and second year students a total 135 students were found, from which fifteen students were excluded for pre-testing. Thus a total of 120 students were the population of the present study. The data were collected through a structured questionnaire prepared by the researcher. Collected data were analyzed by applying frequency, percentage, mean, standard deviation and chi square test. The findings of the study revealed that a large percentage (51.66%) of the respondents belonged to age group of 23-26 years and 87.50 per cent of the respondents were female. Majority (96.66%) of the respondents were from North East region and large percentage (43.33%) of the respondents was from B.Sc. degree programme. Large percentage (45.00%) of the respondents was secured marks between 55-68 per cent in 10th standard and large percentage (72.50%) of the respondents secured marks between 62-75 per cent in 12th standard whereas large percentage (47.05%) of the respondents secured marks between 78-87 per cent in B.Sc and large percentage (40.90%) of the respondents secured marks between 79-87 per cent in M.Sc. Entire respondents belonged to nuclear family and large percentage (63.33%) of the respondents were from small family. Large percentage (50.00%) of the respondents'

father was graduated whereas large percentage (50.83%) of the respondents' mother was HSLC/HS passed. Large percentage (77.50%) of the respondents' father occupation was government service whereas large percentage (55.00%) of the respondents' mother was mainly engaged in household activity. A large percentage (45.00%) of the respondents' family income was Rs 36001 – 50000. Majority (95.00%) of the respondents were unmarried and small percentage (5.00%) of the respondents was married. Majority (40.83%) of the respondents belonged to general caste and large percentage (70.00%) of the respondents belonged to Hindu religion. Large percentage (48.33%) of the respondents was brought up in urban areas and majority (56.66%) of the respondents went to English medium school. Large percentage (54.16%) of the respondents had leadership position in various capacities during their school days of which huge percentage (47.69%) had were member of union body. It is envy to know that large percentage (80.83%) of the respondents is aware of job prospectus in Home Science discipline. Majority (92.50%) of the respondents were access to internet and library facilities. Entire respondents of Home Science College seek help when they need for any circumstances and also entire respondents had some or other kind of involvement in group activities whether it's a small or big issue. It is encouraging that large percentage (62.50%) of the respondents would like to become an entrepreneur after their graduation in Home Science education whereas entire respondents had perceived several qualities through their course of study in Home Science education like psychological, knowledge and skills, management, social, abilities and some special skills. It is observed from the ranking of findings of the present study that the attributes perceived by the respondents were responsible for the work, deep thinking on the subjects, thorough awareness of the subjects in Home Science, skill of writing report after a field visit, emphasizing concept learning before memorising, planning and organising work systematically, behaving properly with teachers, seniors, friends and strangers, respecting and valuing different cultures, customs of various region, motivation skill, listening skill, ability to manage own work, ability to work in team, ability to obtain and process data in computer. It is very encouraging to see that overall acquired attributes perceived by the respondents was medium (65.00%). After attaining multiple of qualities, skills, knowledge and abilities respondents had rank their expectation for gainful employment were more number of job opportunities in Home Science education like other field of professional courses and graduating students should be exposed to world class lecture series to develop their soft skills, Home Science subjects should be eligible in every competitive examination, college authority should link with successful company to take up their students for internship programme, college authority should act as strong motivational force to inspire students for various enterprises. A significant association was found between personal qualities with sex, percentage secured in 10th standard, percentage secured in 12th standard, place of brought up. Association was also found between special skills with sex, percentage secured in 10th standard, percentage secured in 12th standard, place of brought up.

Involvement of Rural Women in selected farm and non farm activities for their household livelihood security

Queen Chetia

The present study entitled "Involvement of rural women in selected farm and non farm activities for their household livelihood security" was conducted in the Jorhat district of Assam. Eight (8) villages were selected from Jorhat and Titabor sub division using purposive sampling method. A total of 120 rural women were selected randomly using simple random sampling method. Personal interview method was applied for the collection of primary data. Data were analysed by using frequency, percentage, mean, standard deviation, coefficient of correlation. It has been observed that rural women were found to be performed in both the farm and non farm activities as well as domestic activities. Cent per cent of the rural women involved in the farm activities such as transplanting, harvesting, winnowing and non farm activities like traditional snacks preparations (94.16%), in weaving (60.00%), pickle making (55.00%). The study also showed that very less number of rural women in the sampled villages took decision independently in different farm and non farm activities. The rural women spent most of their time in family food preparation and farm related activities. When they performed various farm and non farm activities they faced some problems such as lack of scientific knowledge, attack crops by pests/ insects, high cost of inputs. The role of women extends way to beyond home and bringing up children. Women have to perform the dual role of housewife and wage earner. Both roles made heavy demands on women's time and energy. Economic pressure is forcing them to break away their traditional roles of housewives into farm and non-farm labourers. In this present study women contributions in selected farm and non farm activities is more prominent. The findings of the study suggested that there is a need to impart training to these women in order to strengthen the knowledge about farm and non farm activities. In order to improve women's work efficiency, Govt. and Extension worker should plan and execute need based training programmes. Rural women have increased their participation in economic activities. Through involvement in farm and non farm activities rural women have been able to increase their consciousness and economic levels, and thereby making a significant contribution to the well-being of the family. Ultimately, they have been able to break the cycle of poverty. Therefore, involvement of rural women in farm and non farm activities has been a key factor for poverty reduction in rural areas of India.

Knowledge, attitude and practices of farmers towards vermiculture technology

Rashmi Rekha Kalita

Organic manure provides a solution to the alarming environmental damage caused by chemical fertilizers. The residues of chemical fertilizer are not only percolating into the soil but have moved into the reservoirs of water, rivers and streams. With the global concern of safe foods, the concept of organic manure was introduced to the farmers. Among the various sources of organic manure, vermiculture technology recognized as having considerable potential as soil amendments and also source of generating additional income along with the environmental balance. And by looking into the benefit of organic manure, most of the farmers of Jorhat District started vermicompost in their houses. Thus the present study was undertaken to analyse the knowledge, attitude and practices of farmers towards vermiculture technology with the following objectives- i) To study the existing socio-economic status of farmers, ii)To assess the knowledge and attitude of the farmers towards vermiculture technology and iii)To explore the existing practices of vermiculture technology adopted by farmers.

The study was conducted in Jorhat district of Assam. A multi stage purposive cum simple random sampling design was followed for selection of three blocks namely Baghchung, Chipahikhula and Titabor from respective subdivision i.e Jorhat and Titabor. 120 numbers of respondents, irrespective of gender were selected from 12 villages of the three blocks that had been undergone training on vermicompost formally or informally from various sources had been selected for the present study. Data collection was done by using interview cum questionnaire. The findings revealed that majority (45.00%) of the respondents belonged to upper middle age group i.e. 32-45 years. Large majority (62.50%) of female farmers, 87 percent respondents belonged to nuclear family and 45.83 per cent had education up to high school level. Majority of them (81.67%) were married, 58.33 per cent of the respondents belonged to OBC category. 54.17 per cent of respondents had farming as their main occupation and 80.00 per cent respondents had marginal land holding farmers whereas

Abstract of M. Sc. Thesis
Department : Extension and Communication Management (H.Sc)
Major Advisor : Dr. (Mrs) M. Dutta Das

40.83 per cent of the respondents were no membership in any organization. A large majority (66.67%) of the respondent attended training programme regularly on different areas. It was further revealed that majority (70.00%) of the respondents was from medium socio-economic status and 47.50 per cent of respondents had sometimes contact with Non Government Organization (NGO). Data also revealed that 75.00 per cent of the respondent had medium level of knowledge and had strong favorable attitude (74.17%). 69.17 per cent of the respondents had medium practice level towards vermiculture technology. The findings also revealed that education and organizational membership had showed significant association with knowledge of the farmers towards vermiculture technology. Further, it revealed that attending the training programme had also showed significant association with both attitude and practices of farmers towards vermiculture technology.

Women's economic contribution in *Japi* (Traditional Headgear) making industry: A case study of Nalbari district, Assam

Kangkana Kalita

Women play an important role in different home based cottage industry and other traditional art and crafts. In Assam, *Japi* making is a traditional household industry (The telegraph, April 21, 2006). The rural people of Assam also had a long tradition of doing various economic and productive activities out of which "*Japi* making cluster" is noteworthy. Women are involved in *Japi* making industry for income generation. The *Japi* making industry is one of the most important among the cottage industries in Assam which has a glorious past from the time immemorial. The present study was carried out to study the Women's economic contribution in *Japi* (Traditional Headgear) making industry: A case study of Nalbari District, Assam. The main objectives of the study were: a) To study the demographic profile of the selected households. b) To find out the extent of family members' participation in household *Japi* making industry. c) To determine the economic contribution of women in the selected handicraft industry. d) To document case studies of successful entrepreneurs. A purposive cum proportionate sampling design was adopted to carry out the study. Based on highest concentration of *Japi* making households the Pub Nalbari Block was considered for the study from which two villages *viz.,* Mugkushi and Sutarkushi were selected purposively. Total number of *Japi* making households in the selected villages was found to be 400. By following proportionate random sampling technique a total of 120 households were selected for the study. For the purpose of collection of primary data and other relevant information, a schedule was designed for the study and primary data were collected from the respondents by interviewing them personally.

The findings of the study depicts that women give a considerable contribution in *Japi* making industry. Rural women participate in a broad range of activities in *Japi* making industry such as preparation of required materials, decoration, stitching and pasting. The participation of women in *Japi* making industry is higher as compared to male members.

For large size *Japi*, the female labour recorded the higher share (66.24%) of total man days as compared to medium size *Japi* (43.47%). It is interesting to note that benefit cost ratio in *Japi* making was found to be 1.23 on an average *Japi* making farm. It is worth mentioning that in the sample households over all women's economic contribution in *Japi* making was found to be 24.04 per cent. It is envisaged that if the workstation is improved and training on new design can be imparted among the women folk, *Japi* making can emerge as the most important industry for increasing the contribution of women of annual income .Further it will help *Japi* making industry to be more popular and flourished all over India. Skill development training on *Japi* making with improved modern technologies/tools may be popularized among youth across the state with could be taken up as a vocation to earn a respectable livelihood or may be opted for setting up an enterprise.

A study on selection of interior wall paints for residential building

Monika Sonowal

The present study on "A Study on selection of interior wall paints for residential building." was undertaken with the following objectives- 1. To find out the criteria considered while selecting paints for interior walls and ceiling 2. To develop a guideline for right selection of paint for interior wall

A multistage purposive cum random sampling method was adopted to carry out the study. Jorhat Municipality area was considered from which five wards were selected randomly. From each of the wards, by following the probability proportionate to size method the samples were selected purposively and a total of 120 respondents were selected for the study. Interview method was used for data collection.

The findings of the personal and socio-economic characteristics of the respondents showed that majority of the respondents (65%) belonged to the age group in between 25-50 years. Forty five per cent of the respondents were educated up to graduation. Majority of the respondents (66.7%) were service holder. Majority of the respondent (46.66%) belonged to the families earning Rs. 50,100 and above. It was observed that for the highest number (41.67 %) of the respondents, it was 1-2 years since they painted their house. Majority of the respondent (95.84%) mainly used paint for beauty or aesthetic purpose and also for protection. Majority of the respondents (91.66%) collect information from the seller while buying paint for interior wall and ceiling. With regard to criteria considered while selecting paint for interior wall and ceiling majority of the respondents always considered brand (75.00%), price (73.34%) and, durability (62.50%). Type of solvent and drying time were never considered by 75.00 per cent and 70.83 per cent respectively. Further according to monthly family income and criteria considered for paint selection showed that 61.40 per cent respondents from higher income group considered brand for selection of paint. Whereas price was considered by large number of respondent from lower income group (39.28%).

Durability was considered by only 58.55 per cent of respondents from higher income group. Large number of the respondents from higher income group also considered ease of cleaning (57.14%), suitability (40.24%), stain proof (45.04%), techniques of using (46.66%), green mark on the label (55.55%), types of finish (46.31%), types of material or surface to be painted (52.17%), previous experience (46.00%), drying time (45.71%) and type of solvent (43.33%). Analysis on awareness level of the respondent revealed that half of the respondents were aware about the adverse effect of paint on human health. Based on the findings of the study a guideline was prepared for right selection of paint.

Assistive technology and home living elderly people

Nilakshi Borah

As a normal process aging affects the well-being of every person in some way. The social implication of this change in age structure will have serious implications and would be felt by various sections of society in different ways. Dependency, both physical and financial tends to grow with age.At the family level, a lot of other changes are also taking place which have a direct impact on the life of the elderly people. Assistive technology is used to support elderly people to get back into their normal life and enhance the independent living. Assistive technology "refers to a broad range of devices, services, strategies, and practices that are conceived and applied to ameliorate the problems faced by individuals who have functional disabilities" (Cook and Hussey, 2002). Assistive products are available for aiding the elderly to be independent in their daily living activities but people are not aware about the availability of such products in the market. Another issue for users may be poor design of the products. Products may be difficult to use as the targeted market was not addressed. Keeping it view in the present study on 'Assistive technology and home-living elderly people' had been carried out in Nagaon District of Assam with the following objectives-
1. To assess the prevalence of physical frailty.
2. To study the possession and use of assistive devices by home living elderly.
3. To explore the design needs perceived by elderly people to be in the available assistive devices used for selected activity.

The summary responses on physical frailty of studied respondents revealed that out of five indices, only in case of performance of basic ADL, the respondents were found self-sufficient. Low performance in IADL, high incidences of fear of falling, high prevalence of unintentional weight loss and presence of chronic diseases were observed; indicating frailty among the studied respondents. As regards to the use of assistive devices by the respondents, the present study found that only 10 per cent of the respondents were found using assistive devices while the remaining 90 per cent of the respondents do not use any assistive devices.

Though the analyses of data had shown low functioning of IADLs among the respondents, especially in housekeeping activities, the use of assistive device was observed very low. The most commonly used assistive devices found was canes for mobility (7.5 per cent), followed by wheel chair (1.25 per cent) and hearing loop (1.25 per cent). In the process of generating design specifications on mostly used mobility assistive device, a cane, few suggestions were came into foreface. Based on design modifications as suggested by the studied respondents effort had been made to redesign the cane.

Awareness of women about causes and effects of Indoor Air Pollution

Stephanie K. Sangma

The present study on "Awareness of women about causes and effects of indoor air pollution" was undertaken with the following objectives: (i) To assess the awareness level of women about causes and health hazards of indoor air pollution. (ii) To study the role played by housewives in minimising indoor air pollution at household level. A survey was carried out in Jorhat town of Assam. A multistage purposive cum random sampling method was adopted for the purpose of the study. Municipality area of Jorhat was divided into five parts and from each part one ward was selected randomly and 3 per cent of the total household from each ward were randomly selected to constitute a total sample size of 120. Personal interview method was used for data collection.

The findings of the personal and socio-economic characteristics showed that most of the respondents belonged to the age group of 25-35 years and majority of the respondents belonged to nuclear family with family size less than 5. Majority of the respondents were found to be graduates and were service holders. The monthly family income of majority of the respondents ranged from Rupees 10,000 to Rupees 30,000.

The findings of the awareness level of women about causes of indoor air pollution showed that 49 per cent of the respondents had high level of awareness and 38 percent had low level of awareness and 13 per cent had medium level of awareness. Of all the various causes of indoor air pollution viz., the common sources, sources prevalent inside the kitchen, biological pollutants causing IAP, sources of VOCs and sources of POPs; the common sources was ranked first among all the other causes of IAP as per the respondents' awareness. Biological pollutants ranked second, followed by sources inside the kitchen, sources of VOCs and sources of POPs.

Findings of awareness level of women about health hazards of indoor air pollution revealed that 46 per cent of the respondents had high level of awareness, 36 per cent had low level of awareness and 18 per cent had medium level of awareness about health hazards of indoor air pollution. The respondents were mostly aware about lung cancer caused by

exposure to cigarette smoke and was ranked first among other health hazards of indoor air pollution. Overall distribution about awareness of IAP consisting of both causes and health hazards revealed that 49 per cent had high level of awareness, 43 per cent had low level of awareness and 8 per cent had medium level of awareness.

Another findings showed that the role performance of majority of the respondents in minimizing indoor air pollution were good (48.33%) with cleaning of house regularly being the most performed role; 43.33 per cent of the respondents had poor role performance, and encouraging others to switch on exhaust fans in the bathroom/toilet when being used was the least performed role.

It was found that educational qualification of the respondents had some association with their awareness level about IAP but not with their role performance in minimizing IAP. Age, income and occupation were found to have no association with both awareness level and role performance. However, awareness level of the respondents about indoor air pollution was found to have some influence on the role performance of women in minimizing indoor air pollution.

Housing condition of tribal and non-tribal households in Jorhat district- A comparative study

Syeda Shabana Yasmin

Housing is the physical structure providing shelter, consuming land and providecertain basic services. It has a specific location and once made it is durable (Gandotra, 2006). Keeping it in view the present study on 'Housing condition of tribal and non-tribal households in Jorhat district- A comparative study' was carried out in Jorhat district of Assam with the following objectives-

· To study the housing environment of tribal and non-tribal households.
· To study the selected factors affecting tribal and non-tribal housing conditions.
· To study the awareness level of house wives towards the quality housing conditions.

In the present study comparison of housing condition of Tribal and non-Tribal housing conditions was done where the tribal respondents belonged to the Mishing community which is a major Assamese tribe. The study was conducted by purposive and simple random sampling method. Two agricultural development officer (ADO) circles located in two development blocks of Jorhat district namely Titabar development block and Kaliapani block were purposively considered for the study having basically agrarian population of both tribal (Mishing) and non-tribal. One tribal and one non-tribal village from each block were selected purposively so that comparison can be done properly having the villages situated in the same locality (block). Accordingly 20 tribal households and 20 non- tribal households from each village were selected by following simple random sampling method and accordingly a total 80 households were selected as sample.

It was revealed that the tribal and non-tribal households of similar family income differ in their housing structure. Tribal households had stilted house with raised platform of 5-7feet above ground level, they had less humidity level in their houses and showed no evidence of dampness. They had no drainage facilities for draining out the waste water. They washed utensils on the raised floor (*Chang*) and let the water fall underneath. Half of the tribal households use to keep their live stocks under the platform where they lived.They

mostly incinerate their household waste. Tribal respondents had low cost sanitary latrine provided by government schemes and by the NGOs as compared to the non-tribal respondents which was 55% and were mostly self-constructed. It was encouraging to note that, none of the non- tribal respondents had dug hole latrines and also they did not defecate in open spaces. Open defecation of 12.5% was found among tribal respondents. The study also revealed that majority of the tribal households had bamboo netting as smoke outlet in their house for removal of smoke from the kitchen. Regarding illumination at day and night inside the house, it was found that recommended intensity of daylight and night light was unavailable in many of the rooms in tribal households and thus rooms were inadequately bright.

On the other hand, houses of non-tribal respondents were not raised on stilts but on plinth with a height varying from 2-3 feet from the ground level. Humidity level inside many of the rooms was higher than the recommended level and a sign of dampness was observed. They had improper drainage facilities and mostly they kept their live stocks near the house. Majority of them dump their household waste. Recommended intensity of daylight was unavailable in some rooms but majority of them had adequate lighting in recommended level in almost all the rooms at night. They had proper arrangement, grouping and provision of flexibility in the room as compared to the tribal households. Regarding quality of potable water it was not found to be within the recommended level. Experiments revealed that the average bacterial count in the raw form of tube well water used by the tribal (126 CFU/ml) and non-tribal households (124.33 CFU/ml) was almost similar and was higher than the filtered and boiled forms of water used by both the groups. Overall awareness regarding quality of housing condition meeting the criteria of principles of residential planning was less among tribal respondents (22.5%) as compared to the non-tribal respondents (39.43%).

Assessment of microbiological attributes of commercially available ice creams in Jorhat town

Arundhati Mishra

The present investigation entitled Assessment of microbiological attributes of commercially available ice creams in Jorhat Town was under taken with specific objective to assess the microbiological quality of ice cream samples. Twenty seven ice cream samples of three different flavour namely (vanilla, strawberry, chocolate) were purchased from street vendors, departmental store and ice cream parlour, out of which twelve samples were locally produced, six samples collected were industrially produced (packaged) and nine samples were industrially produced (scooped) ice cream. The hand swab of ice cream sellers hand and air counts around the vended ice cream shops as well as of the parlours and departmental stores were also collected for microbiological analysis. The microbiological assay of the collected samples was conducted following the standard protocols and methodologies to test the presence of *Staphylococcus aureus, Bacillus cereus, Escherichia coli* and Fungus*.* The confirmation and characterization of the isolates was done using morphological and molecular characterization test using standards protocols. The total viable count of microorganisms isolated from scooped vanilla ice cream samples sold by vendors from different areas of Jorhat showed positive growth of *Staphylococcus aureus, Bacillus cereus, Escherichia coli* and Fungus. The presence of *Escherichia coli* was highest in all the samples and ranged from ($220 \times 10^3 \pm 11.31 \times 10^3$ cfu/gm to $277 \times 10^3 \pm 12.02 \times 10^3$ cfu/gm) followed by *Staphylococcus aereus* ($218 \times 10^3 \pm 12.02 \times 10^3$ cfu/gm to $242 \times 10^3 \pm 12.72 \times 10^3$ cfu/gm), Fungus ($43 \times 10^3 \pm 9.89 \times 10^3$ cfu/gm to $58 \times 10^3 \pm 18.38 \times 10^3$ cfu/gm) and *Bacillus cereus* ($40 \times 10^3 \pm 14.14 \times 10^3$ cfu/gm to $54 \times 10^3 \pm 16.97 \times 10^3$ cfu/gm). Similarly, the scoop strawberry and chocolate flavoured ice cream samples also showed a similar trend. The total viable count of *E. coli* ranged from ($226 \times 10^3 \pm 4.24 \times 10^3$ cfu/gm to $281 \times 10^3 \pm 9.91 \times 10^3$ cfu/gm) and ($230 \times 10^3 \pm 1.14 \times 10^3$ cfu/gm to $287 \times 10^3 \pm 4.94 \times 10^3$ cfu/gm) in strawberry and chocolate flavoured ice cream. *Staphylococcus aureus* ranged from ($223 \times 10^3 \pm 9.19 \times 10^3$ cfu/gm to $264 \times 10^3 \pm 5.65 \times 10^3$ cfu/gm) and ($228 \times 10^3 \pm 5.65 \times 10^3$ cfu/gm to $257 \times 10^3 \pm 2.12 \times 10^3$ cfu/gm) and *Bacillus cereus* ranged from ($45 \times 10^3 \pm 5.35 \times 10^3$ cfu/gm to $55 \times 10^3 \pm 3.53 \times 10^3$

cfu/gm) and ($48 \times 10^3 \pm 4.14 \times 10^3$ cfu/gm to $58 \times 10^3 \pm 7.77 \times 10^3$ cfu/gm) in strawberry and chocolate flavoured respectively. The fungal growth of both the flavoured ice cream ranged from ($51 \times 10^3 \pm 8.48$ to $66 \times 10^3 \pm 12.72$ cfu/gm) and ($56 \times 10^3 \pm 7.07 \times 10^3$ to $67 \times 10^3 \pm 12.02 \times 10^3$ cfu/gm), respectively. Microbiological profile of industrially produced (packaged) ice cream samples sold by Departmental store of Jorhat revealed that the vanilla flavoured ice cream of Rollicks was highly contaminated with *E. coli* ($228 \times 10^3 \pm 8.48 \times 10^3$ cfu/gm) followed by *Staphylococcus aureus* ($54 \times 10^3 \pm 18.38 \times 10^3$ cfu/gm), Fungus ($65 \times 10^3 \pm 24.74 \times 10^3$ cfu/gm) and *Bacillus cereus* ($44 \times 10^3 \pm 14.44 \times 10^3$ cfu/gm). Similarly in strawberry and chocolate flavoured ice creams, the growth of *E. coli* was highest ($225 \times 10^3 \pm 10.60 \times 10^3$ cfu/gm and $232 \times 10^3 \pm 5.65 \times 10^3$ cfu/gm) followed by *Staphylococcus aureus* ($70 \times 10^3 \pm 21.22 \times 10^3$ cfu/gm and $76 \times 10^3 \pm 16.97 \times 10^3$ cfu/gm), Fungus ($58 \times 10^3 \pm 15.55 \times 10^3$ cfu/gm and $62 \times 10^3 \pm 12.72 \times 10^3$ cfu/gm) and *Bacillus cereus* ($48 \times 10^3 \pm 11.31 \times 10^3$ cfu/gm and $53 \times 10^3 \pm 7.77 \times 10^3$ cfu/gm), respectively. Vanilla flavoured ice cream of Creambell was highly contaminated with *E. coli* ($230 \times 10^3 \pm 14.44 \times 10^3$ cfu/gm) followed by *Staphylococcus aereus* ($79 \times 10^3 \pm 28.99 \times 10^3$ cfu/gm), Fungus ($64 \times 10^3 \pm 8.48 \times 10^3$ cfu/gm) and *Bacillus cereus* ($49 \times 10^3 \pm 14.84 \times 10^3$ cfu/gm). Similarly in strawberry and chocolate flavoured ice creams of creambell also showed highest growth of *E. coli* ($230 \times 10^3 \pm 14.44 \times 10^3$ cfu/gm, $233 \times 10^3 \pm 12.02 \times 10^3$ cfu/gm and $240 \times 10^3 \pm 7.0 \times 10^3$ cfu/gm) followed by *Staphylococcus aureus* ($79 \times 10^3 \pm 28.99 \times 10^3$ cfu/gm, $80 \times 10^3 \pm 28.28 \times 10^3$ cfu/gm, and $94 \times 10^3 \pm 18.38 \times 10^3$ cfu/gm), Fungus ($60 \times 10^3 \pm 8.99 \times 10^3$ cfu/gm, $64 \times 10^3 \pm 8.48 \times 10^3$ cfu/gm, and $68 \times 10^3 \pm 18.38 \times 10^3$ cfu/gm) and *Bacillus cereus* ($49 \times 10^3 \pm 14.84 \times 10^3$ cfu/gm, $51 \times 10^3 \pm 13.43 \times 10^3$ cfu/gm, and $65 \times 10^3 \pm 3.53 \times 10^3$ cfu/gm), respectively. Similarly microbiological profile of industrially produced (scooped) ice cream namely Rollick, Kwality and Creambell sold by different ice cream parlours namely Amul parlour, Scoop parlour and Chill point revealed that all the brands of industrially produced Scoop ice creams showed highest growth *Escherichia coli* followed by *Staphylococcus aureus*, Fungus and *Bacillus cereus*. The vanilla flavoured (scooped) Rollicks ice cream sold in Amul parlour of Jorhat showed highest growth of *E. coli* ($224 \times 10^3 \pm 11.31 \times 10^3$ cfu/gm) followed by *Staphylococcus aureus* ($216 \times 10^3 \pm 9.89 \times 10^3$ cfu/gm), Fungus ($57 \times 10^3 \pm 10.60 \times 10^3$ cfu/gm) and *Bacillus cereus* ($44 \times 10^3 \pm 16.97 \times 10^3$ cfu/gm). Similarly, in strawberry and chocolate flavoured ice creams, the growth of *E. coli* was highest ($227 \times 10^3 \pm 9.91 \times 10^3$ cfu/gm and $237 \times 10^3 \pm 2.12 \times 10^3$ cfu/gm) followed by *Staphylococcus aureus* ($222 \times 10^3 \pm 5.65 \times 10^3$ cfu/gm and $225 \times 10^3 \pm 3.53 \times 10^3$ cfu/gm), fungus ($58 \times 10^3 \pm 9.89 \times 10^3$ cfu/gm and $68 \times 10^3 \pm 2.82 \times 10^3$ cfu/gm) and *Bacillus cereus* ($49 \times 10^3 \pm 13.33 \times 10^3$ cfu/gm and $57 \times 10^3 \pm 7.77 \times 10^3$ cfu/gm), respectively. Similarly, vanilla flavoured Kwality ice cream (scoop) sold in Scoop parlour of Jorhat was highly contaminated with *E. coli* ($221 \times 10^3 \pm 10.60 \times 10^3$ cfu/gm) followed by *Staphylococcus aureus* ($84 \times 10^3 \pm 39.59 \times 10^3$ cfu/gm), Fungus ($77 \times 10^3 \pm 27.57 \times 10^3$ cfu/gm) and *Bacillus cereus* ($53 \times 10^3 \pm 23.23 \times 10^3$ cfu/gm). In strawberry and chocolate flavoured ice cream the growth of *E. coli* was highest ($226 \times 10^3 \pm 7.07 \times 10^3$ cfu/gm and $228 \times 10^3 \pm 5.65 \times 10^3$ cfu/gm) followed by *Staphylococcus aureus* ($88 \times 10^3 \pm 36.76 \times 10^3$ cfu/gm and $102 \times 10^3 \pm 26.87 \times 10^3$ cfu/gm), fungus ($81 \times 10^3 \pm 21.21 \times 10^3$ cfu/gm and $88 \times 10^3 \pm 19.79 \times 10^3$ cfu/gm) and *Bacillus cereus* ($56 \times 10^3 \pm 13.33 \times 10^3$

cfu/gm and $60 \times 10^3 \pm 18.38 \times 10^3$ cfu/gm), respectively. The vanilla flavoured Creambell ice cream (scooped) sold in Chill point parlour of Jorhat was highly contaminated with *E. coli* ($237 \times 10^3 \pm 9.91 \times 10^3$ cfu/gm) followed by *Staphylococcus aureus* ($218 \times 10^3 \pm 8.48 \times 10^3$ cfu/gm), Fungus ($88 \times 10^3 \pm 29.69 \times 10^3$ cfu/gm) and *Bacillus cereus* ($56 \times 10^3 \pm 21.21 \times 10^3$ cfu/gm). In strawberry and chocolate flavoured ice cream the growth of *E. coli* was highest ($241 \times 10^3 \pm 6.36 \times 10^3$ cfu/gm and $245 \times 10^3 \pm 3.53 \times 10^3$ cfu/gm) followed by *Staphylococcus aureus* ($224 \times 10^3 \pm 4.24 \times 10^3$ cfu/gm and $227 \times 10^3 \pm 2.21 \times 10^3$ cfu/gm), fungus ($97 \times 10^3 \pm 23.33 \times 10^3$ cfu/gm and $103 \times 10^3 \pm 19.09 \times 10^3$ cfu/gm) and *Bacillus cereus* ($62 \times 10^3 \pm 16.97 \times 10^3$ cfu/gm and $64 \times 10^3 \pm 15.55 \times 10^3$ cfu/gm), respectively. From the study it was observed that among the different flavoured ice creams, chocolate flavoured ice cream irrespective of brands and types (scoop/packaged) showed highest contamination of *E. coli* followed by *Staphylococcus aureus,* Fungus and *Bacillus cereus*. Among the different industrially produced ice cream (packaged) the total viable count of *E. coli* was highest in all the flavoured creambell ice cream when compared with Rollick. From the different industrially produced ice cream (scooped) the total viable count of *E. coli* was highest in all the flavoured creambell ice cream when compared with Rollick and kwality. Comparison of microbiological profile of ice cream samples from different sources with Food Safety Standard Specification (FSSAI) revealed that 100% of the local scooped ice cream, industrially produced packaged and industrially produced scooped had highest growth of *E. coli* and *Staphylococcus aureus* which was above the prescribed limit of FSSAI where as the total viable count of fungus and *Bacillus cereus* were within the prescribed limit. Hand swab analysis revealed that the total viable count of microorganisms present in the seller's hands irrespective of sources was high when compared with Bureau of Indian Standard (BIS) specification (d" 100 cfu/gm). The total microbial count of *Escherichia coli*, *Staphylococcus aureus, Bacillus cereus* and Fungus of air in different ice cream unit were showed positive growth. Morphological test confirmed the presence of *S. aureus, B. cereus* and *E. coli* were confirmed by Gram staining. *S. aureus* appeared as gram positive bacteria with Cocci in grape-like clusters under microscope *B. cereus* appeared as large gram positive bacilli in short to long chain; spores are ellipsoidal, centre to sub terminal and do not swell sporangium and

E. coli* as gram negative small red coloured rods under the microscope. Presence of *Penicillium* appeared as single chain celled conidia, divergents or columns, hyaline or greenish, smooth or rough walled. Biochemical test confirmed the presence of *Staphylococcus aureus* by Carbohydrate fermentation test (mannitol). *Bacillus cereus* by Lactose gelatine test and Gelatine liquefaction test. The presence of *E. coli* by using KB001 HiLMViC ™ kit. Molecular characterization of isolated Organisms revealed that *S. aureus* have 96 to 97%, *Baccillus cereus* have 99% similarity, *E. coli* have 98% similarity with other known isolates of the same species. *Penicillium* also had 96 to 98% similarity with other known isolates of the same species.

Impact of nutrition counselling on nutritional status of expectant hypertensive and diabetic patient

Ashfeeka Islam

The present investigation entitled "Impact of nutrition counselling on nutritional status of expectant hypertensive and diabetic patient" was undertaken with specific objectives to record the medical history of the targeted expectant hypertensive and diabetic mothers, to assess the nutritional status of the target group, to impart nutrition counselling to the target group and to assess the impact of nutrition counselling on food and nutrient adequacy of the target group. Twenty two expectant hypertensive and diabetic patients were selected from Jorhat Medical College and Hospital, private nursing homes, private doctor's chamber and primary health centres of Jorhat district and were equally divided into two groups, i.e., experimental group and control group. The target respondents were interviewed using schedules to elicit information on their medical history, socio-economic background, food and nutrient intake and knowledge level regarding general nutrition, gestational diabetes mellitus and pregnancy induced hypertension. Nutrition counseling was imparted for three months (experimental group) at 30 days interval about pregnancy induced hypertension and gestational diabetes mellitus, signs and symptoms, causes, risk factors, complications and dietary management. The anthropometric parameters were also measured. It could be revealed from the results that the total target population (n=22) were suffering from pregnancy induced hypertension and gestational diabetes. It was observed from the present study that significant improvement was seen in food habits and dietary pattern of the experimental group while that of the control group were non significant. The mean daily intake in the experimental group for pulses had no significant change (100.03 to 100.3%), while that of cereals (79.44 to 96.15%), milk and milk products (29.95 to 39.81%), meat, fish and poultry (76.64 to 100.42%), fruits (39.09 to 77.95%), green leafy vegetables (54.15 to 110.58%) and other vegetables (52.72 to 104.99%) was increased significantly and mean daily intake of roots and tubers (30.72 to 13.87%), fats and oils (115.96 to 60%) and sugar and jaggary (41.8 to 8.15%) decreased significantly in the experimental group. However, the mean daily

intake in the control group had no significant change for pulses (90.93 to 11.66%), cereals (87.08 to 92.23%), milk and milk products (31.77 to 31.94%), meat, fish and poultry (170.4 to 128.14%), fruits (40 to 37.72%), green leafy vegetables (56.53 to 56.81%), other vegetables (54.54 to 65.36%), roots and tubers (33.12 to 22.59%) and sugar and jaggery (39.5 to 34.05%) while a significant decrease was observed in the mean daily intake of fats and oils (118.96 to 84.24%) in the group. The mean daily intake of energy (108.6 to 108.83%) and protein (101.63 to 139.04%) had no significant changes while that of iron (71.76 to 100.78%) and calcium (54.43 to 78.33%) was increased significantly and mean daily intake of fat (170.03 to 119.83%) and sodium (205 to 105.33%) decreased in the experimental group. In the control group, significant change was found in the mean daily nutrient intake of sodium (187 to 98.33%) whereas the changes were non significant in the intake of energy (101.63 to 102.11%), protein (145.75 to 145.81%), fat (146.1 to 127.26%), iron (70.57 to 77.5%) and calcium (55.08 to 59.99). The anthropometric parameters were compared with the ICMR standards where the experimental group had a standard increase in the mean weight (57.83 to 60.02 kg) and mean Body Mass Index (23.52 to 24.48 kg/m^2) while the control group had an excess gain in the mean weight (55.99 to 60.29 kg) and mean Body Mass Index (23.68 to 25.47 kg/m^2). There was also significant increase in the knowledge score obtained by the respondents in the experimental group regarding general nutrition (14.22 to 21.12), gestational diabetes mellitus (16.4 to 21.42) and pregnancy induced hypertension (17.36 to 21.46). Thus it can be inferred from the study that nutrition counseling significantly improved the nutritional status and the nutrition knowledge of the experimental group suffering from pregnancy induced hypertension and gestational diabetes mellitus.

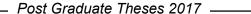# Development of value added products from Bael (*Aegle marmelos* Correa)

Gayatri Sharma

The present investigation was undertaken with an aim to develop value added products from bael fruit and to study the physico-chemical, sensory and storage quality of the products. A series of laboratory experiments were carried out to find the nutritional properties of the bael and its value added products. The bael fruit is round and spherical in shape, greenish yellow in fruit colour with light yellow pulp, having 218.33±54.84 g fruit weight, 76.13±12.18 g rind weight, 125 ± 25.00 g pulp weight and 12.84 ± 4.35 g seed weight. Total soluble solid was 12.2 %°Brix and pH was 4.8. It was found that the bael fruit contains moisture 71.09±0.35%, carbohydrate 24.97±0.11 g/100g, protein 1.49 ± 0.10 g/100g, crude fat 0.25 ± 0.02 g/100g, crude fibre 1.08 ± 0.02 g/100g, total mineral 1.12 ± 0.07 g/100g, iron 0.93 ± 0.01 mg/100g and calcium 101.68 ± 0.84 mg/100g. Three value added products of bael fruit namely bael powder, bael jam and bael RTS with two variation each i.e. mature green and ripe powder, high and low sugar ratio jam and RTS with 10% and 15% TSS were standardized and developed by using standard procedure. Sensory evaluation of the products was done through 9 point Hedonic scale by 10 panel members. Ripe powder, high sugar jam and 15% RTS were found better in overall acceptability and were selected for further analysis. Further the physico-chemical characteristics of the selected products were studied. Physico-chemical characteristics of bael powder (4.2 pH, 0.18% acidity and 8.62 mg vitamin C), jam (4.55 pH, 72% TSS, 0.51% acidity and 22.80 mg vitamin C) and RTS (3.95 pH, 20% TSS, 0.62% acidity and 18.20 mg vitamin C) was recorded. Also colour characteristics of the products was observed for powder (L*- 66.22, a*- 15.76, b*- 31.15), jam (L*- 35.60, a*- 10.42, b*- 15.93) and RTS (L* 29.12, a* 4.55, b*- 7.14). Bael powder was also analyzed for its proximate composition and antioxidant activities and results showed that it contains moisture 2.97 ± 0.85%, carbohydrate 79.64 ± 0.52 g/100g, protein 6.56 ± 0.75 g/100g, crude fat 1.10 ± 0.18 g/100g, crude fibre 4.78 ± 0.27 g/100g, total mineral 4.95 ± 0.04 g/100g, iron 4.11 ± 1.06 mg/100g and calcium 446 ± 0.04 mg/100g. The DPPH free radical scavenging activites

(% inhibition) in bael powder was 72.07%. Physical observation and sensory evaluation of products across storage shown that jam and RTS were acceptable upto 30 days and 15 days of storage respectively whereas powder remained almost of same characteristics. Microbial studies revealed that jam and RTS were safe for consumption upto 30 days and 15 days of storage respectively. On the other hand, powder can be stored upto 60 days without any marked growth of microorganisms. So from the present study it can be concluded that bael fruit has high nutritional as well as medicinal value and also have unlimited potential in its processed form.

Physico-chemical and functional properties of proso millet (*Panicum milliaceum* L.)

Papori Bora

The present study entitled "Physico-chemical and functional properties of proso millet (*Panicum miliaceum* L.) was undertaken to assess the physical characteristics, functional properties, chemical composition and its impact on plasma lipid in proso millet samples collected from Gosaigaon, Kokrajhar district of Assam. Proso millet samples were milled to obtain dehusked and polished grains and powdered to flour to evaluate its quality.

The physical characteristics of proso millet grains in terms of size revealed that milling significantly reduced the grain sizes. Length got reduced from 2.99 mm in whole grain to 2.18 mm in dehusked grain and 2.00 mm in polished grain. Similarly breadth got reduced from 1.98 mm in whole grain to 1.86mm in dehusked grain and 1.56 mm in polished grain. Thickness got reduced from 1.41 mm in whole grain to 1.04 mm in dehusked grain and 1.00 mm in polished grain. For the colour of grains mean L^* (lightness) and b^* (yellowness) value were highest in polished grain (63.04 and 25.17) followed by dehusked grain (62.14 and 24.46) and whole grain (56.37 and 18.46), respectively. Mean a^* (redness) value was found to be highest in whole grain (4.18) than in dehusked grain (1.93) and polished grain (0.79). Whole grain possessed significantly highest weight (4.94 g/1000 grains) and volume (6.64 ml/1000 grains), than dehusked (4.23 g and 5.0 ml/1000 grains) and polished (4.24 g and 4.9 ml/1000 grains) grains. No significant difference was found in bulk density of whole grain and dehusked grain, but polished grain (0.89 g/ml) showed significantly highest bulk density than both whole (0.80 g/ml) and polished grains (0.80 g/ml).

The nutrient composition of proso millet showed that whole grain contained 8.31% moisture, 3.20% ash, 13.67% protein, 3.96% fat, 6.14% crude fibre, 64.90% carbohydrate and 348.29 kcal/100g energy. Dehusked proso millet contained 8.95% moisture, 1.46% ash, 14.69% protein, 5.32% fat, 0.21% crude fibre,69.42% carbohydrate and 383.78 kcal/100g energy whereas polished grain contained 10.05% moisture, 1.19% ash, 13.94% protein, 2.57% fat, 0.07% crude fibre,72.15% carbohydrate and 367.51 kcal/100g energy. The

Abstract of M. Sc. Thesis
Department : Food Science and Nutrition (H.Sc)
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amylose content of proso millet was 5.50% in whole grain, 6.00 in dehusked grain and 6.60 in polished grain. The amylopectin content were 94.50% in whole, 94.00% in dehusked and 93.40% in polished grains.

The total phenolic content was present significantly higher amounts in whole (164.46 mg GAE/100g) and dehusked (145.81 mg GAE/100g) grains than polished grain (69.37 mg GAE/100g). Phytate content was highest in dehusked grain (682.50 mg/100g) than whole (574.74 mg/100g) and polished (194.00 mg/100g) grain. Whole grain possessed significantly highest total antioxidant capacity (281.79 mg TE/100g) than dehusked (156.93 mg TE/100g) and polished (144.94 mg TE/100g) grains.

Functional properties indicated that water absorption capacity was highest in whole grain flour compared to dehusked (102.54 g/100g) and polished grain flours (93.65 g/100g). The oil absorption capacity was 152.63 g/100g in whole grain flour, 104.30 g/100g in dehusked grain flour and 100.17 g/100g in polished flour. Bulk density was highest in polished grain flour (0.775 g/ml), followed by dehusked (0.712 g/ml) and whole (0.691 g/ml) grain flours.

The results of impact of supplementation of proso millet based diets (both whole and dehusked) on plasma lipid profile of experimental rats showed significant improvements in plasma high density lipoprotein (HDL) cholesterol, low density lipoprotein (LDL) cholesterol, total cholesterol and triglycerides level after maintaining a 28 days of feeding period, in comparison to the group feed with only high fat diet (HFD). The overall increase in mean and percent total cholesterol and LDL- cholesterol level in rats fed with HFD ranged from 12.15 mg/dl (16.15%) to 88.50 mg/dl (117.61%) and 11.04 mg/dl (23.98%) to 56.02 mg/dl (121.68%), respectively as the days progressed from 7 to 28 days. Whereas HDL-cholesterol level decreased from 0.44 mg/dl (2.74%) to 3.88 mg/dl (23.95%) from 7 to 28 days. Plasma triglyceride (TG) level showed non-significant change. The overall increase in mean and percent HDL-level in experimental rats fed with whole grain proso millet (WGPM) diet were 1.45 mg/dl (8.43%) in 10%, 3.94 mg/dl (24.67%) in 20% and 6.11 mg/dl (37.39%) in 40% and with dehusked proso millet (DPM) diet were 0.44 mg/dl (2.55%) in 10%, 1.32 mg/dl (8.26%) in 20% and 3.86 mg/dl (22.41%) in 40% incorporation into HFD in comparison to HFD control group at the end of intervention period of 28 days. It was observed that LDL-level gradually increased in all the experimental groups, but in comparison to HFD control group, it was seen that all the test diet treated groups had lesser extent of increase and found that overall mean and percent increase in LDL-cholesterol in supplementation with proso millet at 10%, 20% and 40% dietary level were 45.90 mg/dl (98.90%), 40.94 mg/dl (90.43%) and 33.70 mg/dl (74.52%) in WGPM and 51.05 mg/dl (109.74%), 48.20 mg/dl (106.42%) and 45.17 mg/dl (98.73%) in DPM, respectively which were lower than the percent elevation of LDL-cholesterol level observed in HFD group at the end of intervention period. In proso millet supplementation at 10%, 20% and 40% dietary level along with HFD possessed mean and percent increase in total cholesterol level as 78.04 mg/dl (103.34%), 73.09 mg/dl (96.37%) and 67.15 mg/dl (88.88%) in WGPM diet and 85.10 mg/dl (114.06%), 81.81 mg/dl (108.20%) and 78.67mg/dl (103.79) in DPM diet, which were also lower than the elevation of total plasma total cholesterol level produced by HFD control group at the end of intervention

period. The overall mean and percent decrease in plasma triglycerides level in experimental rats fed with whole grain proso millet with HFD were 4.03 mg/dl (4.16%) in 10%, 8.64 mg/dl (12.08%) in 20% and 14.53mg/dl (17.16%) in 40% incorporation whereas in experimental rats fed with dehusked proso millet with HFD were 2.89 mg/dl (3.86%) in 10%, 5.78 mg/dl (6.08%) in 20% and 7.95mg/dl (12.07%) in 40% incorporation into HFD in comparison to the HFD control group, after maintaining for 28 days of intervention period. Therefore, it is evident from the present study that the proso millet is nutritious, healthy and versatile and hence would be a healthy addition to one's diet.

Nutritional status of senior citizens of Jorhat district of Assam

Shreya Dutta

The study was undertaken to assess the nutritional status of the senior citizens of Jorhat district of Assam. The specific objectives of the study were to assess the nutritional status of the senior citizens of Jorhat, to assess the food intake and nutrient adequacy of the target population and to correlate the prevalence of disease with food habit and activity pattern among the target population. A sample of 200 respondents consisting both male and female genders in the age group of 60 years and above were selected purposively. Their socio-demographic characteristics, general dietary practices and prevalence of diseases were studied by specially formulated schedule whereas quantitative daily food intake was assessed by 24-hour recall method. The study revealed that 49% of the respondents were male while the rest 51% were female. About 53% of the respondents belong to nuclear families, 39.5% belong to extended families and only 7.5% belong to joint families. Most of them (29%) have a graduate degree and on the contrary none have been found to be illiterate. Family pension, services in government and private firms, salary of the family members, agriculture and business are the main sources of income. A total of 70 female were housewives and only 32 women were engaged in private and government job. Though the mean BMI of the respondents indicate a normal nutritional status , distribution of respondents according to individual BMI showed that 73.5% of the respondents had a normal nutritional status, 8% had mild chronic energy deficiency, 16% belong to low weight normal category and only 2.5% in grade I obesity. Modified Mini Nutrition Assessment (MNA) scores showed 24.5% were at risk of malnutrition. Dietary survey revealed that about 38% were non-vegetarian, 45.5% were occasionally non vegetarians while 16.5% were vegetarians. The percentage of adequacy for different food groups for both male and female was lower than BDR except for fats and oils. In case of nutrients, fats, energy and vitamin C have been found to be in excess than RDA but the diet is deficient in important micronutrients like iron, calcium and vitamin A. Highest prevalence of diabetes (33.5%)

was observed in the study population followed by hypertension (26.5%). It was also found that they suffer from other ailments like general weakness, insomnia, constipation, gastritis, low blood pressure, arthritis, liver ailments, respiratory infection, kidney disease, dental problems, cataract/loss of vision and anaemia. The physical activity pattern indicates sedentary lifestyle which increases with advancement of age. Though the activity hours were same in both the genders, the energy expenditure was found to be more in females. Results show a positive correlation of diabetes with carbohydrate and energy intake and hypertension with fat intake. A negative correlation exists between diabetes as well as hypertension with physical activity. The study thus observed a normal nutritional status of majority of respondents with prevalence of age related diseases. Such changes can be delayed, controlled or even prevented by modifying life style, habits and diet to achieve the best possible outcome of ageing.

A comparative study of Social Intelligence of Academically high and low achievers

Aloka Ghosh

Social intelligence (SI) is the capacity to effectively navigate and negotiate complex social relationship and environments (Ross, 2015). It develops from the daily interactions in the social setting from peoples around the social environment. Social intelligence becomes more important in determining success in life. Academic success also depends on a great deal with the social intelligence of human beings. Academic achievement in school or college is a consequence of the interplay of different social factors. Students experience high level of stress due to negligence, impatient behaviour, low confidence level, non-agreeableness with their classmates, tactfulness etc. Social intelligence plays a significant and important role to tackle with all this problems.

The present study entitled, "A comparative study of Social Intelligence of Academically high and low achievers" was undertaken at Jorhat sub-division of Jorhat district with the following objectives:

•   To identify the students with academically high and low achievement
•   To find out the social intelligence of high and low achievers
•   To compare the levels of social intelligence between high and low achievers
•   To find out the gender difference in social intelligence of students

A total of 200 students (100 high achievers and 100 low achievers) studying in the 1st year of three years degree course were selected purposively from the selected colleges of Jorhat sub division. Data was collected by using 'Social Intelligence Scale' (SIS) developed by Chadha and Ganesan (2009). The Social Intelligence scale was used to identify the levels of social intelligence under the dimensions namely: patience, cooperativeness, confidence, sensitivity, recognition of social environment, tactfulness, sense of humour and memory respectively. The background informations were also collected by using a questionnaire and the characteristics of the respondents were found out with the help of a Likert Scale.

Findings of the present study highlighted that all the high achievers were identified in three different colleges and all the low achievers were identified in four different colleges out of six colleges selected for the study. High achievers had more orientation towards parents, friends, academics and social application but the low achievers were merely involved in social application like chatting, uploading photos and playing games in mobile phones etc. Majority of the high achievers had high level of social intelligence than the low achievers in the dimension of patience, cooperativeness, confidence, sensitivity, recognition of social environment, tactfulness, sense of humour and memory. Statistical analysis also showed that there were significant differences between high and low achievers in all the dimensions of social intelligence, where high achievers possessed better level of social intelligence. As regard to gender, majority of female high achievers were significantly better than their male counterparts in the dimension of patience, confidence, tactfulness, sense of humour and memory. Study found that the percentage of female high achievers were more in high and very high level of patience and confidence. The percentages of female low achievers were also higher in the dimensions of tactfulness, sense of humour and memory but the percentage male low achievers was higher in high and very high level of confidence.

The overall picture of the social intelligence of high and low achievers highlighted that low achievers are not at par with the social intelligence of high achievers. Hence, measures at school level must be taken for imparting education for social learning so as to elevate their level of social intelligence.

A Study on gut feeling in Business Decision

Dharitri Sarma

Gut feelings are sudden and strong judgments that appear quickly in consciousness, whose underlying reasons we are not fully aware of, and is strong enough to act upon. Gut is the tube through which human and other animals transfer food to the digestive organs. The instinctive feelings we have from the gut region are the gut feeling or gut reaction. Both our gut and our brain systems are connected via a cable called the vagus nerve which gives the brain-gut connection. Through the bidirectional communication between gut and brain the bacteria in gut send messages to the brain andthe messages affect our psychological health. So, when we get a strong "gut feeling" it's actually every cell in our body remembering, thinking and deciding on matters and those decisions arewithout any doubt right for us.

There are a number of ways to make decisions, but most of the time we prefer two main approaches for making effective decisions *viz*. Rational or Analytical approach and Intuitive Decision Making Approach: relying on "gut feeling". Nowadays the business situations are becoming too complex to be solved. Thus, businesspersons need to take lot of major decisions in situations of emergency where they do not get adequate time for proper planning. As appropriate decisions are the vital component for business success, often the businesspersons prefers to rely on their gut feeling to make different decisionsrelated to their business.

With this background the present study entitled "A study on gut feeling in business decision" was undertaken with the following objectives:
1. To find out the decision making approaches of businesspersons
2. To study the application of gut feeling in business decision
3. To explore the factors which influence the 'gut feel' in business decision making

A total 60 businesspersons were selected purposively from three different sub-divisions namely Jorhat sub-division from Jorhat district,

Guwahati sub-division from Kamrup metro district and Mangaldoi sub-division from Darrang district. With prior permission from the respondents data was collected by using two questionnaires and three interview schedules. To elicit the background information of

the respondentsone questionnaire was constructed. Rational-Experiential Inventory developed by Pacini & Epstein (1999) was used to study the decision making approaches of businesspersons. To find the decisions making approaches in different areas of business and application of gut feeling in business decision two interview schedules were constructed and administered. To explore the factors which influence gut feeling in business decision, a questionnaire was constructed.

The findings of the study revealed that 53.33 per cent of the respondents were under the age group of 41 to 50 years and 50 per cent of them had educational qualification up to graduation. In the types of business 53.33 per cent of respondents possessed whole sale as well as retail business. In case of ownership of business 80 per cent of businesspersons owned sole proprietorship business. More number of respondents (53.33%) had completed 10 to 20 years of business experience. It was found that majority of the respondents had good level of experiential ability and experiential engagement (ability to make decisions based on gut feeling) in making business decisions. But in case of decisions regarding a specific area or component of businessrespondents mainly prioritized rational decision making approach at a high level. In the application of only gut feeling in business decision most of the businesspersons used their gut feeling principally. It was found that experience is the most contributing factor which influence gut feeling in making business decisions. Findings also revealed that there is significant positive correlation between experience and knowledge with experiential ability and experiential engagement.From the study it was found that majority of the decisions were influenced by gut feeling. It can be concluded that subjective experiences of businesspersons can be of great value for relying gut decisions and thereby practicing a holistic decision making approach to achieve greater success.

Assessment of family dynamics and its impact on only child's personality

Freyanki A. Sangma

The influence of the family on the child is immense. The influence of others agencies, although indispensable, must built upon the groundwork furnished by the family. It provides the basic environment for building the personality of the individual with its warm interpersonal relationship contributing to their feeling of security and belongingness. The family environment can be a strong source of support, providing close relationships, strong parenting skills, good communication, and modeling positive behaviours for developing children. With this background the present study entitled, "Assessment of family dynamics and its impact on only child's personality" was undertaken in Tura Town during 2015-2017 with the following objectives:

·   To assess the family dynamics of the single child families.
·   To assess the personality traits of only child.
·   To assess the impact of gender of the only child on various dimension of family dynamics.
·   To find out the relationships between various aspects of family dynamics and big five personality traits of single child.

A total number of 120 numbers of only children from grade X, XI, XII of Tura town were selected purposively for the study. A questionnaire was prepared to elicit background information of the respondents. A standardized test that is 'Family Environment Scale' (FES) was used to assess the family dynamics of the selected families and 'Big Five Inventory Scale' (BFIS) was used to find out the personality traits of only children. The FES was administered on the parents and the BFIS was administered to only children. The collected data were coded and analyzed.

The findings of the study revealed that almost all the families scored average on most of the dimensions of Family dynamics such as Cohesion, Expressiveness, Acceptance and caring, Active recreation orientation, Independence, Organization, and Control etc, except

for the dimension of Conflict where majority of families scored low. Majority of only children scored average in extraversion, openness to experience, conscientiousness, and agreeableness. In case of neuroticism the only children scored low. It was also found that the cohesion dimension of family dynamics significantly differ according to the gender of the only child. The conflict dimensions of family dynamics significantly differ according to the gender of the only child, which indicates that there is a significant difference in conflict dimension of families having female only child and families having male only child. Statistically significant positive correlations have been found between the family dynamics of cohesion and only child's personality traits extraversion and between family dynamics of organization and only child's personality traits openness. Results of the regression analysis indicated that the change in the dependent variables of openness and extraversion can be predicted by the change in the independent variables of organization and cohesion respectively.

Effect of School and Home Environment on Creative Thinking of High School Students in Jorhat

Joonmoni Gogoi

Creative thinking is the merging of ideas which have not been merged before. Every individual has the potentials for creativity in varying degrees. Therefore from the early period, they need right environment to flourish their creative thinking. Both home and school environment plays an important role in inculcating the creative thinking. Parents are the first teachers and role models for their children. The early parental attitudes play an important role towards the children's expression of creativity. Similarly after the home, school environment is an important determinant of creativity of students. If the school condition is unfavorable, it can counteract much of the stimulation of creativity provided by a favorable home environment. Therefore, proper stimulating environment should be provided to the children from their early period to enhance their creative thinking.

With this background the present study entitled 'Effect of school and home environment on creative thinking of high school students in Jorhat' was undertaken in Jorhat town during 2015-2017 with the following objectives:

1. To assess the creative thinking of high school students.
2. To study the influence of home and school environment on creative thinking of students.
3. To find out the creative thinking abilities of government and private secondary school children.
4. To find out sex differences in creative thinking of high school students.

A total of 240 students of class VI, VII and VIII (Age group of 11-14 years) were selected randomly from four co-educational Assamese medium high schools, i.e. two government and two private schools of Jorhat town. Data was collected from the respondents by using two standardized tools, *viz*. Non verbal test of creative thinking (Dr. Baqur Mehdi) and School Environment Inventory (Dr. Karuna Shankar Misra) in order to assess the creative thinking and the school environment of the students respectively. To assess the home environment of the students, a questionnaire was constructed consisting of background information and a total of 36 statements regarding the home environment of the students.

The findings of the study revealed that majority of the high school students had high level of creative thinking. It was found that there is high significant difference between government and private schools in creative thinking abilities. In private schools, the mean scores in elaboration and originality are high as compared to scores of government schools. Similarly, a significant gender difference existed in the originality dimension of creative thinking of the respondents. Boys had better originality of creative thinking than girls. But there is no significant difference in the elaboration dimension of creative thinking between boys and girls. In case of home environment, majority of the respondents were found to have good parenting style which influences more in creative thinking. Regarding the school environment, majority of the respondents belonged to high level in the dimension of creative stimulation. It was found that there is a significant difference in creative stimulation of government and private schools. Private schools are better in creative stimulation than the government schools. No significant differences were found between government and private schools on other dimensions of school environment, i.e., cognitive encouragement, acceptance, permissiveness, rejection and control.

A study on the effect of peer attachment on adjustment pattern of high school students of Assam: A case study of Nalbari District

Juri Deka

Adolescence is believed to be a period of great stress and storm as rapid physical and psychological changes occur during this period. During this time the growing person makes the transition from childhood to adulthood. High school students belong to this period. As they reach high school, students begin to spend more time with their peers. They develop a strong affectionate bond with their peers who are close to them. Being able to attach with peers is important for personal well-being and for fostering a supportive social network. Hence, their adjustment in all the four aspects namely home adjustment, health adjustment, emotional adjustment and social adjustment would be affected by their attachment with peers during high school years. Satisfactory adjustment in all these areas is very important because it can exert powerful influence on their developing personality.

With this background the present study entitled "A Study on the effect of peer attachment on adjustment pattern of high school students of Assam: A case study of Nalbari district" was undertaken in the Nalbari sub-division during 2015-2017 with the following objectives:

1. To study the level of adjustment pattern of high school students
2. To assess the level of peer attachment of high school students
3. To examine the relation of peer attachment to adjustment of high school students

A total of 180 students of Class VIII, IX and X (age groups of 13-16 years) were selected randomly from five government co-educational Assamese medium high schools of Nalbari district of Assam. Data was collected from the respondents by using Bell's adjustment inventory, developed by Dr. R. K. Ojha (1968) in order to assess the levels of adjustment pattern of students. To assess peer attachment of students, Inventory of Parent and Peer attachment (IPPA-Revised version) developed by G. Armsden and M. Greenberg (2009) was adopted.

The findings of the study revealed that majority of the high school students had average level of adjustment in the area of home, health and social adjustment. In the case of emotional adjustment, majority of the students had unsatisfactory emotional adjustment. It was also seen that there is significant positive correlation between different areas of adjustment i.e. home, health, social and emotional adjustment. In peer attachment of high school students, the responses of the students were mostly in average level in all dimension of peer attachment scale, i.e. peer trust, peer communication and peer alienation. It was found that majority of the high school students had average level of peer attachment. Results revealed that there is significant positive correlation between peer attachment and adjustment of high school students. The findings also revealed that peer attachment is highly correlated with emotional adjustment of high school students.

Teacher-student relationship and its effect on self-efficacy of student

Roma Islam Hazarika

The teacher-student relationship is an important element within the learning environment. It is very important for children because children spend large part of a day with teacher in school. The student-teacher relationship becomes stronger when teachers inspire students to interact constructively in classroom situations. Trusting relationship between teacher-student, support of teachers, willingness of the teachers to listen to student and their concern towards student helps the student to develop confidence in them. This in turn aids student to gain positive self-efficacy in their life. Self-efficacy is the belief in one's capacities to complete tasks and reach goals. It is the self-evaluation of one's competence to successfully execute a course of action necessary to reach desired outcomes.

With this background the present study entitled, "Teacher- student relationship and its effect on self-efficacy of student" was undertaken during the calendar year 2015-2016 with the following objectives:

§ To find out the teacher-student relationship.

§ To assess the self-efficacy of student.

§ To find out whether there exist any relation between self-efficacy and teacher-student relationship.

§ To compare teacher-student relationship and self-efficacy of students in government and private schools.

A total of 200 students were selected purposively from eight different (four government and four private) schools of Jorhat district of Assam. Data was collected from the respondents by using two different questionnaire namely questionnaire for teacher-student relationship to find out the teacher-student relationship of the students and questionnaire to assess the level of self-efficacy of the students. The teacher-student relationship was studied in terms of acceptance, encouragement, resourcefulness, and empathy.

The findings of the study revealed that the responses of the students in teacher-student relationship were mostly in the average level and only a few were found to be in higher level. It was also found that the responses of the student's in self-efficacy were mostly in average level. The findings also revealed that there exists a co-relation between teacher-student relationship and self-efficacy of students. It was found that the effect on self-efficacy of students with the changes in teacher-student relationship was more as compared to the effect on teacher-student relationship with the changes in self-efficacy of the students. Statistical analysis (t-test) showed no significant differences between government and private schools in the variables of teacher-student relationship and self- efficacy of the respondents.

Designing and creating of apparels inspired from traditional motifs of Mishing Community of Assam

Lizamoni Chungkrang

Designs are of great importance when it comes to give an enchanting and intriguing look to the textile products. Textile designing is full of creativity and scope with vast horizon, and is a demanding and emerging field. With the changing world of fashion, the field of textile demands for unique, different and fresh designs which give us the opportunity to use the adapted traditional motifs. Escalating demands of consumers requires modification in the fashion industry with respect to design, colour, style and technique. So, an attempt was made to designing apparels inspired from traditional motifs Mishing community of the Assam with following objectives-

    1. To study and document the traditional motifs and designs of Mishing Community of Assam

    2. To develop and create patterns for apparel using the existing motifs in a diversified way

    3. To construct selected apparels for adolescents

    4. To assess the consumer acceptability of the products.

Through this study the investigator attempts to popularize the traditional textile motifs of Mishing community and its value addition to different apparels. To carry out the study, wide range of Mishing traditional textile motifs were documented and collected from six selected districts of Assam- Dhemaji, Lakhimpur, Dibrugarh, Sibasagar, Jorhat and Golaghat through personal visit to common textile weavers. A preliminary study was conducted on the selection of the motifs. A set of fifty two numbers of ladies and gents apparels suitable for adolescents were designed and sketched with different colour combination and placed the chosen motifs for their opinion. Out of fifty two, fourteen designs were selected based on the results of the survey conducted. The selected designs were: 1(W), 2(W), 3(F), 4(W), 5(E), 6(W), 6(F), 7(E), 8(B), 9(B), 10(W), 11(W), 12(W), and 13(W). For woven techniques, peg plans were prepared in REACH Tax Software for each and every motif and carried out

the weaving process. For other three techniques, the patterns of motifs were developed in Coral Draw Software. The basic blocks were prepared and drafted based on the standardized body measurements. The cost of each constructed garments were calculated by considering the cost of material, cost of accessories used, labour cost and the profit.

The constructed apparels with different techniques were: Tunic (woven), Short summer dress (woven), Long gown (fabric painting), Top and Capri (woven), Palazzo (embroidery), Kurti (woven), Kurti (fabric painting), Fitted skirt and top (embroidery), Stole (block printing), Mekhela chadar (block printing), Neck tie (woven), Gent's formal shirt (woven), Nehru jacket (woven) and Gent's waist jacket (woven).

The constructed apparels were displayed at the Department of Textiles and Apparel Designing, Faculty of Home Science, AAU, Jorhat and systematically evaluated by a panel of 50 judges including staff members and Ph.D scholars based on criteria's like proper placement of the motifs, forms of existing motifs, colour combination, fitness and overall appearance of the apparel.

The constructed apparels were again evaluated by 50 consumers from different fields of textiles, to assess the consumer's acceptability in terms of general appearance, design of the apparel, colour combination of the apparels, selection of the traditional motif, arrangement of the motif, colour combination of the motifs. The evaluation was carried out in Faculty of Home Science, Assam Agricultural University, Jorhat-13, Department of Fashion Technology, Women's University, Jorhat and Jorhat market, including faculty members; Post graduate students, Ph.D scholars and Fashion designers. The evaluation was carried out with the help of a structured questionnaire.

From the results of the survey, majority of the respondents rated as excellent in terms of general appearance, design of apparels, colour combination, selection of the motifs, techniques used for developing the motifs, arrangement of the motifs and overall appearance of the constructed apparel. They also stated that all selected motifs were nicely incorporated in the respective apparels with exclusive colour combinations. Among all the 14 numbers of constructed apparel, the Design No. 1(W) was rated 1st rank whereas Design No. 6(F), 12(W), 10(W), 11(W), 8(B), 6(W), 3(D), 13(W), 5(E), 9(B), 2(W), 4(W) and 7(E) were rated rank from 2nd to 14th respectively.

From the above findings it can be concluded that it is possible to develop new and interesting designs from the existing Mishing traditional motifs to meet the excessive demands of contemporary designs in the fashion and apparel fields and also increase the variety of designs in the field of textiles. This study will help the fashion designers for creating more innovative ideas in the field of fashion designing and also it will help the motivates people to come up with an ingenious work, which indirectly help in upgrading the art and craft of Assam as well as India's.

A study on changing trends in Bodo costume of Assam

Parishmita Neog

The present study entitled "A study on changing trends in Bodo costume of Assam" was undertaken with the following objectives (1) to study the history and cultural practices in relation to the costumes (2) to study about the costumes used in different occasions (3) to study the changing trends in costumes.

Eighty respondents representing families selected randomly from six villages of Sonitpur district were interviewed through an interview schedule to study the traditional costumes and their changes taking place due to modernization now a days. General background information was also collected from the respondents.

The traditional costumes of Bodo tribe including dresses, ornaments, head-dresses used in day to day life as well as festive and religious occasions were studied. Traditionally, Bodo men wore Phali(gamusa) and Shirt as daily wear. During festivals they usually wear white shirt and Phali and Aronai in neck and head. On the other hand, Bodo women wore Dokhona and Blouse in daily wear. During festivals, they wear Dokhona, Blouse, Pharsa and Aronai. They have no definite costumes for new born baby. Dance performers wore their traditional dresses in vibrant colors. The Bride and Groom also wore their traditional dresses.

Changes have gradually taken place in day-to-day dress habits of men and women of the Bodo tribe due to various factors as revealed by the respondents.

Designing ready to attach yokes for kurtis using kantha embroidery

Pompy Jilly Borah

Yokes are horizontal divisions within a garment which may be functional or decorative. They are usually small, flat panels of fabric at the shoulder, waist, or midriff. Embroidered decorative yokes look attractive and are very much popular.

The present study deals with designing ready to attach yokes for kurtis using kantha embroidery stitches. Kantha is the traditional form of embroidery of West Bengal. Running style stitch is used to create various patterns and details for this embroidery. Kantha is an indigenous household craft popular among the rural women in West Bengal. The traditional form of this embroidery is done on soft dhotis and saris.

For the present study materials were collected from Jorhat town. The selected material for yoke was one coloured plain weave fine casement fabric. Cotton lining fabric of the same colour was also selected. Black poplin material was selected for the bindings. Printed cotton fabric was selected for the kurtis. The investigator designed and embroidered 7 yokes using kantha embroidery. The yokes were finished with bias binding so that they were ready to be attached on kurtis. Seven constructed kurtis were displayed and views of college girls were taken with the help of an interview schedule. From the data collected it has been found that Design No. 4 was ranked 1st for style of the yoke and Design No. 2 was ranked 1st for the embroidery design and also for colour combination of embroidery design. However, when the overall final rank was calculated, Design No. 2 and 3 were ranked 1st, Design No. 4 was ranked 2nd, Design No. 1 was ranked 3rd, Design No. 5 and 7 were ranked 4th and Design No. 6 was ranked 5th.

Abstract of M. Sc. Thesis

Department : Textiles and Apparel Designing (H.Sc)

Major Advisor : Dr. S. Kaur

Developing block for choli blouse

Sulekha Doley

A study was planned to develop block for choli blouse of bust measurement 80-88 cms size. The main objective of the study was to prepare blocks for choli blouse using three different drafting instructions and to construct the blouses. The basic block of simple blouses having bust size 80-84 cms and 84-88 cms developed by Borthakur (1995) was used to prepare blocks for choli blouse. The standard measurements available in the department were used to prepare the blocks.

Three different instructions given by Zarapkar (1990), Sodhia (2005) and Karampuri (2010) were followed to prepare the blocks in brown paper. Six numbers of basic bodice blocks (3 basic bodice blocks for each size) were constructed by using the loosely hand woven checked material. The constructed choli blocks were tried on 10 numbersof women and fitting was observed. Out of 10 women two numbers were selected as model for two different bust sizes (80-84 cms and 84-88 cms). Fifty different respondents observed and filled up interview schedule prepared to take view on fitting of the blocks. Most of the respondents preferred the choli blocks prepared following the drafting given by Karampuri. The instructions of Karampuri required minimum alterations for both the sizes. The altered and constructed choli blocks were tried on models and the fittings were observed. Two numbers of choli blouses of "U" neckline were stitched for each size using the suitable fabric and prepared blocks. The constructed choli blouses were again tried on models for each size. The final choli blouses fitted properly on the body of models of both sizes.

From the study it was found that choli blouse is the best replacement of simple blouse pattern. Most of the Indian women prefer choli blouse because it gives a sensous look even with a simple saree or gorgeous saree. Some women like to stitch their own blouse but due to lack of proper instruction and non-availability of blocks in Assam, they find difficult to stitch. Therefore blocks of choli blouses of two different sizes have developed which will help in stitching choli blouses.

Master of Fishery Science

- Aquaculture

Blank

Evaluation of Fermented Ipomoea aquatic Leaf Meal as Fish Feed of Indian major Carp fingerling, *Labeo rohita* (Hamilton)

Dharitri Baruah

The present study was conducted to evaluate the growth performance in terms of weight, feed conversion ratio, Protein efficiency ratio of Indian major carp yearling, Labeo rohita fed with fermented Ipomoea aquatica leaf meal for period of 90 days. The fingerlings were stocked in cement cisterns with 1.2 m ± 2cm water level. Eighty four no's of rohu fingerlings were divided into four treatments. Each treatment was further sub divided into three replicates. Four different diets prepared with fermented Ipomoea aquatica (0%, 30%, 40% and 50%) were fed to the four different treatments (T-I , T-II ,TIII ,T-IV) of rohu fingerlings, unfermented Ipomoea aquatica was taken as a reference diet. Out of four different treatment, the best growth of fish was recorded in treatment T-III (40% fermented Ipomoea aquatica) though T-II (30% fermented Ipomoea aquatica) also showed significantly better growth than the other two treatments (0% and 50% fermented Ipomoea aquatica). The feed conversion ratio was significantly higher in T-III (1.42) & TII (1.64) treatments fed with diet containing 40% & 30% fermented Ipomoea aquatica than other two treatments. However, the protein efficiency ratio was better in treatment T-III (2.23). However, the water quality parameters were not affected by the level of different diets. These findings suggest that diet containing 40% & 30% fermented Ipomoea aquatica appears to be sufficient for obtaining optimum growth in Indian major carp yearling, Labeo rohita in cisterns. The result also indicates the possibilities of substituting MOC with fermented Ipomoea aquatica in the diets of rohu & other IMC fingerlings.

Breeding and larval rearing *of Monopterus cuchia*(Ham-Buch)

Gobinda Basumatary

An experiment was conducted from August 2016 to July 2017 in the College of Fisheries, Assam Agricultural University, Raha to study the breeding and larval rearing of Monopterus cuchia under captive condition. During the experimental period, feeding of Monopterus cuchia was one of the major challenges. Being predatory in feeding habit it didn't feed on the artificial feed. However, brood stock of mud eel could be successfully raised in the brood stock rearing tank containing pond mud with live feeds. The GSI of the mud eel indicated that the breeding season extends from May to August with peak at July. Current experiment on breeding of Monopterus cuchia in captive condition was attempted in different environmental conditions in C-I, C-II and C-III. The induced breeding trials were made with GnRH and HCG hormones in different doses in 2:1 male female ratio. Successful breeding of mud eel could be achieved with HCG @ 1000 IU/kg female fish and 500 IU/Kg male fish but the numbers of eggs laid were very less. The larvae obtained were very few in numbers and could not successfully be reared beyond 5th days of rearing. The physiochemical parameters of water were found to be in the optimum ranges. Since Monopterus cuchia is an endangered fish and has lots of remedial and economic aspects, therefore, detail scientific study relating to brood stock rearing, artificial propagation and larval raising are in need to save the species from extinction. Detail aspects of M. cuchia need to be studied in order to develop mud eel culture technology to save the species from future extinction

Comparative Assessment of Growth performance of Indian Major Carps on Periphyton and Supplementary Feed

Kalpajit Gogoi

An experiment on comparative assessment of growth performance of Indian major carps in periphyton based aquaculture and conventional polyculture culture system was conducted for a period of 90 days in 12 rectangular cements tanks. Four treatments in triplicate were tried: only fertilization T0 (control), fertilization plus bamboo substrate (T1), fertilization plus bamboo substrate plus feed (T2) and fertilization plus feed (T3). Each of the 12 tanks was limed and fertilized then stocked with 30 fingerlings of Catla catla, Labeo rohita, Cirrhinus mrigala (average initial size, 10.82 ± 0.05 gm, 10.78 ± 0.06 gm, 10.73 ± 0.07 gm and length of 11.43 ± 0.06 cm, 12.86 ± 1.74 cm and 11.35 ± 0.06 cm respectively). Fishes were fed with rice bran and mustard oil cake at 1:1 ratio on w/w basis and fortified with vitamin and mineral mixture at 1 % of total feed. Fishes showed significantly ($p\bar{A}0.05$) higher mean weight gain in T2, T3 and T1 (125.08 g, 66.60 g and 54.86 g respectively) compared to control. Survivability rate was highest ($p\bar{A}0.05$) in T2 (87.77 %), followed by T1 (85.55 %), T0 (76.66 %) and the lowest was in T3 (72.22 %). Among the treatment T2 showed 283.71 % higher production followed by T3 (71.30 %), T1 (69.11 %) compared to control. Net weight gain of catla and rohu highest in T2 (139.78 ± 4.96g) followed by T1 (66.69 ± 2.33g), T3 and T0 but the in case of catla and mrigal highest net weight gain was recorded in T2 followed by T3, T1 and T0. Improved FCR value was observed in T2 (1.34) compared to T1 (1.85) and addition of substrate leads to 38.05 % reduction in FCR value. Up to 2.91 % of SGR was observed in rohu in T2. A total number of 39 genera of periphytic community were identified. Among them 28 genera of algae periphyton comprised of four different groups, Bacillariophyceae (10 genera), Chlorophyceae (12), Cyanophyceae (4) and Euglenophyceae (2) as well as 11 genera of periphytic animal community comprised of Protozoa (2 genera), Rotifera (4), Copepoda (2), Cladocera (3) along with macrobenthic invertebrate (Chironomids larvae) were recorded from bamboo substrate. Treatments differed significantly in some water quality parameters (transparency, dissolved oxygen, ammonia-nitrogen, ammonia-nitrogen and phosphatephosphorus) and periphyton biomass (dry matter (DM), ash-free dry matter (AFDM) and ashcontent).

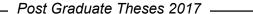**Abstract of M. F. Sc. Thesis**
Department : Aquaculture
Major Advisor : Dr. D. K. Sarma

Effect of Crude Extract of Neem (*Azadirachta indica*) and Guava (*psidium guajava*) on *Aeromonas hydrophila, Pseudomonas fluorescens* and *Edwardsiella tarda* infection in Fresh water Fish *Labeo rohita* (Hamilton)

Manash Pratim Gogoi

Bacterial fish diseases are always havoc to the fish farming industry and the use of antibiotics to control these can lead to the emergence of antibiotic resistant microorganisms. Herbal products not only serve as antimicrobial agent, but also work as immunostimulator. Keeping in view the importance of different herbal derivatives in aquaculture the present study was undertaken from August 2016 to June 2017 to study the antimicrobial effect of Neem (Azadirachta indica) and Guava (Psidium guajava) extracts respectively against Aeromonas hydrophila, Pseudomonas fluorescens and Edwarsiella tarda. These fish pathogens were isolated from the diseased fishes encountered in Nagaon and Morigaon districts of Assam. Disease outbreaks due to A. hydrophila and P. fluorescens were very frequent in these two districts of the state. Aqueous extract of both the herbs had antimicrobial effect against the three bacterial fish pathogens in different spectrum. All the concentrations of Neem and Guava extract had bactericidal effect against the studied pathogens with maximum effect for 200 mg/ml. An increase in concentration of the herbs showed an increasing trend of antimicrobial effect. There was no effect of Neem extract against the emerging fish pathogen E. tarda. Crude extract of Guava leaves had prominent effect against all the three bacterial pathogens. Antimicrobial property of Guava was found to be higher compared to that of Neem. Both the extracts of Neem and Guava elicited immunostimulatory response in L. rohita. Incorporation of crude extract in feed did not affect the acceptance level of the feed by the fishes. There was increase in the RBC, WBC and Hb content in experimental fish fed with feed incorporated with the extracts of

Neem and Guava. Supplementation of feed with crude extract of Guava can enhanced the resistance of L. rohita against A. hydrophila, P. fluorescens and E. tarda infections through enhancement of the non-specific immune responses. The crude extracts of Neem and Guava may thus form the source of natural and alternative drug that can improve the treatment of infection caused by bacterial fish pathogens. Consequently, it can be recommended that the dietary inclusion of crude extract of guava leaves up to 200 g/kg in the diet, could boost the immune response of L. rohita against A. hydrophila, P. fluorescens and E. tarda infections.