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Ph.D (Agriculture)

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- **Agricultural Biotechnology**
- **Agricultural Economics and Farm Management**
- **Agronomy**
- **Crop Physiology**
- **Entomology**
- **Extension Education**
- **Horticulture**
- **Nematology**
- **Plant Breeding and Genetics**
- **Plant Pathology**
- **Sericulture**
- **Soil Science**
- **Tea Husbandry and Technology**

A Study on the Role of Rhizospheric Bacteria in Promoting Plant Growth and Alleviating Biotic Stress in its Host

Alokesh Ghosh

Cabbage is susceptible to various fungal pathogens such as Xanthomonas campestris, Alternaria brassica, Rhizoctonia solani, etc. Various fungicides have been recommended such as chlorothalonil and tebuconazole, which are highly toxic to both soil and aquatic ecosystem and may induce tumors in mammalian cells. Bio-inputs can be the most sustainable and eco-friendly approach to mitigate plant diseases. In the present study, two rhizospheric bacterial isolates Bacillus amyloliquefaciens AG1B and B. subtilis AG2B showed antagonistic activity against Alternaria brassicicola AG1F. Previously reported endophytic bacteria, B. subtilis Scb-1 also showed similar antagonistic activity against the same pathogenic fungi. The cell-free supernatant of the bacterial isolates showed a significant reduction in fungal growth. Microscopic studies revealed deformed hyphae and conidia with bubble formation when co-cultured with the antagonist bacterial isolates. Lipopeptides are bioactive compounds that pose substantial challenges to the structural integrity of fungal cell walls and are regarded as antifungal in nature. LC-MS analysis showed that co-cultivation of B.amyloliquefaciens AG1B with A. brassicicola AG1F results in the secretion of several lipopeptide and polyketide compounds such as surfactin, iturin, etc. Similar results were also obtained when B. subtilisAG2B and B. subtilis Scb-1 were co-cultured with A. brassicicola AG1F, respectively.The complete genome of the potential bacterial isolate; B. amyloliquefaciens AG1B with a percentage inhibition of 76.47 % against A. brassicicola AG1F was reconstructed through de novo assembly, revealing a genome size of 3.89 Mbp. This genome encompasses genes associated with plant growth promotion, lipopeptides and polyketides synthesis, and genes that confirm its affiliation with rhizobacterial interactions. Differential expression analysis of key genes such srfAB, ItuA, fenF etc., involved in the synthesis of lipopeptides and polyketides during the dual culture condition showed significant transcriptional up-regulation, validating the results of metabolite profiling. Moreover, the bioprimed seeds of cabbage with the

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potential bacterial isolates, B. amyloliquefaciens AG1B, B. subtilis AG2B and B. subtilis Scb-1 respectively, showed better germination percentage, increase in root, and shoot length. Foliar application of the potential bacterial isolates B. amyloliquefaciens AG1B, B. subtilis AG2B and B. subtilis Scb-1 efficiently resulted in a reduction of disease severity up to 80%. Thus, multifaceted bio-inputs like B. amyloliquefaciens AG1B, B. subtilis AG2B and B. subtilis Scb-1 can be used for making bioformulation for sustainable management of fungal diseases.

Genome wide DNA methylation analysis in response to drought in two contrasting rice genotype of Assam

Dipen Nama Adhikari

Drought is a significant environmental stress factor that adversely affects rice productivity. However, many details regarding the molecular mechanisms of rice against drought are still unclear. In this study, leaf transcriptomics and physiological traits of two rice genotypes with differing drought resistance were analyzed. Transcriptome sequencing identified 5517 and 1418 differentially expressed genes (DEGs) in ARC10372 and Ranjit respectively in case of tillering stage and in Panicle initiation stage number of DEGs are 5712 and 7026 in ARC 10372 and Ranjit respectively Functional analysis suggested that numerous genes are highly involved in soxidative defense, protein modification, photosynthesis, phytohormone response, MAPK signaling, and transcription factors (TFs). Compared to Ranjit, ARC 10372 had a higher expression of DEGs related to antioxidant enzymes, photosynthetic electron transport, heat shock proteins, and indole-3-acetic acid (IAA) signaling under drought conditions, which might contribute to its tolerance mechanisms to drought. Stress-induced TFs may play a crucial regulatory role in genotypic differences. Moreover, the physiological changes and gene expression abundance determined using quantitative reverse transcription polymerase chain reaction(qRT-PCR) were consistent with the RNA sequencing data. A total of 37,711 differentially methylated regions (DMRs) were detected between the two genotypes under stress conditions, and the DMR-associated genes in ARC 10372 were mainly related to stress response, programmed cell death, which are implicated to constitutive drought stress tolerance. A comparison of the DNA methylation changes in the two genotypes under drought conditions indicated that ARC 10372 plants have a more stable methylome, with only 31,439 droughtinduced DMRs, than Ranjit with 6272 DMRs. The study results suggest that the higher drought tolerance of ARC 10372 than Ranjit can be attributed to stronger stress defense capabilities, IAA signal transduction, and more stable photosynthesis.

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Major Adviser: Dr. P. Sen

Investigation into the polymer- digesting ability of greater wax moth (*Galleria mellonella* L.)

Gadi Sri Harsha Vardhan

Plastic pollution, particularly from polyethylene (PE) and polystyrene (PS), poses a significant environmental challenge. Interestingly, *Galleria mellonella*, an insect-pestof honey-hives, is a voracious feeder of the honey-wax, which shares similar bonding properties with common plastics. The larvae of the insect also consume plastic-polymers. This research delves into the plastic feeding behaviour of *Galleria mellonella*larvae, examining their physiological properties and their core gut microbiome in relation to various feeding substrates. Larval feeding experiments confirmed utilization of PE and PS, albeit with reduced growth compared to conventional diets. 16S metagenomic analysis revealed a prevalence of *Enterococcus* species in PE and PS feeding groups, contrasting with other groups dominated by *Rhodothermus marinus, Pyrodictium delaneyi, Candidatus* species, among others. Inpursuitofmicrobialcandidatesaidingin plastic digestion, four isolates (GM15, GM16, GM17, GM18) were identified from the larval gut and assembled into a consortium. This microbial consortium demonstrated colony formation on PE sheets, as evidenced by Stereo Electron Microscopy (SEM), revealing an approx. 1.8% degradation of PEsheetsafter30daysofincubationat31°C. Additionally, the study explored the potential of gut microbiome-independent plastic digestion by subjecting GWM larvae to antibiotic treatment. Growth comparisons with the control group and Gas Chromatography-Mass Spectrometry (GCMS) analysis of frass metabolites indicated similarities in metabolite profiles, including long-chain hydrocarbons (hexadecane, heptadecane, heptacosane, pentacosane, eicosane, docosane, etc.). These findings contribute to our understanding of the intricate interplay between *Galleria mellonella*larvae, their gut microbiome to facilitate plastic degradation; nevertheless, further research could potentially aid to tackle the problem of plastic- pollution.

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Estimation of genetic effects for low temperature tolerance in boro rice of Assam through QTL analysis

Gracia Priya Kumari

In recent years, boro rice cultivation in Assam has gained popularity among farmers due to its higher productivity than sali and ahu rice, and has become an alternative to flood affected areas. However, the advantages of boro rice cultivation are limited by low-temperature stress during seedling stage, leading to seedling mortality. Therefore, understanding genetic basis has become a prerequisite and hence the present study was aimed to detect the genetic effects for low temperature stress through QTL (Quantitative trait loci) analysis. The donor parent had been selected based on phenotypic evaluation and marker based genotypic variations for low temperature tolerance in 219 boro rice cultivars collected from Regional Agricultural Research Station (RARS), Karimganj, AAU. Among these cultivars, the donor parent was selected based on its ability to survive the lowest temperature of 5°C. On the other hand, the recipient parent was chosen from high yielding varieties (HYVs), showing susceptibility to low temperatures at 12oC, 8oC and 5oC. Two cultivars were selected as parents, namely PSBRC2 (donor) and Jyotiprasad (recipient), and were crossed to obtain true F1 seed. Subsequently, single F1 seed was selfed, F2 seeds were advanced to F7 generations using the SSD (single seed descent) method to develop a mapping population consisting of 188 RILs (Recombinant Inbred Lines). Parental polymorphism study was conducted using 600 microsatellite markers; among which 90 markers were found to be polymorphic (15% marker polymorphism). The RILs along with parents were then genotyped using 90 microsatellite markers. A linkage map was constructed covering 4391 cM based on 90 microsatellite markers spanning 12 linkage groups using the software Join Map 4.0. The phenotypic scores under field and controlled environment were compared with genotypic data using software, Map QTL6 and R/QTL for identification of the QTLs. The analysis detected six QTLs associated with seedling stage traits in controlled environment under cold stress, located on chromosomes 2 (qCTGRS2, LOD score 2.7; qCTSUR2, LOD score 2.3), 5 (qREC5, LOD score 2.9;

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qSUR5, LOD score 2.7), 8(qREC8, LOD score 2.16), and 12 (qSUR12, LOD score 2.06). Additionally, one QTL was found to influence colouration at seedling stage in field condition on chromosome 1 (qCTS1, LOD score 3.24), and six QTLs were detected for yield attributing traits on chromosomes 2 (qNOT2, LOD score 2.47), 4 (qGY4, LOD score 1.93) and 9 (qNOG9, LOD score 2.27; qDFF9,LOD score 2.47; qSF9, LOD score 2.01).The detected QTL regions were scanned to identify candidate genes associated with cold tolerance in rice. A 10Mb region for each QTL was scanned and a total of 6995 genes were detected; out of which 3171 were annotated. From the annotated genes 32 genes were found to be stress related genes and from these, eleven(11) candidate genes associated with cold stress were detected (OsICE-1, ICE-1, ATG6A, OsATG6a, OsOFP4, OsOFP06, OsOFP6, OFP6, OsPUB3, OsPUB03, PUB3, P5CS2, OsP5CS2, OsALDH18B2, PYL/RCAR3, OsCTZFP8, BIP120, OsUGT90A1, OsFKBP65, OsFKBP62b). These findings hold significant promise for enhancing low temperature tolerance in boro rice, if candidates are identified and introgressed through fine mapping and further map based cloning.

Cloning and characterization of cDNA encoding legume seed defensin and its activity against bruchids

Jyotsna Dayma

Defensins are small cysteine-rich peptides that play a crucial role in a plant's innate immune system and are known for their well-established antimicrobial activity. However, their potential insecticidal properties have received limited exploration. Chen and his coworker have identified a defensin protein from mung bean (Vigna radiata) having insecticidal activity against bruchids. Our previous research confirmed the upregulation of a defensin gene in black gram due to the bruchid infestation. In the present study, sequencing of the full-length complementary DNA of the defensin gene from various legumes was performed. We found two amino acid sequence variants, PEP1 and PEP2 with 90 to 97% homology with the previously reported mung bean defensin protein, respectively. The PEP1 variant was found in black gram, pea, cowpea, and common bean, while PEP2 was found in mung bean, chickpea, and pigeon pea. The amino acid sequence alignment showed there are two amino acid substitutions in the signal peptide and three amino acid substitutions in mature protein regions of PEP1 compared to PEP2. Expression analysis of insecticidal defensin in different legumes revealed significant upregulation of the defensin gene in common beans, followed by black gram and cowpea, whereas, downregulation was observed in the case of pea, pigeon pea, mung bean, and chickpea that are susceptible to the bruchid infestation. The signal-truncated defensin protein was expressed in E. coli bacteria with an intein tag and a 32.5kD fusion protein was isolated. The cleavage of the tag through chitin affinity chromatography yielded mature peptides of 5.5 kD. Computational visualization showed that PEP1 displayed stronger interactions with the α-amylase enzyme of bruchids (Callosobruchus sp.), particularly through inter-chain hydrogen bonding when compared with PEP2. Moreover, PEP1 demonstrated higher (>14%) α-amylase inhibition activity compared to PEP2. In the insect bioassays, bruchids fed on PEP1 through an artificial diet at a concentration of 0.2% and 0.3% exhibited no adult emergence compared to PEP2. A plant expression vector was also constructed for expressing the defensin gene

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in the seeds of legumes. The results suggest the presence of amino acid substitutions in the defensin protein of legumes, which could be associated with the resistance to bruchid infestation. Thus, the expression of the black gram defensin gene regulated by a seed-specific promoter in grain legumes such as chickpea/ pigeon pea could provide durable resistance to bruchids.

Studies toward development of seed less Bhimkol banana (*Musa balbisiana*) using tissue culture approach

Manab Bikash Gogoi

Bhimkol Musa balbisiana (Family Musaceae) under BB diploid genomic group (2n=2x=22) of banana is indigenous cultivar of Assam and has a traditional bond with the indigenous people of this region. Bhimkol is highly nutritious and possess medicinal properties. Fresh ripe pulp of the fruit has antiperoxidative and antioxidant properties which can prevent oxidative stress related diseases. Commercial importance of Bhimkol was realized with presence of industrial baby food products like Bhimvita, Bhim Shakti, Assam Bhim in the supermarket and online platforms like Amazon made from fresh fruit. The demand of 'baby food product is increasing day by day not only in North eastern states but in other parts of India. However, presence of seed in the fruit is undesirable not only from consumption point of view but it impedes product development during industrial processing. Therefore, in the present study tissue culture methods towards development of seedless Bhimkol were studied. Male inflorescences were collected from orchards between 7-9 am to isolate anthers. Pollen viability test was conducted in bracts no 20 to 25 using 1% acetocarmine stain and highest percentage of viable pollen (78.16±15.32) was found in bract no 21. Microscopic study at 100x revealed the presence of uninucleate microspores along with dyad, triad and tetrad cells. Anthers containing uninucleate microspores were selected in the present study. In all, 300 number of anthers were inoculated in modified MS medium for callus induction. The highest frequency of friable androgenetic callus was observed after 60 days in modified MS medium supplemented with 2 mg/l of IAA and 1mg/l of 6-BAP. Calli were transferred in same medium for embryo germination. The germinated embryos were further treated with modified MS medium supplemented with IAA, BAP & CH for shoot induction. Growth regulators combination of 7 mg/l of BAP, 0.5 mg/l of IAA, 350 mg/l of CH was found to be the best for shoot induction and 12 numbers of plants were regenerated with a frequency of (4 %). Chromosome counting at metaphase stage revealed four (4) haploid n=11 with a frequency of (1.3%) and 8 diploids n=22 plants

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with a frequency of (2.66%). The ploidy level was reconfirmed by Flow Cytometer based on histogram florescence intensity associated with relative DNA content. For obtaining triploids endosperm culture was done using three types of explants 1) half cut seed, 2) endosperm and 3) endosperm containing zygotic embryo. Total 250 explants were inoculated in modified MS with different concentrations of growth hormones. Explants with half cut seed and endosperm degenerated after 28 days of inoculation due to blackening, whereas endosperm containing zygotic embryo produced white friable callus in modified MS mediim with 0.1 mg /l of 2, 4-D, 3mg/l of NAA and 0.5 mg kinetin. For shoot induction calli were transferred in different treatments of GR.Treatment no (T5) modified MS medium with 2 mg/l of NAA, 3 mg/l of BA produced the highest number of shoots regenerated and led to 26 numbers of plants. Chromosome counting, Flow cytometry test along with stomatal counts revealed 1 anueploid, 5 diploid and 20 triploids. Studies were also conducted to isolate protoplast from In vitro regenerated haploid and diploids tissue using reported protocol and demonstrated the regeneration of somatic hybrid through fusion of haploid and diploid protoplasts which was confirmed by histogram florescence intensity associated with relative DNA content using a Flow cytometer. The protocol for haploid, triploid and somatic hybridization could be used in future for increasing the frequency of haploid, triploid and somatic hybrids in order to develop seedless Bhimkol production.

A study of sulphur metabolizing bacteria from tea garden soil for improving sulphur uptake in crop plants

Manjistha Baruah

Sulphur, an important element for plant growth, is required for the synthesis of several essential vitamins, amino acids, initiation of enzymes, formation of glucosides, chlorophyll, and glucosinolates. Bacteria with sulphur metabolizing ability are at the center of sulphur cycling taking part in the oxidation, reduction, assimilation and dissimilation of sulphur in the entire ecosystem. In acidic soil, the amount of sulphur is less which affects the plant growth. Sulphur metabolizing bacteria with low pH tolerance can be used as bioinoculum to facilitate sulphur availability to the crop plants. Towards this end, sulphur metabolizing bacteria was isolated from acidic soils and characterized for sulphur metabolizing activity. The most efficient sulphur metabolizing, acid tolerant bacteria along with plant growth promoting activities isolated was identified as Priestia aryabhattai MBM3 as deduced from morphological, biochemical and molecular studies. The genes involved in sulphur metabolic pathway in the bacterial isolate grown in acid stress were upregulated during the lag phase indicating to the low sulphur availability during acid stress and hence higher expression of the gens. Further studies of the isolate for plant growth promotion in Brassica campestris L. variety JT-90-1 (Jeuti) was evaluated through pot experiments. The pot soils with pH 5 were supplemented with 100%RDF (T1), 50% RDF+bio-primed seeds (T2), bio-primed seeds (T3), along with an absolute control. Agronomic and physiological traits in relation to plant height, number of leaves, flavonoid content and total carbohydrate fared better in plants treated with bacteria (T2 and T3) than in control and T1 plants. At a molecular level, the plant sulphur transporters (SULTR1 and SULTR4) and pathway genes such as APS reductase and sulfite reductase had lower expression in roots indicating to favorable uptake of sulphur by the plant and its subsequent transfer to the other parts. This was evidenced by higher expression of the transporter genes in leaves signifying its uptake followed by its subsequent assimilation by the pathway genes viz. ATP sulphurylase, APS reductase, and sulfite reductase. However, in the control and T1

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plants, a significant high expression of APS reductase was observed indicating over production of sulfite. Increased sulfite production is reported to affect chlorophyll content and stunted growth in plants as evidenced by agronomic and physiological traits of the control and T1 plants. The above results suggest that isolate MBM3 was able to elicit a sulphur uptake response in Brassica campestris grown in acidic soil of pH 5 as compared to control revealing a delicate symbiosis between plant and bacterial signaling pathways. Further studies to unravel the plant signaling pathways involved in evoking an enhanced sulphur metabolism due to bacterial treatment will shed more light into role of the bioinoculum before it is taken to the field.

Study the viral disease complex associated with Bhut Jolokia leaf curl disease and application of Virus Induced Gene Silencing (VIGS) in model plants for virus management

Richita Saikia

Bhut Jolokia (*Capsicum chinense* Jacq) is one of the hottest chillies and an economically important crop in North-eastern India. A common problem in cultivation of Bhut Jolokia is the occurrence of leaf curl diseases that causes huge yield losses (Talukdar et al., 2015). In the present study, we attempt to identify the associated viruses and viral components in the occurrence of leaf curl disease in Bhut Jolokia. Sequencing of the PCR amplified viral targets identified multiple viruses. The results suggest that in the same isolated samples, leaf curl disease is caused by multiple DNA and RNA viruses rather than a single virus, representing two major families-Geminiviridae and bromoviridae. We also identified novel betasatellites from Bhut Jolokia infecting samples which has less than 91% pairwise identity with rest of betasatellite sequences deposited in NCBI. The betasatellites detected in Bhut Jolokia from Assam are possibly from a novel strain of a virus and might be related to Chilli leaf curl virus. In addition, understanding the plant-virus interaction mechanisms and identification of specific plant genes playing vital role in disease development could accelerate the resistance breeding process in Bhut Jolokia. Therefore, functional analysis of plant endogenous gene in conferring resistance or susceptibility against Cucumber mosaic virus (CMV) using virus induced gene silencing (VIGS) was conducted. In this study, two Nicotiana tabacum genes- Plasmodesmata located protein (PDLP) and Soybean genes regulated by cold 2 (SRC2) were silenced using the TRV-based VIGS system. The results obtained from the experimental work done suggests that both PDLP and SRC2 are potential candidate susceptibility or resistant genes against CMV infection in Nicotiana benthamiana plants. We also reported that TRV-based VIGS vectors can be used to effectively silence these potential candidate genes in Bhut Jolokia. The role of the newly identified betasatellite in promoting virulence of the cognate virus in still unclear. Thus, further complemention assay is required with or without the cognate virus in the host

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plant. Transgene free genome edited virus resistant plants can also be developed as a long-term goal using CRISPR technology. Further functional studies are required to validate the role of these genes in conferring resistance or susceptibility to CMV in host plants. Overall, the present study provides insight into the causal infecting viral disease complex in Bhut Jolokia and the role of plant endogenous genes in conferring resistance or susceptibility against CMV using VIGS.

Molecular Analysis for traits related to draught adaptation in Rice (*Oryza sativa* L.)

Subhrota Bordoloi

Drought is a major abiotic constraint for rice production worldwide. Model based studies revealed reproductive stage drought stress (RSDS) and intermittent drought stress (IMDS) are expected to reduce yield significantly in Sali and Ahu season, respectively. The present study was conducted with the aim to detect the genetic effects of water stress through quantitative trait locus (QTLs) associated with drought tolerance in rice. The donor and the recipient parent were selected based on the phenotypic evaluation and gene expression analysis using five drought responsive genes in two drought tolerant cultivar (ARC10372, Koimurali) and two susceptible cultivar (Disang, IR-64). Based on the results, Koimurali was crossed with a drought susceptible cultivar, Disang to obtained true F1 seeds. Subsequently the single F1 seeds was selfed for and advanced to subsequent generations (F5:6) using single seed descent (SSD) method to develop the mapping population consisting of 247 RILs. Parental polymorphism study was conducted by screening 600 SSR markers; among which 98 SSR markers were found to be polymorphic (16.33%). The RILs along with their parents were genotyped using the 98 polymorphic SSR markers and a linkage map was constructed covering a distance of 2495.31cM spanning across the 12 linkage groups using the software JoinMap 4.0. The phenotyping score of two different stress condition (reproductive stage drought stress stress and intermittent drought stress condition) were compared with the genotypic data for identification of QTLs. The QTL analysis detected eight QTLs at reproductive drought stress located on chromosome number 3(qGY3LOD 3.54, qYSI3LOD3.54); 4(qGY4LOD 2.57, qTOL4 LOD 2.56, qYSI4 LOD 2.56, qYSI4 LOD 2.59, qRYR4 LOD 2.58, qDSI4, LOD 2.62) and 11 QTLs at intermittent drought stress located on chromosome1 (qFLW1, LOD 2.23, qNOC1 LOD 2.7, qNOG1 LOD 1.83); 3(GLW3 LOD 2.55), 4(qGY4 LOD 2.7, qRYR4 LOD 2.35, qTOL4 LOD 3.5, qTOL4 LOD 2.2, qYSI4 LOD 2.35), 7(qNOG7 LOD 2.91, qTNG7 LOD 2.84). The detected QTL regions were scanned to identify putative genes associated with drought tolerance in rice in both the stress conditions. The putative gene in reproductive drought stress were used to check the expression in four extreme breeding line of different drought

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tolerant capacities. QTL comparision between both the stress conditions were evaluated and one QTL was found common and few shared the same chromosome but in different marker intervals indicating different genetics might control the underlying stress conditions. The putative QTLs and candidate genes identified in the present study need to be further validated, which will be helpful for the improvement of drought tolerance in rice.

Dynamics of Agricultural Labour - Its Demand and Supply Analysis in Assam

Pompi Dutta

India's economy underwent transformation as agriculture's role shifted. In the 1950s, 70% of the workforce relied on agriculture, but technological progress and labor migration led to a decline. India diversified, fostering a balanced economy. Assam saw similar changes. Female participation in agriculture rose, but women preferred labor-intensive roles to cultivation. Migration from agriculture to non-agricultural sectors posed challenges. Climate change disrupted labor and rainfall patterns, affecting farming. Mechanization aimed to reduce labor, but its adoption varied due to factors like farm size. Ensuring equitable benefits of technology and addressing climate and migration challenges are essential. Despite advancements, full automation remains distant, with human involvement crucial. Addressing small farmers' needs and nuanced tasks is vital for balanced progress. Women's role in agriculture grew, but challenges persist. Policy efforts must sustain agriculture, empower workers, and achieve sustainable development. the aim of this research is to measure the disparities in demand and supply, identify what triggers these discrepancies, and evaluate how these causative factors influence the gap. The specific objectives of this study include : a. Examine the magnitude of agricultural labour at disaggregated levels in Assam; b. Estimate the demand for and supply of agricultural labour across agricultural operations with gender participation c. Analyze the effect of farm mechanization, migration and climate change on labour employment decisions d. Study the problems of agricultural labour and suggest suitable measures, if required. The findings of the study indicate a noteworthy shift in the distribution of labor within the agricultural sector. Both main workers and marginal workers have exhibited a decline in the proportion of cultivators, coinciding with a rise in the number of agricultural laborers. Notably, the labor dynamics exhibit a significant contrast between the UBVZ and CBVZ regions. The UBVZ region faces a situation where the demand for labor surpasses the available supply, while the CBVZ region experiences an inverse scenario. Furthermore, the implementation of mechanization practices has led to a reduction in the labor force engaged in mechanized farms utilizing tractors and threshers. In regions prone to floods and droughts, there is

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Department: Agricultural Economics & FM

Major Adviser: Dr. P.B. Gogoi

an observable surge in labor demand, particularly during transplanting activities. It is noteworthy that the UBVZ region addresses labor shortages during peak seasons through the employment of migrant laborers. The challenges faced by farmers are multifaceted, encompassing issues such as labor scarcity and unavailability of machinery. These observations carry implications for policy and agricultural practices, suggesting the need for targeted interventions in regions with varying labor dynamics and specific challenges related to workforce availability and mechanization.

Effect of irrigation regimes on rabi maize (*Zea mays* L) under late sown condition

Deshmane Vishal Babasaheb

A field experiment entitled "Effect of irrigation regimes on rabi maize under late sown condition" was conducted at the Instructional-cum-Research Farm of Assam Agricultural University, Jorhat-13 during the rabi seasons of 2021-22 and 2022-23 with objectives to study the performance of late sown rabi maize under the reduced irrigation regimes. The soil of the experimental site was sandy loam in texture with acidic reaction (pH 5.7 and 5.9), medium in organic carbon (0.68% and 0.74%), low in available nitrogen (265.5 and 277.4 kg ha^{-1}), low in available phosphorus (26.60 and 31.02 kg ha^{-1}) and medium in available potassium (166.6 and 172.8 kg ha^{-1}). The experiment was laid out in split plot design with 3 replications. The treatments consisted of three sowing dates *viz.,* 20th November (D1), 30th November (D2) and 10th December (D3) in main plots and irrigation regimes *viz.,* Rainfed (I1), Irrigation at knee high stage at field capacity (FC) (I2), Irrigation at knee high stage at 60% FC (I3), Irrigation at knee high + tasseling stages at FC (I4), Irrigation at knee high + tasseling stages at 60% FC (I5), Recommended (Irrigation at knee high + tasseling + grain setting stages at 6 cm) (I6). Maize hybrid DKC 9081 was selected for research. The total rainfall received during the crop season was 387.1 mm with 30 rainy days in 2021-22 and 278.5 mm with 21 rainy days in 2022-23 during the whole crop growing period. The mean maximum and minimum temperature during the whole crop growing period ranged from 33.3 to 8.2°C during 2021-22 and 31.9 to 7.9°C during 2022-23, respectively.

The biometry of the plants, such as plant height, stalk girth, number of leaves per plant, leaf area, shoot dry weight, longest root, root volume, and crop growth rate, were significantly influenced by different sowing dates with the highest values observed for the plants sown on 20th November (D1) crop followed by the 30th November sown crop during both the years. The crops sown on 20th November also had a significant impact on the analysis of crop growth rate *viz*., Leaf area index and crop growth rate. Similar effects were observed in yield and yield attributing characters *viz*., number of cobs per plant (1.15 and 1.21), length of cob (21.95 cm and 22.82 cm), girth of cob (16.53 cm and 17.65), number of rows/cob (13.70 and 14.08), number of kernels/row

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Major Adviser: Dr. R. K. Thakuria

(23.85 and 24.64), number of kernels/cob (365 and 370.65), 100-kernel weight (27.53 g and 28.12 g) , cob yield with husk (86.71 q ha^{-1} and 90.29 q ha^{-1}) and without husk (75.75 q ha^{-1} and 79.49 q ha^{-1}). The yield of grain and stover yield was found to be significantly higher in the case of treatment with the 20th November sown crop with pooled yield (66.89 q ha^{-1}) followed by the 30th November sown crop (57.38 q ha^{-1}) and the least values were noted with the 10th December sown crop (50.06 q ha^{-1}) during 2021-22 and 2023.

The highest irrigational water use efficiency was found with the 20th November sown crop (96.05 kg ha-mm^{-1} and 90.35 kg ha-mm^{-1}) followed by the 30th November sown crop (80.55 kg ha-mm^{-1} and 77.36 kg ha-mm^{-1}) during 2021-22 and 2022-23 respectively. The Nitrogen, Phosphorus and Potassium content and uptake by grain and stover of maize were highest with the 20th November sown crop at par with the 30th November and the lowest values were recorded with the 10th December sown crop. In terms of irrigation regimes, the highest values for plant height (195.69 cm and 200.45 cm), stalk girth (11.78 cm and 12.68 cm), number of leaves per plant (10.67 and 11.01), leaf area per plant (5441.87 cm^2 and 5734.10 cm^2), shoot dry weight (107.12 g and 108.87 g), longest root (76.65 cm and 74.37 cm), root volume (159.97 cc and 161.77 cc) and crop growth rate were observed in the recommended irrigation treatment (knee high + tasseling + grain setting stages at 6 cm depth of irrigation) followed by the irrigation at knee high + tasseling stages at FC. Similarly, yield and yield attributing characters *viz*., the number of cobs per plant (1.27 and 1.35), length of cob (22.43 cm and 23.05 cm), girth of cob (17.97 cm and 18.86 cm), number of rows/cob (14.33 and 14.80), number of kernels/cob (390.67 and 396.77), number of kernels/row (25.46 and 26.01), 100-kernel weight (29.70 g and 30.30 g), cob yield with husk (91.18 q ha^{-1} and 95.94 q ha^{-1}) and without husk (79.07 q ha^{-1} and 82.30 q ha^{-1}) and grain yield (Pooled- 72.03 q ha^{-1}) and stover yield (117.12 q ha^{-1}) were found to be significantly increased during both years with recommended irrigation regimes (knee high + tasseling+ grain setting stages at 6 cm depth of irrigation) followed by irrigation at knee high + tasseling stage at field capacity (FC) during both years and low yield was noted in rainfed treatment during 2021-22 and 2022-23. The highest irrigational water use efficiency was found with irrigation at knee high stage + tasseling at 60% FC followed by irrigation at knee high stage at FC (169.26 kg ha-mm^{-1} and 166.79 kg ha-mm^{-1}). The Nitrogen, Phosphorus and Potassium content and uptake by grain and stover of maize were highest in recommended irrigation regimes (irrigation at knee high + tasseling+ grain setting stages at 6 cm) followed by irrigation at knee high + tasseling stage at field capacity (FC). In terms of economics, the highest values of gross return (H 1,77,402 ha^{-1} and H 1,83,313 ha^{-1}), net return (H 1,37,721 ha^{-1} and H 1,43,933 ha^{-1}) and B-C ratio (4.47 and 4.65) were recorded with recommended irrigation treatment (knee high + tasseling+ grain setting stages at 6 cm depth of irrigation) followed by irrigation at knee high + tasseling stage at FC and the least values were recorded with rainfed treatment during both years. Based on two years of studies for late sown rabi maize, 20th November sowing was found to be the best for to increase yield (63%), soil nutrients, irrigational

water use and economics return under recommended irrigation regimes (irrigation at knee high, tasseling and grain setting stages at 6 cm depth) followed by further delayed sowing up to 30th November under deficit irrigation regimes i.e. two irrigations at knee high and tasseling stages with an irrigation water depth of 60-100% FC (14-25% of soil moisture) giving scope of 40% water saving.

Evaluation of tillage, plant growth promoting bacteria and weed management practices in upland direct seeded rice

Jimni Phukan

A field experiment entitled "Evaluation of tillage, plant growth promoting bacteria and weed management practices in upland direct seeded rice" was carried out during 2020 and 2021 at Instructional-Cum-Research (ICR) Farm, Assam Agricultural University, Jorhat to evaluate the effect of different tillage, plant growth promoting bacteria and weed management practices on weed, crop and soil properties. The experiment comprising 20 treatment combinations with 2 tillage practices, *viz*., T1: conventional tillage, T2: reduced tillage up to 50%; 2 plant growth promoting bacteria treatments, *viz*., P1: Pseudomonas fluorescens, P2: no inoculation and 5 weed management practices, *viz*., W1: Sesbania aculeata mulching, W2: brown manuring with Sesbania aculeata, W3: pretilachlor @ 0.75 kg/ha followed by bispyribac-sodium @ 0.025 kg/ha at 30 DAS, W4: mechanical weeding at 20 and 40 DAS, W5: weedy check, laid out in a split-plot design with tillage and plant growth promoting bacteria treatments in main plot and weed management practices in sub-plots replicated thrice. The soil of the experimental site was sandy loam, acidic in reaction (pH 5.5), medium in organic carbon (0.60 %), available N (280.60 kg/ha), available P_2O_5 (22.28 kg/ha) and low in available K_2O (128.07 kg/ha). The initial bulk density, total porosity as well as water holding capacity of the soil at 0-15 and 15-30 cm soil depth were 1.43 and 1.50 g/cc, 44.96 and 42.31% and 43.10 and 41.02 %, respectively. Among tillage practices, conventional tillage resulted in the lower weed growth throughout the crop growth period and the higher crop growth characteristics as well as yield parameters of upland direct seeded rice as compared to reduced tillage up to 50%. The per cent increase in grain yield of upland direct seeded rice under conventional tillage over reduced tillage up to 50% were to the tune of 16.60 and 17.91 in 2020 and 2021, respectively. Among, plant growth promoting bacteria treatments, Pseudomonas fluorescens inoculation recorded better crop growth characteristics as well as yield parameters leading to better weed suppression as compared to no inoculation. The per cent increase in grain yield

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Department: Agronomy

Major Adviser: Dr. Jayanta Deka

under Pseudomonas fluorescens inoculation compared to no inoculation was to the tune of 8.38 in 2020 and 8.84 in 2021. Among different weed management treatments, pretilachlor @ 0.75 kg/ha followed by bispyribac-sodium @ 0.025 kg/ha at 30 DAS and brown manuring with Sesbania aculeata recorded the lower weed growth and nutrient uptake by weeds with higher WCE and WCI during active crop growth period which resulted into the higher crop growth characteristics and yield parameters ultimately reflecting in the higher grain and straw yields with higher nutrient uptake by the crop. The corresponding per cent increase in grain yield of crop in pretilachlor @ 0.75 kg/ha followed by bispyribacsodium @ 0.025 kg/ha at 30 DAS and brown manuring with Sesbania aculeata compared to weedy check was 188.99 and 175.62 in 2020 and 189.24 and 174.85 in 2021, respectively. Treatment combination of conventional tillage either with pretilachlor @ 0.75 kg/ha fb bispyribac-sodium @ 0.025 kg/ha at 30 DAS or brown manuring with Sesbania aculeata recorded higher grain and straw yields as compared to other treatment combinations. Soil physico-chemical and biological properties like carbon stock, periodical soil moisture content, available N, P_2O_5 and K_2O, microbial population, microbial biomass carbon and maximum activity of enzymes, *viz.,* phosphomonoesterace and dehydrogenase was recorded in reduced tillage up to 50% compared to conventional tillage. However, bulk density, total porosity and water holding capacity were better under conventional tillage. Among plant growth promoting bacteria treatments, Pseudomonas fluorescens inoculation recorded higher availability of nutrients, microbial population, microbial biomass carbon and maximum activity of enzymes, *viz*., phosphomonoesterace and dehydrogenase. However, this treatment did not significantly affect the soil physical properties. The higher B-C ratio was recorded under treatment combination of conventional tillage, Pseudomonas fluorescens with pretilachlor @ 0.75 kg/ha fb bispyribac-sodium @ 0.025 kg/ha at 30 DAS (2.01 and 2.04) followed by conventional tillage, Pseudomonas fluorescens and brown manuring with Sesbania aculeata (1.97 and 2.01) in 2020 and 2021, respectively.

Resource conservation through crop establishment methods and weed management practices in winter rice (*Oryza sativa* L.) - garden pea (*Pisum sativum* var. hortense) relay cropping system

Sameeron Bhattacharjya

A field experiment was conducted at the farmers' field at Pirakata Brahmin gaon under the jurisdiction of Krishi Vigyan Kendra, Jorhat with a view to study the resource conservation through crop establishment methods and weed management practices in winter rice (*Oryza sativa* L.) - garden pea (Pisum sativum var. hortense) relay cropping system during 2019-20 & 2020-21. The treatment consisted of four crop establishment methods of winter rice (T) *viz*., T1 : WDSR (Broadcasting), T2 : WDSR (Modified Drum Seeder with furrow opener), T3 : PTR (Farmers' Practice), T4 : PTR (Mechanized Transplanting by paddy transplanter) where WDSR: Wet Direct Seeded Rice, PTR: Puddled Transplanted Rice along with three weed management practices of rice (W) *viz*., W0 : Weedy check, W1 : Pretilachlor 0.75 kg/ha as preemergence fb bispyribac-sodium 0.025 kg/ha (20 DAS/DAT) as post-emergence, W2: Pretilachlor 0.75 kg/ha as pre-emergence fb manual weeding (30 DAS/DAT). The experiment was laid out in a factorial randomized block design with three replications. The soil of the experimental site was sandy clay loam in texture, medium acidic in reaction, mediumin organic carbon and available N and low in available P_2O_5 and K_2O. The study revealed that establishment method i.e. T3: PTR (FP) resulted lower weed growth during 30 DAS in winter rice but T2: WDSR (Drum Seeder) had lower weed growth in subsequent growth stages at par with T3: PTR (FP) and T4: PTR (MTR). It was found that T2, T3 and T4 had higher growth and yield parameters of the crop as compared to T1 : WDSR (B) which resulted higher grain and straw yield of winter rice as well as uptake of nutrients. The highest grain yield of 49.79 and 50.13 q/ha of winter rice was recorded under T4 : PTR (MTR) followed by 46.62 and 47.8 q/ha in T2 : WDSR (Drum seeder) during 2019 and 2020, respectively. Among the weed management practices, i.e. W1: Pretilachlor 0.75 kg/ha as pre-emergence fb. Bispyribac-sodium 0.025 kg/ha (20 DAS/DAT) as post-emergence and W2: Pretilachlor 0.75 kg/ha as pre-emergence fb

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manual weeding (30 DAS/DAT) recorded lower weed growth and nutrient uptake with higher weed control efficiency (WCE) and weed control index (WCI) during active growth period of winter rice. This resulted into higher crop growth characteristics and yield parameters which ensured higher grain and straw yield as well as uptake of nutrients by winter rice. The percent increase in grain yield of winter rice in W1 and W2 as compared to W0 (control) was 82.97, 84.52 in 2019 and 81.62, 81.58, respectively in 2020. The treatment combination T4W2 recorded highest grain and straw yield of winter rice which was statistically at par with T4W1, T2W1 and T2W2. The higher B:C of 2.27 and 2.14 was recorded in T2W1 with higher gross return and net return followed by T2W2 (2.18 and 2.08 during 2019 and 2020, respectively). In case of relay garden pea, no significant difference in green pod yield and stover yield was recorded due to rice establishment methods and weed management practices. Highest green pod yield of 18.54 and 19.10 q/ha was recorded under rice establishment method T4: PTR (MTR) during 2019-20 and 2020-21, respectively. Weed management practice W1 resulted higher green pod yield of 18.23 q/ha during 2019-20 whereas W2 resulted higher green pod yield of 18.36 q/ha during 2020-21. Soil physico-chemical properties like bulk density, water holding capacity, carbon stock of soil at 0-15 cm and 15-30 cm depth, available N, P2O5 and K2O were significantly improved under rice establishment method PTR (MTR). Cost benefit analysis of the winter rice–relay garden pea cropping system revealed that among different treatment combinations highest B: C was registered in T2W1 (2.67 and 2.51) followed by T2W2 (2.49 and 2.37) during 2019-20 and 2020-21, respectively.

Comparative study on existing and improved farming systems in relation to productivity, profitability and carbon budget

Sarat Sekhar Bora

A study was conducted during 2022-23 at Salikihat village of Golaghat district and Dagarmakha village of Udalguri district of Assam, to determine the productivity profitability and carbon budget of the existing farming systems of both villages, along with the improved farming systems of AICRP on IFS of ICR Farm, AAU, Jorhat and AAU-ARRI, Titabar. Benchmark survey was carried out in the villages for identifying different types of existing farming systems. Thirteen models were identified under the existing farming systems, which comprised of different component of two improved models under the improved farming system. The efficient, climate-resilient farming system model with the highest productivity and profitability was identified, and the soil carbon stock of both the farming systems was evaluated. Winter rice followed by toria cultivation was the predominant practice in all the models of both farming system. The highest productivity amongst the different models of both existing farming systems was obtained in Crop + Poultry + Goatery + Piggery + Fishery (Model-VII) and profitability was maximum in Crop + Dairy + Poultry + Goatery (Model-V) with a B:C ratio of 2.48 and 2.38 at Salikihat and Dagarmakha, respectively. In comparison between existing and improved farming system, Crops + Dairy + Fishery + Poultry + Duckery + Goatery + Apiary + Vermicompost (Improved-I) model found to provide maximum productivity and profitability, with a B:C ratio of 2.54. The soil carbon stock of the different models of existing farming system was recorded to be the highest in Crop + Dairy + Poultry + Goatery (Model-V) and amongst the improved farming system, the highest was obtained in Crops + Dairy + Fishery + Poultry + Duckery + Goatery + Apiary + Vermicompost (Improved-I). C-budget among the existing and improved farming systems model was determined by evaluation of total carbon source and sink, and it was found to be the lowest in Improved I with (-) 240.18 CO_2-e (kg). In Salikihat of Golaghat, the lowest C-budget was obtained in Model-V (Crop + Dairy + Poultry + Goatery), whereas in Dagarmakha of Udalguri, Model-XI (Crop + Goatery) recorded the lower C-budget.

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Department: Agronomy

Major Adviser: Dr. Ranjit Kumar Saud

Maximum productivity, profitability and the lowest carbon budget was recorded in Improved-I (Crops + Dairy + Fishery + Poultry + Duckery + Goatery + Apiary + Vermicompost) amongst all the models of existing as well as improved farming systems. Based on the results obtained, improved-I model was the efficient climate resilient model with higher productivity and profitability and hence can be recommended for the farmers of Assam.

Physiological performance of rapeseed (*Brassica rapa* var. Toria)

Rajesh Chintey

The present research work entitled "Physiological performance of rapeseed (*Brassica rapa*, var. Toria) genotypes under rainfed condition of Assam" was carried out at the Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat-13, Assam during rabi seasons of the years 2021-22 and 2022-23. The main objectives of the study were to find out the suitable superior genotypes based on the physiological efficiency and to identify the parameters which contribute significantly towards yield improvement in rapeseed. The field experiment was laid out in randomized block design with three replications comprising of 22 different genotypes of rapeseed including TS-38 (Check), TS46, TS-67, TS-36, TS-29, TS-75-1, TS-75-1TL, TS-75-2ME, TS-75-2-MM, TS-76-1, TS-76- 2, JT-90-1, Panchali, Bhawani, CG Toria-4, TKM-20-1, TKM-20-2, JT-14-5, PT-2018-09, CG Toria-3, Tapeshwari and PT-303. The crops were grown following the recommended package of practice. All the morpho-physiological, biochemical, quality parameters, yield attributes and yield of the crops were taken following the standard methodologies. The results of the study indicated a significant variation of all the morpho-physiological, phenological, quality parameters, yield attributes and yield among the genotypes. The genotypes, TS-75- 2ME, TS-38, PT-303 and TS-36 exhibited morpho-physiological superiority with regard to more number of branches, stem diameter, accumulation of more photosynthates, more AGR, CGR and leaf chlorophyll. The same genotypes also recorded significantly higher yield attributes and seed yield. The correlation studies also showed a significant positive correlation of these parameters with seed yield in the set of the genotypes, indicating clearly that these parameters may be regarded as morpho-physiological indices for improving crop productivity in rapeseed. From the results, the genotypes, TS-75-2ME, TS-38, PT-303 and TS-36 may be regarded as superior genotypes suitable for growing under rainfed condition during rabi season in Assam and North-Eastern states of India and may be used as genetic sources in further yield improvement programme of rapeseed.

Abstract of Ph.D. thesis

Department: Crop Physiology

Major Adviser: Dr. Ratna Kinkor Goswami

Diversity, population dynamics and management of insect pests of tea

Himadri Rabha

Diversity study of insect pest complex of tea was carried out at three agroclimatic zones of Assam *viz*., Upper Brahmaputra Valley Zone (Jorhat) North Bank Plain Zone (Udalguri) and Lower Brahmaputra Valley Zone (Kokrajhar) during 2019-20, 2020-21 and 2021-22, respectively. Laboratory experiments were carried out at Biocontrol laboratory, Department of Entomology, Assam Agricultural University and at laboratory of Krishi Vigyan Kendra, Udalguri. The field experiment was conducted in the tea garden of Udalguri district during 2021-22. Survey results revealed that a total of 4 mites and 22 different insect species belonging to 7 orders and 19 families were found to be associated with tea as recorded from different locations of Assam. In addition, 7 species of insects were found to be as visitors of the tea ecosystem in different period of time. Moreover, 11 different types of natural enemies were also observed. Among the sucking insect pests, per cent infestation of tea mosquito bug was recorded maximum (43.22 per cent) in Jorhat district. Among defoliator pests, per cent infestation of looper caterpillar was recorded maximum (34.23 per cent) in Udalguri district. Among all the insect and mite pests, tea mosquito bug showed highest degree of infestation in Jorhat i.e., 46.21 per cent whereas in case of red spider mite and looper caterpillar, highest degree of infestation was recorded 54.80 and 46.32 per cent in Udalguri district, respectively. Among all the insect and mite pests recorded during the study, tea mosquito bug, red spider mite and looper caterpillar showed moderate (34-66 per cent) degree of infestation, so they are considered as major pests. During 2019-20, the species richness in Jorhat showed maximum value of 1.50 in defoliator pests. The variation of species richness indices indicated a highest value of 1.54 and 1.50 in Udalguri during 2020-21 and 2021-22 in defoliator pests, respectively. Whereas, in Kokrajhar, the highest value was 1.55 in sucking pests (2020-21) and 1.59 in defoliator pests (2021-22). Shannon- Wiener index revealed that the highest value of 2.21 in defoliator pests in Jorhat (2019-20). During 2020-21, in Udalguri, it was found to be highest in sucking pests with value 2.10 and 2.21 in Kokrajhar, respectively. During 2021- 22, Shannon-Wiener index showed highest value of 2.10 in Udalguri district and 2.12 in Kokrajhar

Abstract of Ph.D. thesis

Department: Entomology

Major Adviser: Dr. B.C. Dutta

district in defoliator insect pests. In terms of Simpson's diversity index, highest value of 0.87 was recorded in defoliator insect pests in Jorhat district (2019-20). Likewise, during 2020-21, in Udalguri and Kokrajhar district, the highest diversity value of 0.82 and 0.87 were recorded in sucking pests, respectively. During 2021-22, the highest 21 diversity values of 0.86 and 0.87 were recorded in defoliator pests in Udalguri and Kokrajhar, respectively. In Jorhat (2019-20), the maximum number of tea mosquito bug was observed to be 5.9 per bush during the first week of September. The highest population indices record of 20.27 mites per leaf was recorded during third week of November. The maximum number of looper caterpillar was observed to be 4.26 per bush during fourth week of February. Correlation studies between weather parameters and population indices of tea mosquito bug showed significant positive correlation with maximum temperature, minimum temperature, evening relative humidity and rainfall whereas, red spider mite showed significant positive correlation with maximum temperature and negative correlation with morning relative humidity, evening relative humidity and total rainfall. The population indices of looper showed significant positive correlation with morning relative humidity. In Udalguri (2020-21), the maximum population indices of tea mosquito bug, red spider mite and looper caterpillar were recorded as 5.12 per bush during the last week of August, 14.78 per leaf during March to April and 5.02 per bush during second week of March, respectively. Correlation studies between weather parameters and population indices of tea mosquito bug showed significant positive correlation with maximum temperature, minimum temperature and evening relative humidity. The population indices of red spider mite showed significant positive correlation with maximum temperature, whereas, it showed negative correlation with morning relative humidity, evening relative humidity and total rainfall. The looper caterpillar population showed negative correlation with maximum temperature, minimum temperature, evening relative humidity and total rainfall. During 2021-22, the maximum population indices of tea mosquito bug, red spider mite and looper caterpillar were recorded to be 5.79 per bush, 28.12 per leaf, 5.23 per bush, respectively. Correlation studies between weather parameters and population indices of tea mosquito bug showed significant positive correlation with maximum temperature, minimum temperature, evening relative humidity and total rainfall. Red spider mite showed significant positive correlation with maximum temperature and negative correlation with total rainfall whereas, looper caterpillar showed significant negative correlation with maximum temperature, minimum temperature and total rainfall.

Nutritional profiling of some edible sericigenous insects of Manipur

Th. Aruna Singha

Laboratory experiments were carried out to assess the nutritive value of four edible sericigenous insect species *viz*., *Bombyx mori* L., *Anthrerea proylei* J., *Antherea frithi* M. and *Cricula trifenestrata* H. based on their proximate & elemental content, amino & fatty acid profiles, antioxidant & anti-nutritional properties as well as their microbial aspects in the Soil Arthropod Pests Laboratory, Department of Entomology, Post Graduate Laboratory, Department of Biochemistry and Agricultural Chemistry, Department of Plant Pathology, Assam Agricultural University, Jorhat during 2019-2022. Edible sericigenous insect species cocoons were collected from various locations covering five districts of Manipur. The powdered samples of the pupae were considered for biochemical and microbial analysis. The proximate analysis of four edible sericigenous insect species had significant variation. The moisture content ranged from 2.038-6.075 per cent and the highest moisture content was observed in *A. proylei* (6.075%) and *A. frithi* registered the least moisture content (2.038%) indicating that suitability of sericigenous pupal powder for preservation for a reasonable period of time without any probable risk of any microbial deterioration. The carbohydrate content of the studied species was found maximum (12.130%) in *C. trifenestrata* and the lowest (2.250%) was recorded in *A. proylei*. Appreciable amounts of crude protein content were estimated in all the studied species which ranged from 59.315- 69.418 per cent. The highest (69.418%) crude protein was registered in *A. frithi* and it was found to be significantly superior over the rest of the species. The estimated crude protein content of *A. proylei, C. trifenestrata* and *B. mori* were 65.383, 61.463 and 59.315 per cent, respectively. Crude fat content registered in the studied species varied significantly and ranged from 19.213-30.725 per cent. The highest (30.725%) crude fat content was recorded in B. mori followed by A. proylei (29.750%) and C. trifenestrata (28.738%), whereas A. frithi recorded the lowest (19.213%) amount of crude fat content. The crude fibre content varied from 2.213-8.450 per cent and C. trifenestrata registered a significantly high amount of crude fibre (8.450%), whereas the lowest was found in B. mori (2.213%). The highest (5.275%) ash content was observed in A. proylei, whereas the lowest (4.175%) was registered in *C. trifenestrata*. The ash content of mulberry

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silkworm B. mori (5.150%) was statistically at par with the A. frithi (5.150%). While analyzing the energy content (kcal/100 g) of all the four species, the maximum energy content (560.205) was estimated in A. proylei followed by C. trifenestrata (556.035) and B. mori (534.885), whereas A. frithi detected the lowest energy content of 465.453 kcal/100 g. Altogether 9 minerals as elemental composition were estimated in all the studied species. The mineral analysis indicated that the concentration of macro elements viz., potassium, calcium and magnesium were significantly higher in A. frithi (70.295, 13.993 & 25.889 mg/100 g), whereas the lowest amount (65.663, 8.790 & 23.526 mg/100 g) potassium, calcium and magnesium were observed in C. trifenestrata. However, the highest sodium and phosphorus content (36.026 & 22.429 mg/100 g) were recorded in B. mori and the least amount of sodium (26.489 mg/100 g) and phosphorus (16.062 mg/100 g) were found in C. trifenestrata. Considerable amounts of micro elements like iron was recorded the highest (26.639 mg/100 g) in B. mori. The lowest iron content was observed in A. proylei (8.315 mg/100 g). Zinc, manganese and copper content (mg/100 g) was estimated to be the highest (21.709, 5.445 and 3.123) in A. frithi which showed statistical superiority over other species whereas C. trifenestrata registered with the lowest zinc (15.381 mg/100 g), manganese (1.209 mg/100 g) and copper (0.997 mg/100 g) content. Among all the amino acids 19 common amino acids, 8 were found essential. Glutamic acid was found to be the most abundant (8.88-7.25%) in all the four species followed by aspartic acid (7.83-5.95%). Among the species, the concentration of glutamic and aspartic content was found to be highest in the A. frithi (8.88 & 7.83%). The range of Essential Amino Acids (EAAs) viz., leucine (3.95-5.76%), valine (3.11- 4.22%), isoleucine (2.29-3.29%), lysine (3.65-4.40%), threonine (2.63-3.71%) and phenylalanine (2.90-4.40%) are found in significant amounts. Both the sulphur containing amino acids (methionine and cysteine) were found in relatively low amounts and varied from 1.27-1.95 and 0.35-0.48 per cent. Glycine, alanine and serine were also available in appreciable amounts with values ranging from 3.09-5.87, 3.87-5.48 and 4.52-4.99 per cent, respectively. In case of sweet amino acids (i.e., alanine & glycine), the highest amount was recorded in B. mori (5.48 & 5.87%) but lowest (3.87 & 3.09%) in A. frithi. Most of the amino acid concentration was found to be the highest in A. frithi followed by A. proylei, C. trifenetrata and B. mori, respectively. Total fatty acid analysis revealed that the highest amount of Saturated Fatty Acids (SFA) and Monounsaturated Fatty Acids (MUFA) were recorded in C. trifenestrata (6.69 & 5.26%) followed by A. proylei (4.43 & 4.28%), B. mori (2.38 & 2.70%) while the lowest SFA and MUFA was registered in A. frithi (0.80 & 0.35%). On the contrary, the highest (8.36%) Polyunsaturated Fatty Acids (PUFA) was evaluated in A. proylei followed by C. trifenestrata (7.90%), B. mori (4.36%) and the least amount (0.39%) was recorded in A. frithi. Altogether, 18 fatty acids were registered in A. frithi which was followed by A. proylei and C. trifenestrata (9 nos.) and B. mori (6 nos.). Linoleic and alpha linolenic acid content (2.48 & 5.88%) were found maximum in the A. proylei followed by C. trifenestrata (2.07 & 5.83%) and B. mori (0.78 & 3.58%) while the least linoleic and alpha linoleic acid (0.25 & 0.14%) was observed in A. frithi. In regards of

antioxidant properties, phenol (mg catechol equivalent/g), flavonoid (mg quercetin equivalent/100 g) and antioxidant activity (% DPPH inhibition) were found in all the species and varied from 37.261-92.400, 27.223-35.489 and 35.914-74.587, respectively. Cricula trifenestrata showed the highest phenol and flavonoid content (92.400 mg catechol equivalent/g & 35.489 mg quercetin equivalent/100 g) and which was found to be significantly superior over rest of the species. Antioxidant activity was observed to be the highest in A. frithi (74.587% DPPH inhibition) and least in the C. trifenestrata (35.914% DPPH inhibition). The variability in the concentration of tannin, phytic acid and oxalic acid were ranged from 3.280-6.201 mg tannic acid equivalent/100 g, 2.780-5.238 mg/100 g, 1.762-4.138 mg/100 g, respectively. As regards to anti-nutritional compounds, the highest tannin (mg tannic acid equivalent/100 g), phytic acid (mg/100 g) and oxalic acid (mg/100 g) were observed in B. mori (6.201, 5.238 & 4.138) followed by A. proylei (5.702, 4.510 & 3.572), C. trifenestrata (5.468, 3.304 & 2.819) and A. frithi (3.280, 2.780 & 1.762), respectively. However, the presence of anti-nutritional properties in all four edible insect species were detected much more below the recommended range of 250-500 mg/100 g. Microbial enumeration revealed that total viable counts of B. mori, A. proylei and A. frithi silkworm pupal powders stored under ambient temperature (28 to 32°C) had higher bacterial population (3.331, 3.073 & 3.095 log cfu/g), whereas the least bacterial counts (2.639, 2.520 and 2.564 log cfu/g) of B. mori, A. proylei and A. frithi silkworm were observed when they stored under temperature (-16 to -21°C). Cricula trifenestrata recorded the highest population of bacteria (2.870 log cfu/g) under the temperature (15 to 20°C) and least (2.075 log cfu/g) under the temperature (-16 to - 21°C). The highest yeast and mould population (3.102, 3.069, 2.855 & 2.714 log cfu/g) was observed when B. mori, A. proylei A. frithi and C. trifenestrata pupal powder were stored at -16 to -21°C. Microbial enumeration showed that B. mori pupal powder had the highest microbial contamination among the other studied sample. Total viable counts were under the advised limit of fresh minced meat (< 6 log cfu/g, TAC). Through microbial test kits, it was further confirmed the absence of two most common food borne pathogens i.e., Escherichia coli and Salmonella sp. in all the studied sericigenous insect samples.

A Study on Management Orientation and Productivity of the Members of Farmers Producer Company with reference to Potato Production in Assam

Irshad Hussain

The present study entitled "A Study on Management Orientation and Productivity of the Members of Farmers Producer Company with reference to Potato Production in Assam" was carried out with the following objectives: 1) To study the personal, socio-economic, psychological and communication characteristics of the members of Farmer Producer Company 2) To assess the level of management orientation of the members of Farmer Producer Company 3) To assess the level of productivity of potato by the members of Farmer Producer Company 4) To identify the factors which influence management orientation and productivity of the members of Farmer Producer Company 5) To determine the direct and indirect effects of selected factors on the level of management orientation and potato productivity of the members of Farmer Producer Company 6) To identify the constraints as perceived by the members of Farmer Producer Company in production and marketing of potato The study was undertaken in Sonitpur and Nagaon districts of Assam which were selected purposively, as two Farmer Producer Companies dealing with commercial potato production were operating in these two districts. Two FPCs namely, Satbhani Potato Producer Company limited of Sonitpur district and Sankar Azan Agro Producer Company limited of Nagaon district were selected purposively for the study. Six villages were selected from each of the FPCs therefore all together twelve villages were selected for the study randomly by using the equal allocation method to get a sample size of 300 farmer members. The primary data for the study were collected by the personal interview method with the help of a structured research schedule. The primary data for the study were collected during the month of February, March and April of 2022. Management orientation and productivity of potato were the dependent variables in the study. A standard scale was developed in the present study to assess the level of management orientation of the members of Farmer Producer Company following the

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Department: Extension Education

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procedure followed by Sharma et al. (2012). A total of 21 independent variables were selected for the study. The independent variable included in the study were Age, Education level, Family size, Family type, Potato farming experience, Occupational status, Size of operational land holding, Area under potato cultivation, Net annual income from potato, Social participation, Farm Mechanization, Scientific orientation, Leadership ability, Decision making ability, Risk orientation, Achievement motivation, Economic motivation, Degree of information exposure, Exposure to training on potato cultivation, Adoption of improved potato production technology and Knowledge on potato production practices. The statistical techniques and tests used in the study for analysis and interpretation of the data were frequency, percentage, arithmetic mean, standard deviation, co-efficient of variation, multiple correlations, multiple regression, t-test for testing the significance of the coefficients for correlation and regression analysis and path analysis. The findings of the study revealed that majority of the respondents (56.34%) were belonged to middle aged category and middle school level of education (46.34%). Majority of the respondents (61.33%) belonged to the nuclear family with small family size (51.57%) upto 5 members. Majority of the respondents (59.33%) had medium term potato farming experience with (70.00%) of respondents used to follow cultivation as their occupation. Most of the respondents (38.66%) belonged to the marginal farmer category and (56.33%) of the respondents were having a land area up to 0.8 ha under potato cultivation. Majority of the respondents (52.00%) had high net annual income from potato above Rs. 173543. In case of social participation majority of the respondents (85.33%) were member of one organization. Majority of the respondents had medium level of farm mechanization (71.66%), medium level of scientific orientation (69.66%) and medium level of leadership ability (63.66%). Majority of the respondents had medium level of decision making ability (60.34%), medium level of risk orientation (67.66%), medium level of achievement motivation (65.33%) and medium level of economic motivation (64.33%). Among the personal cosmopolite sources of information, majority (54.33%) respondents used to get the information by Input dealers in regular basis. And through personal localite sources of information, friends/ relatives/ neighbors or fellow farmers majority (41.66%) of the respondents used to get the information regularly. Among the mass-media sources, farm publications were used regularly by majority (24.00%) of the respondents and overall majority of the respondents (55.00%) had medium level of information exposure. It was found that majority of the respondents (51.67%) had no exposure to training. Majority of the respondents (64.00%) were found in the medium level of adoption in case of adoption of improved potato production technology and majority of the respondents (71.34%) had medium level of knowledge on potato production technology. Majority of the respondents (64.34%) belongs to medium management orientation of the members of the farmers producer company, whereas 19.33 per cent of the respondents belongs to the category of low management orientation. The remaining 16.33 per cent of the respondents had high management orientation. It was observed that the majority of the respondents (71.34%) had medium level of productivity followed by 15.33 per cent

respondents with low productivity and 13.33 per cent respondents were found with high level of productivity. The mean value 27.61 indicated that on average respondents had medium level of productivity. The coefficients of correlation were worked out to examine the relationship of 21 independent variables with the management orientation of the members of FPC. Almost all the 17 variables viz., education level (0.149), potato farming experience (0.175), size of operational land holding (0.550), area under potato cultivation (0.583), net annual income from potato (0.744), social participation (0.268), farm mechanization (0.824), scientific orientation (0.865), leadership ability (0.812), decision making ability (0.873), risk orientation (0.822), achievement motivation (0.877), economic motivation (0.782), degree of information exposure (0.888) and exposure to training on potato cultivation (0.178), adoption of improved potato production technology (0.340) and knowledge on potato production practices (0.744) showed significant and positive relationship with the management orientation of the members of FPC at 0.01 level of probability. The correlation analysis of productivity of potato with the independent variable indicated that out of the 21 selected independent variables, 17 independent variables were significantly correlated with the productivity of potato by the members of FPC. Among the 21 independent variables, 16 variables viz, potato farming experience (0.152), size of operational land holding (0.377), area under potato cultivation (0.384), net annual income from potato (0.552), social participation (0.195), farm mechanization (0.636), scientific orientation (0.747), leadership ability (0.724), decision making ability (0.711), risk orientation (0.884), achievement motivation (0.849), economic motivation (0.864), degree of information exposure (0.769) and exposure to training on potato cultivation (0.150), adoption of improved potato production technology (0.288) and knowledge on potato production practices (0.631) showed significant and positive relationship with the productivity of potato by the members of FPC at 0.01 level of probability. Only independent variable family size (0.132) showed significant relationship with the productivity of potato by the members of FPC at 0.05 level of probability. Multiple regression analysis was used to determine the contributory effects of selected independent variables with the management orientation. Results of regression analysis revealed that 8 variables, viz., net annual income from potato (b=0.288), farm mechanization (b=0.132), scientific orientation (b=0.118), decision making ability (b=0.182), achievement motivation (b=0.261), economic motivation (b=0.159), degree of information exposure (b=0.224) and knowledge on potato production practices (b=0.090) had positive and significant relationship with the management orientation of the members of farmers producer company at 0.01 level of probability and 3 variables viz., area under potato cultivation (b=0.108), Risk orientation (b=0.150) and exposure to training on potato cultivation (b=0.039) showed significant and positive relationship with the management orientation of the members farmers producer company of at 0.05 level of probability. The value of coefficient of multiple determination (R2) being 0.923 indicated that the eleven independent variables jointly could predict 92.30 percent of the variation in the level of management orientation. Results of regression analysis of selected independent

variables with the productivity of potato revealed that among the 17 independent variable, 4 variables viz., net annual income from potato (b=0.202), risk orientation (b=0.361), achievement motivation (b=0.199) and economic motivation (b=0.306) had positive and significant relationship with the productivity of potato by the members of farmers producer company at 0.01 level of probability and 2 variables viz., potato farming experience (b=0.053) and area under potato cultivation (b=0.167) showed significant and positive relationship with the productivity of potato by the members of farmers producer company of at 0.05 level of probability. The value of R2 (0.837) indicated that 6 independent variables selected for the study were efficient in predicting the productivity of potato by the members of FPC. The 6 independent variables fitted in the linear regression analysis could predict 83.70 per cent of the variation in the productivity of potato by the members of FPC. Path analysis was done to get a clear picture of how the chosen independent variables affected both directly and indirectly the level of management orientation and productivity of potato by the members of the Farmer Producer Company. The results of path analysis in management orientation revealed that the highest direct effect on the management orientation was exhibited by net annual income from potato (0.274) which was followed by achievement motivation (0.263) and degree of information exposure (0.209). The maximum indirect effect was exhibited by the degree of information exposure (1.315), which was followed by scientific orientation (1.218). The highest total effect on the management orientation by the members was exhibited by degree of information exposure (1.524) and followed by scientific orientation (1.312). In case of productivity of potato the results of path analysis revealed that the highest direct effect on the productivity of potato was exhibited by risk orientation (0.363) which was followed by economic motivation (0.315) and area under potato cultivation (0.231). The maximum indirect effect was exhibited by the achievement motivation (0.832), which was followed by economic motivation (0.769). And the highest total effect on the productivity of potato by the members was exhibited by risk orientation (1.108) followed by economic motivation (1.084). The most important constraints faced by the majority of the respondents (82.66%) is the ‘Blight problem’ in production faced by the members of FPCs. The other constraints faced by the members in order of importance were ‘Lack of availability of good quality seeds’ (75.33%), ‘Unavailability of fertilizers in planting time’ (68.00%), ‘High cost of good quality inputs’ (62.66%) and ‘Labour shortage problem during the planting and harvesting time’ (59.00). Regarding marketing constrains majority of the respondents (86.33%) perceived that ‘Lack of proper market place’ was the most important constraint faced by the members of FPCs. The other constraints faced by the members in marketing of potato were ‘Lower market price due to import from other states’ (78.66%), ‘Involvement of middleman in the marketing system’(64.33%), ‘Low price given by the brokers’(59.00%), ‘Inadequate storage facility’ (49.66%) and ‘Increasing charge of cold storage’ (35.33%).

An assessment of food security condition among selected tribals of Bodoland Territorial Region of Assam

Lohita Rabha

Food and nutrition security remain the world's biggest issues for human welfare and economic development. In the 21st century, many lack nutritious meals despite food security in many countries. India produces food, but food insecurity slows progress. The "triple effect of malnutrition" hurts India, which grows the most food grains. Despite many welfare programmes, Scheduled Tribe groups are the most disadvantaged. Most go hungry. Many ethnic tribes live in Assam. Assam faces food security issues due to poverty, food grain shortages, and nutritional ignorance. This study examined tribal food security in Assam's Bodoland Territorial Region (BTR). Food security of tribal's of BTR has been compared. Food security in selected BTR tribes was examined. Food insecurity was also assessed by gender. Finally, government food security programmes for BTR tribal communities were evaluated. This study randomly sampled respondents. BTR randomly selected Udalguri and Baksa. Each section randomly selected two blocks. Ten villages per district were randomly selected from five tribe-dominated villages per block. Tribal respondents numbered 400. 204 Bodo and 196 Rabha responded. However, in case of objective 3, to evaluate the impact of food insecurity on gender, wives of the respondents were also selected as respondent. In this case, data related to female members were needed and for only that purpose wives of respondents (400 in numbers) were considered. As a result total number of respondents for objective 3 was increased to 800. Interviews with the researcher's interview guide collected data. The analysis included frequency, percentage, mean, standard deviation, coefficient of variation, class interval, food security index, shortfall/surplus index, head count index, Karl Pearson's coefficient of correlation, multiple linear regression, and z-test. The analysis of profile characteristics revealed that, average age of Bodo and Rabha respondents was 46.46 years and 45.54 years respectively. Majority of respondent belonging to Bodo (35.78%) and Rabha (32.14%) tribes were illiterate. The average family size of Bodo respondents was five persons and 5.12 persons for Rabha respondents. Most Bodo (87.75%) and Rabha respondents (78.06%) had nuclear

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Department: Extension Education

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families. About (46.56%) of Bodo and (50.51%) of Rabha respondents depended on farming and labour as primary occupation. For (88.23%) of Bodo and (86.22%) of Rabha respondents, none of the family members were employed. The average land holding of Bodo and Rabha respondents was 1.18 ha and 0.98 ha respectively. For Bodo respondents, average annual income was ` 1,85,616.51 and crops provided their larger share of income (` 61,820.1). In case of Rabha respondent, average annual income was ` 1,86,526.63 and the highest portion of their income (` 49,662.47) was contributed by off-farm income. For both Bodo and Rabha respondent maximum expenditure was spent on farm operation (59.14% for Bodo and 53.16% for Rabha). Perceived food availability revealed that (77.45%) of Bodo and (72.96%) of Rabha respondents had food available in the household. The majority (57.84%) of Bodo and (65.30%) of Rabha respondents held debt. About (38.73%) of Bodo and (32.65%) of Rabha respondents were accessed to credit. Most Bodo (88.73%) and Rabha (95.92%) respondents had drinking water facilities within their households. For (50.49%) of Bodo and (50.00%) of Rabha respondent, government hand pump/well was the source of drinking water. Most of the Bodo (80.88%) and Rabha respondent (81.63%) were access to PDS, about (57.35%) of Bodo and (54.08%) of Rabha respondents lost their cultivable land. Majority (58.82%) of the Bodo and (58.16%) of Rabha respondents used food grain to prepare alcoholic beverages. In case of both Bodo and Rabha respondents, (100.00%) of them consumed cereal daily as a staple food but its consumption was only (57.69%) and (58.35%) of the recommendation by Bodo and Rabha tribe respectively. Total calorie obtained by Bodo and Rabha respondents from the consumption of different food items was 994.64 kcal/AE/day and (985.50 kcal/AE/day) respectively. Overall Bodo and Rabha respondents were food insecure, with respective index values of 0.415 and 0.411. The z test result revealed no significant difference between overall Bodo and Rabha respondents in food security condition. In contrast, analysis of the food security situation from among the respondents revealed that (19.60%) of Bodo and (19.88%) of Rabha respondents were food secure. Majority (80.39%) of Bodo respondents were food insecure, with an index value of 0.27. The average per capita calorie intake of food-insecure households was 653.89 kcal and fell short by (72.75%) of the calorie requirement. The remaining (19.60%) of respondents had adequate food supplies. Food secure household consumed average 2401.23 kcal per day and had a food security index of 1. They exceeded the calorie requirement by (0.05%). In case of Rabha respondents, (19.88%) were food secure with an index value of 1, while the majority (82.14%) was food insecure with an index value of 0.28. The average daily calorie intake per person in the food-secure Rabha respondent was 2,401.01 kcal and exceeded the calorie requirement by (0.04%). Average daily calorie intake per capita for food insecure Rabha respondents was 679.99 kcal and was fell short by (71.66%) of calorie requirement. Education of household head, employed members in the respondent's household, annual income, operational landholding, food expenditure, access to credit, perceived food availability, drinking water facility at home were positively and significantly correlated with food security status among Bodo respondents, as determined by correlation

analysis. However, the variables like age of household head, family size, family type, loss of cultivable land, indebtedness, foodgrain used for liquor preparation were negatively and significantly correlated with food security status. In case of Rabha respondent, education of household head, employed members in the respondent's household, annual income, operational landholding, food expenditure, access to credit, perceived food availability were positively and significantly correlated with food security status. But, variables like age of household head, family size, loss of cultivable land, foodgrain used for liquor preparation were negatively and significantly correlated with food security status. A Multiple Linear Regression analysis showed that Co-efficient of determination (R2) for Bodo respondent was 0.737 and 0.806 for Rabha respondents depicting about model's explanatory variables explained (73.70%) and (80.60%) of variation in the food security status of Bodo and Rabha respondent respectively. Variables such as age of household head, family size, employed members in the respondent's household, annual income, access to credit, loss of cultivable land, indebtedness and access to Public Distribution System were significant in explaining the variation in food security status among Bodo respondents. In the case of Rabha respondents, however, age of household head, family size, employed members in the respondent's household, annual income and operational landholding were significant indicators of food security. In case of Bodo respondent, among the different impact of food insecurity significant difference was observed between male and female concerning migration (z value=15.64**), chronic energy deficiency (z value= -12.10**) and thinness (z value= -1.81***). Similarly, Rabha respondents showed significant differences between males and females in migration (z value= 15.50**) and chronic energy deficiency (z value= -12.36**). Concerning the different government initiatives considered under study, the respondents received benefits less than their entitlements in case of Antodaya Anna Yojana, Priority household, Pradhan Mantri Garib Kalyan Anna Yojana, PM-KISAN, Pradhan Mantri Krishi Sinchai Yojna, Pradhan Mantri Awaas Yojana-Gramin, etc. Moreover, in case of MGNREGA, the highest proportion (99.06%) of the respondent received an average of 22 days of employment per year instead of 100 days of employment in a year as was guaranteed in the scheme. Therefore, the study suggested that people should be educated on the importance of consuming various foods to meet their calorie requirements. To ensure that food is available and accessible to all, the government must take both immediate and long-term measures. Policies in multiple sectors (agricultural, credit, and labour markets) must acknowledge women as equal workers and contributors to household food security and the overall household economy by ensuring equal access to resources, services, and labour returns. Implementation issues with various schemes can be resolved by employing interventions that are scheme specific. Key areas that require attention are identifying target homes, modernization of the delivery system, and efficient monitoring of the food security programme.

Ornamental crop as a source of food and fabric colourant

Aanmona Bora

The experiment was conducted in the Laboratory, Department of Horticulture during 2020-2022, Assam Agricultural University, Jorhat to harness the dyeing properties of four locally available flower crop sources viz., Melastoma malabathricum and Gomphrena globosa for food colouring and, Calendula officinalis and Hibiscus rosa-sinensis for fabric dyeing, using their semi-dried petals. The extraction condition for melastoma pigment had been standardized at 510 nm in 25:75 (v/v) ethanol: water solvent concentration with a solvent-to-solid ratio of 15:1 (ml/g) at 80°C for 75 minutes and that of gomphrena pigment at 533 nm in 0:100 (v/v) ethanol: water solvent concentration with solvent-to-solid ratio of 5:1 (ml/g) at 40°C for 105 minutes. The total anthocyanin content of melastoma pigment was found to be fairly high, about 313.88 mg/L with a reasonably low degradation index of 1.20 and tinctorial strength of 4.05. The betacyanin content of gomphrena pigment recorded 270.23mg/L with a tinctorial strength of 6.71. The degradation for both the pigments followed first order reaction kinetics and the extracted melastoma pigment recorded a rate constant of 0.001857 min-1 with half-life of 396.67 min while, the gomphrena pigment recorded a rate constant of 0.003133 min-1 with a half-life of 223.34 min, which is notably good for a natural colourant. The ten week storage study of both melastoma and gomphrena pigments was best recorded at 4°C in dark (or refrigerated condition) to obtain a half-life of 384.97 days and 92.41 days, respectively meaning greater pigment stability and longer shelf-life as compared to their storage at room temperature (30±2˚C) in dark conditions followed by light, which accelerated the pigment degradation rates and drastically reduced their half-lives. For fabric colourant both Calendula officinalis and Hibiscus rosasinensis pigments were standardized for extraction at 430 nm in alkaline medium (1% Na2CO3 solution) at 90 and 45 minutes, respectively. The dye absorption percentage was recorded highest for dye: material concentration of 3g/100ml in both the pigment classes. The carotenoid content in calendula pigment was estimated to 270.23 mg/L and the total anthocyanin content in hibiscus pigment resulted in 209.10 mg/L. The dyeing time for calendula pigment was standardized at 30 minutes for cotton fabric and in silk

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at 60 minutes while that for Hibiscus pigment it was standardized at 90 and 30 minutes for cotton and silk fabrics, respectively. With alum as mordant the standardized mordant concentration for both calendula and hibiscus pigment-dyed cotton and silk fabrics recorded optimum results at 2% while with fresh tea leaves the optimum concentration was recorded at 1%. During standardization of mordanting time, both alum based calendula and hibiscus pigment-dyed cotton fabrics resulted best at 60 minutes and were further standardized for mordanting method i.e., pre-mordanting and simultaneous mordanting methods, respectively. Similarly, for their results upon silk fabric the optimum mordanting time was recorded at 45 minutes and, further standardized with simultaneous mordanting method in silk fabrics and pre-mordanting method in cotton. With fresh tea leaves as mordant, irrespective of the dye or fabric source used, the mordanting time was standardized at 15 minutes and the optimum mordanting method was evaluated as pre-mordanting method. Among the various treatment combinations calendula pigment-dyed and alum-mordanted silk fabrics resulted best for all the physical properties tested and fastness to washing, crocking and sunlight, followed by hibiscus pigment-dyed and fresh tea leaves-mordanted silk fabrics with excellent fabric thickness property and fastness to washing, pressing and perspiration. Thus, all the four locally available ornamental crop sources viz., Melastoma malabathricum, Gomphrena globosa, Calendula officinalis and Hibiscus rosa-sinensis, studied in the present investigation could be put forward as potential natural colourant sources for food and fabric dyeing.

Standardization of crop geometry, fruit thinning and nutrient management in watermelon (*Citrullus lanatus* Thumb.)

Bhabesh Deka

The present experiment on ―Standardization of crop geometry, fruit thinning and nutrient management in watermelon (Citrullus lanatus Thumb.)‖ was carried out for two successive years during 2020-21 and 2021-22 in the farmer‘s field East″1.1′ North latitude and 94°25″16.8′Nahat Chapani village, Teok, Jorhat (26°48 longitude) with the objective to optimize the planting density for maximum yield and quality, to study the effect of crop load on growth, yield and quality and to study the effects of integrated nutrient management on growth, yield and quality. The experiment was laid out in factorial Randomized Block Design with 3 factors viz. Spacing, Fruit thinning and INM with three replications and the data of individual years were subjected to pooled analysis. The spacing levels were D1 (2.5m x 2m), D2 (1.5m x 1m) and D3 (1m x 1m) where F1 (no thinning), F2 (Thinning up-to 1 fruits /primary vine) and F3 (Thinning up-to 2 fruits/primary vine) were the fruit thinning levels. A total of 4 INM treatment were given i.e. N1 (100% RDF), N2 (50% RDF + 50% RDN through FYM), N3 (50% RDF + 50% RDN through vermicompost) and N4 (50% RDF + 25% RDN through Vermicompost + 25% RDN through FYM). The treatments significantly influenced the various parameters except a few. The spacing D1 (2.5m x 2m) recorded the maximum days to flowering (25.59 days), maximum fruits/plant (3.93) and fruit weight (2.34 kg) leading to higher yield per plant (8.87 kg) although the spacing D3 (1m x1m) exhibited minimum days to flowering (25.59) and maximum yield (8.14 t/ha) owing to maximum plant population. Quality parameters were not affected significantly by distance. Fruit thinning significantly influenced the yield attributing and quality parameters. Fruit thinning level (F2) resulted in maximum fruit weight (2.92 kg) and yield (5.3 t/ha) which was at par with F3 (5.38 t/ha). Fruit quality was significantly improved by fruit thinning recording highest values of TSS (12.65 oB), total sugar (8.88%), reducing sugar (5.94%) and DPPH scavenging activity (54.57%). Among the INM treatments, N3 (50% RDF + 50% Vermicompost) was most effective with respect to growth,

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reproductive, physiological, quality and soil parameters viz., Highest fruits per plant (4.21), yield per hectare (6.26 t), TSS (13.10 oB), total sugar (9.14%), carotenoid (8.22 mg/100g), Lycopene (7.16 mg/100g), DPPH scavenging activity (54.86%), total chlorophyll (2.39 mg/g FW), soil available N (311.86 kg/ha), P (33.15 kg/ha), K (274.49 kg/ha) and organic carbon (1.19%). 26 The interaction of three factors revealed that T35 (D3F3N3) recorded maximum production (10.05 t/ha) that was at par with T31 (D3F2N3) recording 9.82 t/ha yield. T7 recorded the highest values of fruit weight (3.2 kg), TSS (13.28 oB), total sugar (9.24%), carotenoid (8.3 mg/100g), lycopenne (7.19 mg/100g), and DPPH scavenging activity (54.97%) which was at par with T27 (D3F1N3), T31 (D3F2N3) and T35 (D3F3N3). Significantly higher values of soil available N (313.66 kg/ha), P (33.64 kg/ha) and K (295.69 kg/ha) was observed in T35 (D3F3N3). Computation of production economics revealed the B:C ratio to be the highest in D3F3N3 (6.53) which was at par with T31- D3F2N3 (6.35) and T27-D3F1N3 (6.12).

Morphological, physico-chemical and molecular characterisation of mango (*Mangifera indica* L.) genotypes of Upper Brahmaputra Valley of Assam

Binita Hazarika

To study the extent of variation among the different mango genotypes of Assam, the present investigation entitled "Morphological, physico-chemical and molecular characterisation of mango (Mangifera indica L.) genotypes of Upper Brahmaputra Valley of Assam" was carried out during 2021-23 in Golaghat, Jorhat, Sivasagar and Tinsukia districts of Assam. A total of 100 accessions were surveyed out of which 33 accessions were finally selected based on acceptability. All the morphological characteristics were studied as per descriptor of IPGRI, Rome (2006). Results revealed significant variation in qualitative as well as quantitative traits. Tree height (tall, medium and dwarf) varied significantly among the accessions. Leaf features did not significantly differ between accessions, but flower color (yellowish green, yellow, and pink), panicle location (axillary, terminal, and terminal), and the presence of leafy bracts showed significant variations. Substantial differences in fruit shape (roundish, oblong, obovoid, elliptic) and fruit apex shape (round, obtuse, acute) were also observed. Stone and seed characteristics varied among the accessions with respect to type of veins on stone, quantity of fibre on stone, adherence of fibre to stone, seed shape and type of embryony. Quantitative characteristics of leaf, panicle, stone, seed and fruits also varied significantly among the accessions. Highest length:breadth ratio of leaf was observed in AMG-5 (8.89) and lowest in AMS-2 (2.78). Panicle length:breadth ratio was highest in AMS-7 (3.13) and lowest in AMJ-13 (1.04). The number of secondary rachis per panicle, sex ratio, number of fruits per panicle, per cent fruit drop and per cent fruit retention also varied. Study of physical characteristics of fruits revealed that accession AMG-2 had highest fruit weight 1206.48 g and 1197.92g both at harvest and at ripening respectively, whereas, fruit weight at harvest and ripening was lowest in AMG-5 86.31g and 75.67g, respectively. Similarly, significant variations were observed in characters like shape index, lenticels density, stone per cent, pulp: stone ratio, waste index and pulp percent. Study also revealed significant differences in

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chemical characteristics of fruit. TSS was highest in AMS-6 (18.80°Brix) and lowest in AMJ-13 (10.26°Brix). TSS: Acidity ratio was highest in AMJ-11 (91.00) and lowest in AMG-7 (24.50). Ascorbic acid content was highest in AMT-1(52.70 mg/100g) and lowest in AMJ-14 (22.63 mg/100g). Other chemical characteristics of fruits like total sugar, sugar:acid ratio, carotenoid content, moisture content also significantly varied among the accessions. The PCA for 55 quantitative characters in mango accessions revealed considerable variation among the accessions. 15 components displayed a total variation of 89.55% and were consequently considered to exhibit notable variance. 35 characters contributed to the 18.21% variation in PC1. Cluster analysis revealed maximum Euclidean distance of 17.10 that was observed between the two accessions of Golaghat, AMG-2 and AMG-8, and minimum Euclidean distance of 6.131 was observed between the two accessions of Sivasagar, AMS-3 and AMS-6 indicating that variation was influenced by genetic factor. Despite SSR markers demonstrating that there was no polymorphism, the occurrence of diversity in morphological and physiological traits necessitated additional molecular level studies using a wider array of markers. It can be concluded from the study of the accessions that there is considerable variation among them, and that accessions with distinguished characteristics can be exploited in mango improvement programmes.

Floral behaviour, growth and post-harvest quality of dragon fruit [*Hylocereus costaricensis* (Weber) Britton & Rose]

Gerik Bagra

An experiment was conducted on "Floral behaviour, growth and postharvest quality of dragon fruit [Hylocereus costaricensis (Weber) Britton & Rose] during 2019-20 and 2020-21 in the farm of KVK, Jorhat and Laboratory, Department of Horticulture, Assam Agricultural University, Jorhat with the objectives to study the floral behaviour, growth and development of dragon fruit and also the effect of various post-harvest treatments on its post-harvest quality and shelf life. The plants were tagged at bud initiation stage. The floral behaviour of the fruits was studied in the selected plants. The fruits were collected at 7 day intervals after flowering, till harvest for estimation of various physico-chemical parameters. Six post-harvest treatments; T1(Dipping fruits in ascorbic acid 500ppm solution for 5 minutes, air dried and packed in transparent 0.2% perforated LDPE bags), T2(Dipping fruits in 100 ppm sodium hypochlorite for 5 minutes, air dried and packed in transparent 0.2% perforated LDPE bags), T3(Dipping fruits in 1% Chitosan solution for 2 minutes, air dried and packed in transparent 0.2% perforated LDPE bags), T4(Dipping fruits in 1% Calcium Chloride solution for 30 minutes, air dried and packed in transparent 0.2% perforated LDPE bags), T5(Air dried fruits packed in transparent 0.2% perforated LDPE bags),T6(Air dried fruits were kept in open condition without packing and chemical treatment) were applied to fruits. Fruits were subjected to post harvest treatments after harvest and kept at ambient conditions (mean temp 30.5 0C and RH 82.5%). Physicochemical qualities were studied at 2 days, 4 days, 6 days and 8 days after storage (DAS). The laboratory experiment (Part II) was laid out in a factorial CRD with three replications. The flower bud initiation started in the second week of July and it took 18 days to flower. Anthesis started in the afternoon and the period lasted from 4.30 to 9.00 pm. The dehiscence of anthers took place 7 hours after opening of flowers. Pollen viability percentages were found to be 85.77±0.89 and 84.62±0.20 under 10x and 40x magnification, respectively. Fruits reached harvest maturity at 28 days after flowering when peel colour changed to pink red. At harvest, it recorded fruit weight 239.92 g, specific gravity 1.05, pulp:peel ratio 2.59 and the fruit

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contained TSS 11.95 0Brix, titrable acidity 0.26%, TSS:acid ratio 48.20, total sugar 8.12 %, crude protein 1.19 %, Crude fibre 0.84 mg/g, Total phenolics 51.94 mg GAE/g, Betalains 8.60 mg/100g. Physiological loss in fruit weight (PLW) were increased during storage. T2 recorded the lowest PLW (1.66%) 6 and absence of rotting of fruits which was followed by T1. In T2 and T1, no fungal organism was detected. TSS and sugars were found to increase during storage while titrable acidity and ascorbic acid content decreased. T2 registered the lowest titrable acidity (0.16%) which was followed by T1 & T3 (0.18 %). Highest TSS (12.21 OBrix) and total sugars (8.30%) were recorded in T1 which had statistical parity with T2. Maximum retention of ascorbic acid (8.04%), Crude protein (0.72%), total phenolics (49.28mg GAE/100g), crude fibre (1.03%), Betalain (8.54mg/100g), total antioxidant (53.14 mg/g) were recorded in T2 which was followed by T1. Organoleptic qualities of fruits were found to decrease with the advancement of storage period. The highest organoleptic score values in respect of colour (7.89), taste (7.678), flavour (7.19) and texture (7.20) were obtained in T2 followed byT1. Maximum shelf life of 8 days was recorded in T2. Thus, it may be concluded that dragon fruit should be harvested at 28 days after flowering when peel colour is pink red, specific gravity (1.05), pupl:peel ratio 2.59 and TSS:acid ratio 48.20. Dipping fruits in 100 ppm sodium hypochlorite solution for 5 minutes, air dried and packed in transparent 0.2% perforated LDPE bags is the best treatment with minimum PLW, rotting and microbial activities retaining maximum sugars, ascorbic acid, crude protein, crude fibre, betalains, total antioxidant which extended the shelf life up to 8 days at ambient condition.

Nutritional Profiling of Some Underutilized Fruits and Vegetables of Assam

Soumitra Goswami

There exists a vast array of species, that have great potential but are often neglected and are termed as underutilized species. Underutilized fruits and vegetables are one such potential bio-asset, that could become a major tool in addressing global malnutrition, poverty and economic prosperity of millions of people. The present study covered assessment of nutritional and anti-nutritional constituents of 42 numbers of underutilized vegetables and fruits (28 vegetables and 14 fruits). The selected vegetables also showed significant variations in their biochemical constituents like moisture content (72.82 - 92.84 g 100g-1), ash content (3.82 - 15.37 g 100g-1), crude fat content (1.51 - 8.33 g 100g-1), crude fibre content (1.62 - 24.67 g 100g-1), crude protein content (1.80 - 9.79 g 100g-1%), potassium content (19.30 - 624.30 mg 100g-1), sodium content (2.34 - 234.11 mg 100g-1), calcium content (69.04 - 858.28 mg 100g-1), phosphorus content (25.94 - 579.15 mg 100g-1), iron content (31.34 - 401.34 mg 100g-1), zinc content (0.03 - 8.02 mg 100g-1), manganese content (25.36 - 264.59 mg 100g-1), Vitamin C (as Ascorbic acid content) (25.64 - 366.98 mg 100g-1), total phenol content (0.63 - 6.54 mg 100g-1) and free radical scavenging activity (72.31 - 95.09 %). The selected samples also contained anti-nutritional properties like saponin (0.13 - 1.08 mg 100g-1), tannin (0.23 - 2.79 mg 100g-1), phytic acid (0.16-0.61 mg 100g-1), oxalate (0.14 - 7.23 mg 100g-1). Similar to the vegetables, the selected fruits also showed significant variations in their biochemical constituents such as moisture content (68.96- 92.46 g 100g-1), ash content (1.39-5.38 g 100g-1), crude fat content (0.41-0.56 g 100g-1), crude fibre content (0.61–5.11 g 100g-1), crude protein content (0.51-8.99 g 100g-1),Potassium content (10.00- 982 mg 100 g-1), Sodium content (0.14 -70.99 mg 100 g-1), Calcium content (1.12-463.83 mg 100 g-1), Phosphorus content (4.57 -306.24 mg 100 g-1), Iron content (0.73 -163.30 mg 100 g-1), Copper content (0.14 -6.19 mg 100 g-1), Zinc content (0.24– 28.94 mg 100 g-1), Manganese content (0.15 -14.64 mg 100 g-1), Vitamin C (as Ascorbic acid content) (5.96 - 117.16 mg 100 g-1), total phenol content (21.08 - 900.84 mg GAE 100 g-1) and free radical scavenging activity (59.05 - 94.73 %). The selected samples also contained anti-

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nutritional properties like saponin (0.01–7.98 mg 100 g-1), tannin (0.49–8.44 mg 100 g-1), phytic acid (0.32-8.05 mg 100 g-1) and oxalate (0.71 -28. 05 mg 100 g-1). However, after determining proportionate values of anti-nutritional components and their related nutrients showed lower than critical values for bioavailability of the related nutrients in majority of the selected fruits and vegetables. Hence, this study may be considered as a benchmark for planning future studies in the field of development of nutraceutical formulations in managing the issue of under nutrition and general wellbeing of the population.

Bio efficacy of native entomopathogenic nematodes against major insect pests of cruciferous crops in Assam

Amuri Bharath

A survey was conducted during the year 2020-2022 for isolation of entomopathogenic nematodes (EPNs) in cruciferous and vegetable growing areas of Jorhat district of Assam from 7 locations viz., Experimental Farm, Dept. of Horticulture, ICR Farm, AAU, Jorhat, Tea Plantations, AAU, Jorhat, Nemati Ghat, Moran Gaon, Titabor and 7 different isolates of EPN were recovered with 3.50 percent frequency of occurrence. Based on morphological and morphometric studies the isolates were identified to be Oscheius chongmingensis (EPN 1and 2), Heterorhabditis indica (EPN 3, 4and 5) and H. bacteriophora (EPN 6 and 7). Further, molecular characterization was done by amplification of ITS region of 5.8s mtDNA. The sequences of genus Heterorhabditis and Oscheius isolates were subjected to BLAST at NCBI and on the basis of aligned sequences, the isolates were identified to be Heterorhabditis indica, H. bacteriophora and Oscheius chongmingensis by using construction of phylogentic tree in MEGA 11.00. Efficacy of Oscheius chongmingensis, Heterorhabditis indica and H. bacteriophora were tested against Diamond backmoth (Plutella xylostella) and Cabbage butterfly (Pieris brassicae) under in-vitro conditions with six different concentrations of infective juveniles (IJs). With the increase in the concentration of IJs and with time of exposure, there was a corresponding increase in the mortality of the insect larvae. Heterorhabditis indica and H. bacteriophora showed 100 per cent mortality of P. xylostella and P. brassicae at 96 h of exposure with highest concentration of IJs/larva (i.e. 300 IJs/larva) as compared to O. chongmingensis (50.00 % mortality). The LD50 values of both the EPNs decreased when exposure period was increased. A pot experiment was also conducted to study the efficacy of two best EPNs viz. H. indica and H. bacteriophora against P. xylostella taking different doses viz. 200, 400 and 600 IJs/ pot with another treatment with water as control. H. indica exhibited maximum mortality at 600IJs after 72hrs of exposure and was found to be at par with the treatment with H. bacteriophora. The effective EPN species has to be further tested under filed conditions to identify the proper doses and method of delivery.

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Department: Nematology

Major Adviser: Dr. Bhabesh Bhagawati

Morpho-molecular profiling of induced visible mutants of Joha rice (*Oryza sativa* L.) for sd1 and BADH 2 genes and their phenotypic stability

Lonishree Dutta

Mutation breeding offers a simple, fast and efficient way to rectify major defects without altering their original identity. The present study deployed radiation (gamma rays @ 200 and 300Gy)-induced mutation for the improvement traditional aromatic rice landraces namely Kon Joha. Among the various putative mutants identified in the M 2 generation, only sixtysix rice mutants were advanced to M3 generation. In the present study 28 mutants of Kon Joha from M3 generation were raised in M4 generation along with their parents and four checks for evaluations based on 16 agro-morphological and 9 grain quality traits. Interestingly, all the mutants showed a reduction in plant height as compared to their parents in all the three generations. The reduction in plant height varies from 35 to 45% . Furthermore, mutants of Kon Joha have increased their yield potential over their parents. Interestingly, JKOJM-300-1007-14(3.5 ton/ha) and JKOJM-200-1512-1 (3.2 ton/ha) exhibited the highest yield advantages over their parents. Study on DUS characterization showed variability among the cultivars studied, showing monomorphism for 33 traits and polymorphism for 23 traits. Thus, the phenotypic characterization of the aromatic cultivars established distinctiveness for their utilization in breeding programmes. UNJ clustering based on usual Euclidean distances for the polymorphic traits grouped the cultivars into four multi-genotypic clusters. Further, a pooled analysis of variance based on a randomized complete block design revealed ample variations among the genotypes for the studied traits. The differences observed between genotypic and phenotypic coefficients of variation were low for days to 50% flowering, days to maturity, culm height (cm), culm length (cm), thousand-grain weight (g) and grain yield per hectare (kg), which facilitate selection in the presence of sufficient genetic variability for the traits studied. Mahalanobis D 2 analysis revealed three multi-genotypic and one mono-genotypic clusters of the cultivars. Moreover, in the association analysis, grain yield plant-1 is significantly and positively correlated both at genotypic and phenotypic levels with

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culm height, culm length, panicle length, filled grains panicle-1 , chaffy panicle, spikelet fertility, straw yield plant -1 , biological yield plant-1 and harvest index. JKOJM-300-186-14 exhibited the highest amylose 13.05 and highest crude protein was exhibited by JKOJM-200-1512-1 (8.65). The aroma score of the Kon Joha mutants were higher than the checks like Kon Joha, Keteki Joha, Badshah Bhog and Kola Joha. As per sensory evaluation JKOJM-300-158-11, Kon Joha mutant has the overall acceptability. The SSR marker-based genome similarity in rice mutants and corresponding parents ranged from 98.91 to 93.48% indicating the trueness of the mutants. Moreover, the UPGMA algorithm and Gower distance-based dendrogram, neighbour joining tree and PCA scatter diagram assured that mutants were grouped with their respective parents and fell into separate clusters showing high similarity between mutants and parents and dissimilarity among the checks. Three genotypes were identified for nitrogen responsiveness. There was absence of sd1 gene in the mutants. Therefore, it can be concluded that some other genes are responsible for dwarf varieties. BADH2 gene was present in all the genotypes. Four mutants along with four checks were send for multi-location trial . Eberhart and Russel model found JKOJM-300-584-5 (Xi = 3141.9, bi = 1.01 and S2 di=0.02) followed by JKOJM-300- 158-11 (Xi = 3131.1, bi = 1.04 and S2 di=0.09), JKOJM-300-1353-8 (Xi = 2987.29, bi = 1.11 and S2 di=0.15) JKOJM-300-1007-14 (Xi = 2845.76, bi = 0.97 and S2 di=0.03) exhibited stability under all the environment. Shukla's stability model also concluded JKOJM-300-584-5 as the most stable genotype. Two-dimensional GGE biplot was generated using the first two principal components (axis 1 and axis 2), which accounted for 69.9% and 18.04 % difference in GEI for yield per hectare, respectively. Locations were found to be the most significant causes of yield heterogeneity, accounting for 75.73 % of overall G + E + G × E variation, respectively, according to the combined study of variance. All the GGE biplots for the grain yield revealed G3 (JKOJM-300-1007-14) as the most stable genotype. AMMI 1 biplot for GYH indicated that G1, G4, G2 and G3 as the high yield genotypes however, only G1 and G3 can be considered as the stable genotypes among them. AMMI 2 biplot was also analysed which revealed that the G8 (E2), G5 (E2), G7 (E6, E5), G6 (E5), G2 (E7, E3) and G4 (E7 and E3) as the high yielding genotypes for GYH for the mentioned environments. Based on ideal genotype ranking genotype G2 followed by G1 was the best performer, with a high mean yield and high stability in the tested environment. According to the AEC line, genotypes G2 and G4 were extremely stable with a high average yielding per hectare. Overall, the information and materials generated from the current study will be very useful and informative for students, researchers and plant breeders. Additionally, our results also showed that irradiation could generate a considerable amount of genetic variability and provide new avenues for crop improvement and diversification.

Genetic Variation and Nature of Gene Action in Assam Rice for Grain Zinc Concentration and Bio-Fortification Potential

Nabajyoti Bhuyan

The cultivated gene pool of rice is deficient in most of the required micronutrients. Zinc is one of the most important among these to mention about. Twenty (20) percent of the world population is at risk of Zn deficiency resulting from inadequate dietary Zn intake that causes stunted growth (Brown et al., 2009). Genetic and agronomic manipulations for biofortification to raise the concentration of the nutrients in the grain are suggested to overcome the problem. The present investigation was undertaken to study genetic diversity for grain Zn in Assam rice germplasm and also to explore the possibility of bifortification potential. A set of 29 ahu genotypes randomly collected from different places along with the high yielding sali rice variety Shraboni, known to be rich in Zn, were evaluated in 4 different micro-environments created by differential application of Zn fertilizer in ahu season of 2019. Among these, 6 were randomly selected for combining ability studies through diallel mating system without the reciprocals. Observations were taken on different morphological and quality characters and the recorded data were subjected to different statistical analyses following standard procedures. Out of 30 genotypes, 9 were grouped as low (30 mg 1000g-1) grain Zn genotypes as per their grain Zn content. Grain Zn content was found highest (52.35 mg 1000g-1) in Shraboni and lowest (11.73 mg 1000g-1) in Basantabahar. GCV, PCV and heritability were high for grain Zn for the genotypes. Grain Zn showed a significant positive correlation with panicle length, grains per panicle and spikelet fertility. Highest grain Zn was recorded in the environment which had relatively high initial soil Zn and was then further added with fertilizer Zn while the lowest grain Zn was recorded in the environment which had low initial soil Zn and no further Zn was added with Zn fertilizer. However, increase in grain Zn with the addition of fertilizer Zn was not uniform across the tested genotypes. The genotypes - Shraboni, Dehangi, Kopouguni, Laishanka and Negilai recorded high grain Zn content across all the environments. Inglongkiri, Panimudi, Arpang and Ranga Ahu showed good grain Zn

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content in low Zn environment while Begungutia, Kolong, Disang and Ikhajoy showed good grain Zn content in high Zn environment. The results suggest the possibility of identifying high Zn genotypes and also the possibility of agronomic biofortification as most of the genotypes showed increase in grain Zn with addition of external Zn to soil. The genotypes exhibited significant variation in the individual environments as well as over environments for most of the characters studied including yield and grain Fe. Based on D2 analyses the genotypes were grouped in 5 different clusters of which 4 were mono-genotypic and the rest one was with 26 genotypes. Significant variation among the genotypes as well as tested environments was also reflected in the stability analysis. Shraboni, Dikhow and Rangadaria for grain yield and Shraboni, Dehangi, Kopouguni, Laishanka and Negilai for grain Zn showed high mean performance with average stability. There is significant variation among the crosses both in low and high Zn environments for almost all the characters. Significant positive GCA effects were found for grain yield and grain Zn for Inglongkiri and Kolong in both high and low Zn environments. Heterosis over mid parent was seen for grain Zn in Kasalath×Inglongkiri and for grain yield in Kasalath×Ikhojoy and Ikhajoy×Kolong. Heterobeltiosis was recorded for grain Zn in Kasalath×Kolong in high Zn environment.

Survey, identification of phytopathogens causing diseases of dragon fruit in Assam, crop loss assessment and integrated management

Joyarani Pegu

Dragon fruit (*Hylocereus* spp.) is an exotic, high value, newly and emerging fruit crop in Assam. Due to its high commercial value and higher consumption, interest in planting and cultivation of this fruit is increasing in the state. Several diseases have also arisen with significant impact, likely due to increase in planting acreage and the consequent buildup of pathogen inoculum. Actions are needed to address these diseases associated with the crop as effective, sustainable and practical management strategies are yet to be identified. Hence, the present study was conducted to identify diseases associated with the crop and to develop suitable integrated disease management strategies. Prevalence of stem anthracnose, stem rot and stem gray blight with highest disease incidence of 30, 35 and 25 per cent were recorded from Gogamukh and Rongdoi during the survey conducted in eight districts of Assam respectively. Morphological and molecular study including pathogenicity test confirmed the pathogens as Colletotrichum gloeosporioides OQ274997, Fusarium oxysporum OQ274999, Fusarium dimerum OQ274998 and Diaporthe phaseolorum OQ275000 causing stem anthracnose, stem rot and stem gray blight disease of dragon fruit. The diseases reported in the present study are new disease found in the crop in the state and to the best of our knowledge, this is the first report of anthracnose, stem rot and stem gray blight disease of dragon fruit in Assam. In vitro efficacy of fungicides (Trifloxystrobin 25%+Tebuconazole 50%, Azoxystrobin and Copper oxychloride) at three different concentrations and bio control agents (Trichoderma viride KF439055, Pseudomonas fluorescens KT258013 and Bacillus subtilis ON3861930 were carried out against the pathogens. Promising Tebuconazole 50%+Trifloxystrobin 25% WG @ 0.05 per cent and T. viride KF439055 @ 5ml/l were further evaluated in the field condition. Field evaluation indicated that cutting treatment followed by soil drenching and foliar application with Trifloxystrobin 25%+ Tebuconazole 50% WG @ 0.05% and T. viride @ 5ml/l found very effective in reducing the anthracnose and stem rot diseases of dragon fruit in field conditions with a per cent disease reduction of 80.0 and 87.57, inducing early flowering and fruiting over control respectively.

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Major Adviser: Dr. Popy Bora

Molecular Epidemiology and Diversity of Tomato Leaf Curl Virus (ToLCV) species of Assam

Kanuri Komala Siva Katyayani

Tomato (*Solanum lycopersicum* L.) is a member of the Solanaceae family, is one of the most commonly consumed and widely grown vegetables in the world. Despite its economic significance, Tomato is threatened by a variety of plant diseases that negatively impact production quality and quantity. Tomato leaf curl is one of the most common and serious viral disease in Assam. In order to determine the severity and diversity of this virus, a roving study was conducted in certain Tomato growing districts of Assam and 58 per cent of average ToLCV incidence was recorded. Survey conducted five Agro climatic zones to assess the leaf curl disease in Tomato growing areas viz., Jorhat, Kamrup, Nagaon, Diphu and Lakhimpur revealed the occurrence of disease in the range of 40 to 90 per cent. Among the districts surveyed, highest average disease incidence was recorded in Jorhat (90 %) and least incidence was recorded in Sonitpur (40%). Tomato leaf curl isolates collected from surveyed areas were tested by PCR using Deng Primers. The virus was detected by coat protein (CP) specific primers, which amplified ~530 bp. The sequence of CP of ToLCV Jorhat Isolate shared nucleotide identity of 96 % with Chilli Leaf curl virus and 87% with Pepper Mosaic virus isolate whereas ToLCV shared maximum identity of 95% with Tomato leaf curl Joydebpur virus isolate. Phylogenetic analysis of CP sequences of both isolates revealed that ToLCV-JL from Jorhat isolate from Jorhat district (ToLCV-JRT) clustered with Bangladesh Tomato leaf curl virus isolate. ToLCV beta DNA satellite molecule of ~1.3 kb was amplified only from different zones of samples and shared 94% nucleotide sequence identity with Papaya Leaf Curl beta satellite molecule and Tomato leaf curl Joydebpur Isolate. Thus indicates that there is an involvement of two distinct Begomoviruses in causing Tomato leaf curl disease in Northern Part of India, Uttar Pradesh. Tomato leaf curl virus isolate from Jorhat was successfully transmitted to tomato, chilly, Capsicum and King chili through whiteflies (Bemisia tabaci). Among the various inoculation time points in Tomato, chilli, Capsicum and King Chilli showed 60-80 per cent transmission showing typical leaf curl symptom of all the four ToLCV isolates and no transmission was observed in brinjal. Total phenolic content was more in

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brinjal followed by tomato, capsicum, King chili and chili. Highest phenol content observed in Brinjal (97 mg/g) and lowest in Chilli (4 mg/g), which represents the maximum whitefly incidence was observed in hosts with low phenol content, whereas minimum whitefly infestation was observed on Tomato with more quantity of phenol. The morphological and biochemical parameters also affect the host and vector relationship and develop defence mechanism to manage the ToLCV. As the temperature and relative humidity increases the population of whitefly increase but in case rainfall it decreases. In case of ToLCV incidence same effect of epidemiological factors was found. Temperature was directly proportional to the disease incidence. The present investigation yielded good results, suggesting that the development of transgenics and gene silencing methodology for Tomato resistance transformation may be utilised in future research.

Assessment of virulent strains of *Ralstonia solanacearum* affecting brinjal crop (*Solanum melongena* L.)

Rajashree Chetia

Bacterial wilt caused by Ralstonia solanacearum (Smith) Yabuuchi is a major constraint in the cultivation of solanaceous vegetables in India. Managing this disease is difficult due to the pathogen's adaptability, viability, and diverse nature. The present study aimed to investigate the pathogen's genetic diversity and develop strategies to combat bacterial wilt in eggplant cultivation in Assam, India. A survey was conducted in eleven districts of Assam, representing four different agro-climatic zones, namely UBVZ, LBVZ, NBPZ, and CBVZ, to identify the occurrence of bacterial wilt. The highest incidence was found in the Kokrajhar district (22.65%), followed by Jorhat district (22.52%). A total of 25 isolates were collected and 20 isolates were selected based on their virulence for further characterization and confirmation by using specific primers (OLI 1/Y2). Results revealed that all these isolates belonged to Race 1, biovar 3. Genetic diversity exploration utilizing phylotype-specific primers, revealed that all the isolates produced a 144 bp amplicon specific to Phylotype I, indicating that the R. solanacearum isolates in this study belonged to Phylotype 1, originating from Asia. Sequevar identification based on the endoglucanase gene identified the presence of sequevars 48, 14, and 12 in the brinjal-growing regions of Assam, giving a new insight on the diversity of R. solanacearum in the region. Further, screening of 25 brinjal varieties against bacterial wilt identified the local variety Khorua bengena as resistant, while other local varieties showed varying levels of resistance or susceptibility. Screening different brinjal varieties provides valuable insights for breeding programs to develop resistant varieties. For eco-friendly management of bacterial wilt, 41 rhizospheric microbes and 11 botanicals were screened in vitro, and the most effective rhizospheric microbe and botanical were selected for pot experiments. The rhizospheric isolate Bacillus velezensis showed the highest inhibition (81.11%) and was identified based on morphological, cultural, biochemical, and molecular characteristics. Among the botanicals, the aqueous extract of Tagetes erecta demonstrated the highest inhibition

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(78.44 %) against R. solanacearum in vitro. In pot experiments, the combination of B. velezensis with Tagetes erecta extracts significantly suppressed bacterial wilt, followed by B. velezensis. GC/MS analysis revealed various bioactive compounds in Tagetes erecta and B. velezensis, highlighting their potential against R. solanacearum. The study identified genetic variability within R. solanacearum race 1, biovar 3 populations in Assam, posing challenges for developing effective management strategies against bacterial wilt in brinjal. The findings from this study will contribute to the design of management strategies and the development of resistant brinjal varieties for Assam's conditions. Additionally, the information on R. solanacearum strain diversity will be useful for pathogen population analyses and breeding programs in the region.

Artificial intelligence and IOT in precise evaluation of citrus canker disease suppression in Assam lemon due to application of organic formulations, botanicals, and beneficial microbe

Swagata Saikia

Citrus Canker caused by Xanthomonas citri pv. citri (Xcc) is one of the most destructive disease of citrus. The present study was aimed at managing the disease using beneficial microbes (Endophytes and rhizospheric microbes), Botanicals (Aloe, Neem, Bael, Onion, Lemon grass, Garlic) and Organic formulations (Panchagavya and Jeevamrut). The treatments were tested in vitro against the pathogen using dual culture assay. The results showed that Endophyte (Bacillus velezensis), Rhizospheric microbe (Pseudomonas putida), Botanicals (Cymbopogon citratus and Allium cepa) and Organic formulation (Panchagavya) were the most effective with inhibition percent of 54.14, 55.55, 52.66, 59.11 and 51.33, respectively which were later evaluated in field conditions. In a step further, the bio-agents subjected LC- MS metabolite profiling, indicated the potential activity of the secondary metabolites in inhibition of pathogen. The presence of compounds with antifungal and antibacterial principles, phenolic esters and fatty acids indicates the effectiveness of beneficial microbes. GC-MS analysis of the effective botanicals showed the active components present in Cymbopogon citratus oil and Allium cepa extract that helped in control of the pathogen. Assessment of Percent disease severity, soil nutrients and yield enhancement of different treatments at different time intervals was done using AI and IOT technology. Manual observation of Percent disease severity and yield was also done to check accuracy of both the datasets. Endophyte Bacillus velezensis applied both in soil and as foliar spray reduced the disease (81% in case of AI and 77.67% in case of manual observations) and also enhanced the yield (120 no of fruit/plant in case of AI and 130 in case of manual observations). Soil nutrients have also increased in rhizosphere highest after treating it with Bacillus velezensis, followed by Pseudomonas putida, Cymbopogon citratus, Allium cepa and Panchagavya. T-test analysis have revealed the efficacy of AI over

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manual observations and showed a positive correlation between both the data sets. The induction of defence related bio chemicals in Assam Lemon plants in response to application of beneficial microbes, botanicals and organic formulations were also assayed. The highest total phenol (13.25mg/g dry weight), flavanoid (6.14mg/g dry weight), alkaloid (10.13%), Tannin (1.26mg/g dry weight), Saponin (1.517 mg/g dry weight), Terpenoid (20.883 mg/g dry weight), Vitamin C content (55.75 g/100ml) was found in plants treated with Bacillus velezensis, followed by Pseudomonas putida, Cymbopogon citrates, Allium cepa and Panchagavya.

Assessment of soil quality in Tezpur Litchi growing areas of Assam

Gundlapalli Swathi

Tezpur litchi (Litchi chinensis Sonn.) is a special type of litchi bearing attractive red colour, excellent quality, pleasant flavour, juicy tight pulp and grown originally the fruit crop was grown in Litchupukhuri and Porowa villages of Sonitpur, Assam. The crop got GI tagged in the year 2015. Litchi growers of the state are unable to get the same qualities of the fruit when grown in some other parts. Among various other factors governing the quality of the fruit, soil management practices followed in the particular pockets may be crucial. Existing soil management practices have profound impact on soil properties, and thus lies the importance of assessing of soil quality of the area. Therefore, the present investigation was carried out to assess the soil quality in Tezpur litchi growing areas of Assam and to understand the impact of existing (in field) soil management practices. Sixty four geo-referenced soil samples from 0-20 cm and 20-40 cm depths were collected from five different locations where Tezpur litchi is grown, viz. Tezpur litchi orchard, Napaam, Tezpur; Krishi Vigyan Kendra (KVK), Dibrugarh; Aujari progeny orchard and seed farm (APOSF), Morigaon; farmer's training centre (FTC), department of horticulture and food processing, Byrnihat and Rangolu nursery, Nagaon. A total of forty two parameters soil parameters (physical, chemical and biological) were analyzed using standard protocols for both the two depths. Analysis of soil physical properties like soil texture, bulk density, soil moisture and aggregate analysis was done. The soil textural group of Tezpur Litchi Orchard, Napaam and in sites of KVK, Dibrugarh was recorded to be sandy loam, in both the depths. Clay loam soil was observed in APOSF, Morigaon and FTC, Byrnihat at both depths. The surface soils at Rangolu Nursery in Nagaon had a composition of sandy clay loam, while the sub surface soils exhibited clay loam texture. The mean bulk density (BD) ranged in between 1.37 (FTC, Byrnihat) and 1.51 Mg m-3 (KVK, Dibrugarh) across the locations at 0-20cm, while at depth of 20-40cm the mean BD ranged between 1.44 (KVK, Dibrugarh) and 1.59 Mg m-3 (FTC, Byrnihat).

Analysis of soil chemical properties of the sites revealed that pH ranged between 4.40 and 7.80 with a mean of 5.29 (±0.01) for the surface soils. At a depth of 0-

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20cm, 6.25% of the soils were extremely acidic (<4.5), 18.75% were very strongly acidic (4.5-5.0), 56.25% were strongly acidic (5.1-5.5), 12.5% were moderately acidic (5.6-6.0) and 3.125% of the soils were slightly acidic (6.1-6.5). An increasing trend of pH with depth was observed in all sites. The organic carbon (OC) % in Tezpur Litchi Orchard, Napaam varied significantly, with 90% of the area exhibiting >1.5% OC, while 10 % area indicated medium range of OC (0.5-1.5%), while the remaining sites recorded uniformly high OC%. However, at 20-40 cm depth, OC% ranged from medium to high. The carbon fractions like very labile carbon (VLC), labile carbon (LC), less labile carbon (LLC) and non-labile carbon (NLC) in surface soils were 1.82, 1.50, 0.60 and 2.92 g kg-1 and that in sub surface soils were 1.15, 1.36, 2.61 and 1.64 g kg-1, respectively. The total organic carbon (TOC), humic acid carbon (HAC) and fulvic acid carbon (FAC) were highest in 0-20 cm than 20-40 cm depth. Highest TOC of 3.99 mg C g soil−1 at 0-20 cm was observed in Tezpur Litchi Orchard, Napaam, while higher HAC (0.43%) and FAC (0.82 %) as recorded at 0-20 cm depth in APOSF, Morigaon. Analysis of major nutrient revealed that available nitrogen status was low at both the depths across the sites, while available phosphorus (P2O5) was recorded to be low (mean value of Tezpur Litchi Orchard, Napaam: 19.54 kgha-1), to medium in surface soils of all the remaining sites. At 20-40 cm depth available P2O5 was medium in APOSF, Morigaon (24.42 kgha-1), and recorded low in all other sites. Available potassium (K2O) levels in surface soils across Tezpur, Dibrugarh, Morigaon, Byrnihat and Nagaon were recorded in medium range. In sub surface soils, Tezpur Litchi Orchard, Napaam and APOSF, Morigaon recorded in medium range, while other sites showed variable ranges of available potassium. Secondary nutrient calcium was recorded significantly highest content (1.60 mg kg-1) in Rangolu nursery, Nagaon and low content (0.62 mg kg-1) was recorded in APOSF, Morigaon at 0-20 cm depth. In sub surface soil samples of Tezpur Litchi Orchard, Napaam and KVK, Dibrugarh a combination of deficiency and sufficiency was recorded for exchangeable calcium. Deficient range of exchangeable magnesium was observed at both the depths. The highest available sulphur (S) content was recorded at Tezpur Litchi Orchard, Napaam (27.44 mg kg-1), while the lowest was observed at FTC, Byrnihat (11.3 mg kg-1) in surface soils. At 20-40 cm depth, a decreasing trend of available S with increasing depth was observed. Diethylene triamine penta-acetic acid-iron, manganese (DTPA-Fe, Mn) status was very high at both depths, where as Diethylene triamine penta-acetic acid-copper (DTPA-Cu) was found to be high range at both the depths. In surface soils, 78.12% of samples had a high range and 21.87% had a low range of triamine penta-acetic acid-zinc (DTPA-Zn). In case of sub surface soils, 56.25 % of samples were in the low range, 43.75 % were in the high range. The biological properties like microbial biomass carbon (MBC) were recorded to be highest in APOSF, Morigaon 995.16 µg g-1 and lowest in KVK, Dibrugarh at surface soils. At 20-40 cm depth, it was found to be highest in FTC, Byrnihat (973.62 µg g-1) and lowest in KVK, Dibrugarh (176.87 µg g-1). Dehydrogenase (DHA) and phosphomonesterase activity (PMEase) in both soils

comes under low (<100 µg TPFg−124 h−1) category. The Fluorescein di-acetatehydrolysis (FDA) activity in surface soils ranged between 2.29µg fluorescein g-1 h-1 and 25.76 µg fluorescein g-1 h-1 with a mean value of 7.25 µg fluorescein g-1 h-1 (±4.65). However, there was a no significant variation in FDA among the sites at 0-20 cm depth. Arylsulphatase (ARS) activity in surface soils was low in the low range (<30 µg p-ntrophenol g-1 h-1) and recorded in high range (>50 µg p-ntrophenol g-1 h-1) in the sub surface soils. The soil respiration (SR) rate and total population count (bacteria, fungi, Azotobacter, Azospirillum and phosphorus solubilising bacteria was found to be higher in surface soils which showed a decreasing trend with increase in depth. After descriptive statistics, different soil quality indices were developed integrating 38 soil (physical, chemical and biological) attributes. The principal component analysis soil quality index (PCA-SQI) of the sites under Tezpur Litchi growing areas in surface soils was significantly higher in KVK, Dibrugarh (0.79), followed by Rangolu Nursery, Nagaon (0.75), APOSF, Morigaon (0.69), FTC, Byrnihat (0.66) and Tezpur Litchi Orchard, Napaam (0.57). In case of sub surface soils, it was significantly higher in APOSF, Morigaon (0.74), followed by Tezpur Litchi Orchard, Napaam (0.63), Rangolu Nursery in Nagaon (0.48), FTC, Byrnihat (0.47) and KVK, Dibrugarh (0.44). Upon computation of relative soil quality index (RSQI) at 0-20 cm depth, >70% of the soils of sites belonged to good category, whereas as in sub surface soils, 81.25% and 18.75% of samples showed good and medium category, respectively. Computation of biological fertility index (BFI) revelaed that in Tezpur Litchi Orchard, Napaam, 40 % of soils were observed at good range (19-24) and 60% with high range (25-30). In KVK, Dibrugarh, 57.14% and 42.85% of the samples were found to be good and high range for BFI, while remaining sites belongs to high range at 0-20 cm. At 20-40 cm depth BFI was of significantly higher range at Tezpur Litchi Orchard, Napaam (20. 20) and FTC, Byrnihat (20. 20), followed by APOSF, Morigaon (19.40), Rangolu Nursery in Nagaon (19.20) and, KVK, Dibrugarh (16.71). The expert opinion soil quality index (EO-SQI) ranged between 0.55 and 0.86 with a mean value of 0.70 (±0.09) in surface soils, while in sub surface soils it varied from 0.43 to 0.85 with a mean value of 0.56 (±0.07). EO-SQI was significantly higher in APOSF Morigaon at both the depths. The significant correlation of PCA-SQI, RSQI, BFI and EO-SQI, illustrated that the EO-SQI and BFI, EO-SQI and RSQI, BFI and RSQI, PCA-SQI and BFI, PCA-SQI and EO-SQI, and PCA-SQI and RSQI based on soil functions could adequately provide information needed for selection of soil management practices. Therefore, site specific management practices would help in soil health maintenance and augment sustainability of the Tezpur litchi growing sites of Assam.

Assessment of soil properties and carbon sequestration under fodder crop based system

Manjurima Gogoi

The present investigation was carried out for assessment of soil physicochemical and biological properties, distribution of different forms of soil carbon and contribution of different forms of soil carbon on soil aggregation under different fodder crop based system. Soil samples were collected from twenty three crop situations of three locations of Jorhat and Golaghat districts of Assam including virgin soils. Samples were collected as bulk soil samples, large core samples and mini core samples from 0– 20, 20-40, 40-60, 60-80 and 80-100 cm soil depth from each plot under fodder crop and virgin soil. It was observed that soil physico- chemical and microbiological properties were greatly improved by continuous cultivation of fodder crops. The pH of soils under fodder crops down the depth were higher than those in virgin soils making these soils less acidic in reaction. Continuous cultivation of fodder crops increased the per cent organic carbon content of soil and it is high in case of napier than other fodder crops. Available nitrogen, phosphorus, potassium, calcium and magnesium contents increased due to continuous cultivation of fodder crops and continuous cultivation of napier grass as well as setaria showed high range of these nutrients than other fodder crops. Continuous cultivation of fodder crops increased hydraulic conductivity of soils and six years continuous cultivation of napier showed highest range of hydraulic conductivity of 0.119 cm sec -1 to 0.001 cm sec -1 with a mean value of 0.028 cm sec-1 . Bulk density decreased due to continuous cultivation of fodder crops and continuous cultivation of setaria for six years showed lowest bulk density ranged from 0.93 Mg m-3 to 1.05 Mg m -3 with a mean value of 1.00 Mg m-3 . Per cent available water content increased due to continuous cultivation of fodder crops and fourteen years continuous cultivation of napier showed highest range of available water content of 13.37% to 6.79% with a mean of 10.59%. Continuous cultivation of napier, setaria and congosignal showed higher soil aggregation and mean weight diameter than other fodder crops and virgin soil. The microbial biomass carbon, phosphomonoesterase activity and dehydrogenase activity of fodder crops was much higher than the virgin soils. The highest microbial biomass carbon range was found in case of fourteen years continuous

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cultivation of napier (769.3 µgm gm-1 to 96.6 µgm gm-1 with a mean of 388.3 µgm gm-1). Six years continuous cultivation of maize showed highest phosphomonoesterase activity (336.5 µgmgm-1 hr-1 to 210.1 µgmgm-1 hr-1 with a mean of 249.0 µgmgm-1 hr-1) and five years continuous cultivation of hybrid napier showed highest dehydrogenase activity (22.94 µgmgm-1 hr-1 to 5.69 µgmgm-1 hr-1with a mean of 15.82 µgmgm-1 hr-1). The highest total organic carbon content wasfound in case of continuous cultivation of napier followed by continuous cultivation of setaria and it was higher in 20-40 cm layer of soil than in 0-20 cm layer. Six years continuous cultivation of napier showed highest range of soil carbon stock of 37.01 t ha-1 to 24.64 t ha-1 with a mean of 31.46 t ha-1 . The oxidisable organic carbon decreased with the increase in soil depth down the profile anddue to high vegetative growth, continuous cultivation of napier or hybrid napier showed high oxidisable organic carbon in soils. Highest hot water extractable organic carbon was found in continuous cultivation of hybrid napier followed by setaria. The highest cold water extractable organic carbon content was 6 found in six years continuous cultivation of cowpea. The highest range ofhumic acid and fulvic acid were found in continuous cultivation of napierfollowed by continuous cultivation of setaria.The very labile carbon and labile carbon also decreased down the profile with increase in soil depth and continuous cultivation of napier as well as setaria showed higher values than other fodder crops and virgin soils. Fourteen years continuous cultivation of napier showed highest very labile carbon (0.94% to 0.27% with a mean of 0.58%) and labile carbon (0.87% to 0.20% with a mean of 0.50%).The highest range of less labile carbon was found in six years continuous cultivation of napier (0.29% to 0.47% with a mean of 0.39%) which was high in lower soil depths than upper 0-20 cm soil layer. The non labile pool of carbon first increased and later decreased down the profile with increase in soil depth in both fodder crops and virgin soils. Significant positive correlation was observed for labile carbon with very labile carbon; cold water extractable organic carbon with hot water extractable organic carbon; humic acid with very labile carbon, labile carbon and hot water extractable organic carbon; fulvic acid with very labile carbon, labile carbon ,hot water extractable organic carbon, cold water extractable organic carbon and humic acid; microbial biomass carbon with labile carbon, hot water extractable organic carbon, humic acid and fulvic acid; phosphomonoesterase activity with hot water extractable carbon, humic acid, fulvic acid and microbial biomass carbon; dehydrogenase activity with hot water extractable organic carbon, humic acid, fulvic acid and microbial biomass carbon; mean weight diameter with hot water extractable organic carbon, humic acid and fulvic acid.Less labile carbon and non labile carbon showed negative correlation with almost all the parameters. Aggregation was higher in macroaggregates than microaggregates and in upper layers of soil mainly 0-20 cm and 20-40 cm soil layers. Growing of napier grass and also setaria, seemed to have greater influence on soil aggregation as compared to other crops. Different forms of aggregate associated soil organic carbons were higher in fodder crops than virgin soils and aggregate associated total organic carbon, oxidisable organic carbon (%), hot water extractable organic carbon, cold water extractable organic

carbon, humic acid and fulvic acid, very labile carbon and labile carbon of soils were higher in 0.25 mm to 1.00 mm size range of aggregates in case of both fodder crops and virgin soils. Very labile carbon and labile carbon content were higher in 0.5 mm to 0.10 mm size range than 0.25 mm size range. The aggregates in the size range of 0.50 and 0.25 mm contained higher humic acid as compared to the other size ranges.The aggregate associated less labile carbon per cent were higher in case of macroaggregates. The non labile carbon was higher in 20-40 cm soil depth and in 5.00 mm, 2.00 mm and 0.10 mm size range of aggregates than 0.25 mm to 1.00 mm size range. It is seen that continuous cultivation of napier showed highest percentage of aggregate associated different forms of soil carbon.

Molecular Characterization of Arsenic Oxidizing Bacteria from Hot Spots of Assam

Nilakhi Dutta

In view of wide scale toxicity of Arsenic (As), development of a sustainable low cost As `detoxification technology is an urgent need of time. Bioremediation of As by microorganisms has been widely hailed because of their potential advantage in As transformation through oxidation, reduction, methylation and volatilization. As (III) oxidizing bacteria plays a key role in the biological conversion of highly toxic and mobile As(III) to less toxic As(V) in the environment and hence can be a potent candidate for bioremediation of As contamination. 44 georeferenced soil samples and 22 georeferenced water samples were collected from As contaminated hot spots of Jorhat, Darrang and Nagaon districts of Assam for isolation of As(III) oxidizing bacteria. A total of 52 As tolerant isolates (39 from soil and 13 from water samples) were obtained initially in nutrient agar(NA) media supplemented with 1mM As(III). Highest percentage recovery of As tolerant bacteria was observed in sample DS6 (56.02%) of Darrang district. Significant correlation ($p \leq 0.01$) was established between percent recovery of As tolerant bacteria with total As content in soil and water samples. Following primary screening based on minimum inhibitory concentration (MIC) of As, 15 isolates that could tolerate upto 17.5 mM As(III) or above were selected for further studies. Morphological and biochemical characteristics of the selected As tolerant bacteria were studied. All the 15 isolates showed positive response to citrate utilization tests and negative for Indole, H2S production and Voges Proskauer test. The isolates also showed significant variation in carbon source utilization indicating diversity of organism to utilize different carbon sources. Antibitotic resistance profile of the isolates revealed that all the isolates showed resistance to penicillin. DS1al and DS13a showed resistance against 8 tested antibiotics. The growth of all isolates was found to be optimum at pH 7.2 and at temperature 300C ranging from 20 to 177 cfu mL-1 and 20 to 185 cfu mL-1 respectively. Study of growth pattern in terms of colony forming units (CFU) and optical density(OD) of the isolates at 0h, 24h, 48h and 72h interval showed higher reduction in growth in presence of As(III) compared to the presence of As(V). Heavy metal tolerance limit of the isolates ranged from NiCl2 (1-6 mM), CuSO4 (1-7

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mM), CoCl2 (0.1-1 mM), ZnSO4 (0.5-3 mM), HgCl2 (0.1-0.5 mM), Pb(NO3)2 (4-10 mM) and AgNo3 (0.5 mM). Ten isolates viz., DS1al, DS2a, DS5a, DS7am, DS8bm, DS11ama, DS13a, DS15a, DS17b and NS12c showed positive oxidation reaction in both AgNO3 and Microplate screening assay done to detect the As oxidizing isolates. Quantitative assessment of As oxidation using high performance liquid chromatography (HPLC) revealed that these isolates can transform As(III) to As(V) in the range of 46.53 -73.29 % in presence of 15.5 mM As(III). Highest oxidation efficiency is shown by isolate DS2a (73.29%) followed by NS12c (62.84%) and the lowest being in DS15a (46.53%). Overall, all these 10 selected isolates showed potential detoxification response against As. Scanning electron microscopy done for observation of invitro As bioaccumulation of the isolates revealed distinct changes in cellular morphology including decrease in cell length, increase in cell volume and typical dents in septal area. Taxonomic identity of the entire ten As oxidizing isolates revealed their close identity to Pseudomonas laurentiana, Glutamicibacter creatinolyticus, Providencia huaxiensis, Myroides profundi, Citrobacter tructae, Citrobacter murliniae, Bacillus pseudomycoides and three isolates identical to Lysinibacillus boronitolerans.

Ph.D (Veterinary Science)

- **Animal Biotechnology**
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EXPRESSION OF *ATP1A1* AND *HSP 72* GENES IN RELATION TO MILK YIELD OF LAKHIMI, SAHIWAL AND CROSS-BRED COWS IN DIFFERENT TEMPERATURE-HUMIDITY INDICES

Debahuti Hazarika

The present study was conducted to study *ATP1A1* and *HSP72* mRNA expression of Lakhimi, Sahiwal and Crossbred cows of Assam in relation to their physiological response in different temperature-humidity indices. The study included a total of 18 of healthy lactating Sahiwal, Crossbred (Jersey x Holstein-Friesian) and Lakhimi cows six each, reared under intensive system in Instructional Livestock Cattle Farm of College of Veterinary Science, Khanapara, Assam. The experiment was conducted during three different periods *i.e.,* Period1 (month of July, P1), Period2 (month of September, P2) and Period3 (month of December, P3). The physiological parameters such as milk yield (kg/day), rectal temperature (°C) and respiration rate (breaths/min),were recorded consecutively for seven days prior to blood collection from the animals and seven days after blood collection from the animals during the three periods. The temperature humidity index (THI) was calculated as THI=0.72 (Tdb+Twb) +40.6 where, Tdb and Twb were the dry bulb and wet bulb temperatures, respectively. Conventional heat tolerance test namely Benezara Co-efficient of Adaptability (BCA) was conducted to determine the level of heat tolerance (HTC) in the experimental animals. Jugular blood (5ml) was collected twice in a week and transported to the laboratory and stored at -20°C refrigerator until RNA extraction and hormone estimation during different periods of the experiment. The level of thermal stress in related blood hormones such as Triiodothyronine (T3), and Cortisol were estimated by Radioimmunoassay (RIA) technique. The relative expression of *ATP1A1* and *HSP-72* was studied by Real-time PCR (RT-PCT).

In the experiment, the Period P1 that falls in July with an ambient temperature of 31.83 ± 0.16 °C and relative humidity 88.50±0.23 resulted into the temperature humidity index (THI) of 81.66±0.01 which suggested severe heat stress and moderate stress in Period P2 (falls in September) with an ambient temperature of 28.41±0.22°C and relative humidity 80.66±0.18 and Period P3(falls in December) with lowered ambient temperature of 16.58 ± 0.22°C and relative humidity 76.08 ± 0.89) respectively. The physiological performance in three different periods of experiment revealed rectal

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temperature of 101.05±0.11°F to 101.27±0.01°F with no significant variation between different breeds and periods, whereas respiration rate was significantly higher in P1 Period as compared to P2 and P3 Period. Sahiwal (19.92±0.23) and Crossbred (18.42±0.26**)** cows showed significantly higher respiration rate as compared to Lakhimi breed (14.75±0.13) in P1 period. Heat tolerance coefficient (HTC) values were significantly different between periods and breeds with significantly lower value in P3 period (falls in December).

The Lakhimi breed in the present experiment revealed lowered HTC as compared to Sahiwal and Crossbred. Analysis of variance revealed no significant variation on the mean level of Triiodothyronine (T3) and Cortisol between different periods of the experiment and between breeds. In respect to serum T3, the values ranged from 1.25±0.07 to 1.62±0.10 (nmol/L) and serum cortisol ranged from 19.59±1.48 to 28.19±4.08 (nmol/l). Analysis of variance of milk yield in different periods revealed significant differences between breeds and periods. The average milk yield of Lakhimi breed of Assam ranged from 1.10 to 1.33 litres/day, Sahiwal breed yielded from 5.46 to 9.83 litres/day and Crossbred yielded from 11.83 to 12.33 litres/day in different periods of the experiment. P1 period of the study recorded significantly lower milk yield as compared to P3 period that falls in December. Lakhimi breed of Assam showed no variation between P1 and P2 periods. In P3 period that falls in December, significantly higher milk yield was recorded in Crossbreed and Lakhimi cows. In respect to temperature humidity index (THI) P1 period recorded 81.66±0.01. THI index indicating heat stress. With THI, 77.10±0.8, P2 period revealed moderate heat stress in the present experiment which might have resulted into lower milk yield recorded in Sahiwal and crossbreed as compared to Lakhimi breed of Assam. In the present experiment, mean ΔCT Value of *ATP1A1* gene expression showed significant increase in P1 period of the experiment as compared to P2 and P3 periods of the experiment in all the three breeds of lactating cows. Significantly lesser relative expression was observes in Lakhimi breed of Assam as compared to Sahiwal breed and Crossbred cows. In respect to mean ΔCT Value of *HSP-72* gene expression in the present study positive relative expression of *HSP-72* were recorded in different periods of the experiment. P1 period showed significantly higher values as compared to P2 and P3 periods of the experiment in all the three breeds.

The correlation co-efficient of *ATP1A1* and *HSP-72* expression with thermo-physiological performances in the three different breeds of cows revealed significant negative correlation ($P<0.01$) of HSP-72 with milk yield in Sahiwal cows and *ATP1A1* and *HSP-72* expression with T3 level in Crossbred cows in P1 period of the present experiment. In Lakhimi cow, there was significant negative correlation ($P<0.01$) of *ATP1A1* with heat tolerance coefficient (HTC). However, in P2 and P3 period of the present experiment, there was no significant correlation of *ATP1A1* and *HSP-72* expression with the physiological parameters in the three different breeds under study.

GUT BACTERIAL METAGENOME OF INDIGENOUS PATI DUCK (*ANAS PLATYRHYNCHOS DOMESTICUS*) OF ASSAM AND IDENTIFICATION OF POTENTIAL PROBIOTIC ISOLATES

Simanta Koushik

Indigenous *Pati* ducks (*Anas platyrhynchos domesticus*) of Assam are well known for their resistance to enteric pathogens. The gut microbes play an essential role in nutrient digestion and absorption, immune system development and the host's protection against pathogens. Hence, the present study was undertaken to analyze the gut microflora of *Pati* ducks through metagenome profiling which was expected to provide a comprehensive picture of the diverse microbial community including the potential probiotic bacteria existing in the gut. The cloacal and oro-pharyngeal samples were collected from six different locations of Assam ,*viz.*, Khanapara, Sonapur, Hajo, Kaliabor, Sivasagar and Dhubri. A few samples were also collected over two different seasons from the Sonapur area of Kamrup district to study seasonal variation in the composition and diversity of gut microbiota. Metagenomic DNA were extracted from these samples and 22 samples were subjected to amplification of V3 and V4 regions of the bacterial *16S rRNA* gene sequence and the corresponding high-throughput sequence data were generated by outsourcing. Upon metagenomic analysis, geographical and seasonal variations were observed in the gut microbiota of *Pati* ducks while occurrence of bacteria belonging to the genus *Lactobacillus* was recorded in all the samples, irrespective of location or season.

For isolation of potential probiotic bacteria including *Lactobacillus* and *Bifidobacterium*, faecal samples from the ducks were inoculated in MRS broth with overnight incubation, followed by culture on MRS agar to obtain pure cultures. A total of 117(50.43%) of 232 samples tested yielded *Lactobacillus* isolates and 5(2.15%) *Bifidobacterium* isolates, which were identified based on morphological, cultural, biochemical characteristics followed by molecular confirmation by PCR amplifying the genus-specificsegment of *16S rRNA* gene. All PCR-positive isolates were further tested for their *in-vitro* probiotic efficacy based on tolerance to acid, bile salt, hydrogen peroxide and lysozyme, auto-aggregation activity, cell surface hydrophobicity,

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haemolytic activity, antimicrobial activity and resistance to antimicrobial agents based on minimum inhibitory concentration and antibiotic sensitivity tests. Out of 117 *Lactobacillus* isolates, 19 (16.24%) could pass all the *in vitro* tests for probioticefficacy, while none of the *Bifidobacterium* isolates could show acid tolerance and hence they were not subjected to further tests.

The purified PCR amplicons of *16S rRNA* gene of six most promising probiotic *Lactobacillus* isolates selected on the basis of the *in vitro* assessment were sent for sequencing by outsourcing and based on sequence alignment by NCBI-BLAST, three of them were identified as belonging to the *Lactobacillus reuteri* and the other three as *Lactobacillus fermentum*.

Further, to validate the efficacy of the selected probiotic isolates, *in vivo* pathogen challenge trials were conductedin chicken and duck. A consortium was prepared with the selected *L.reuteri* (3)and *L. fermentum*(3) isolates at 1×108cfu/ml concentration in equal proportion and was tested for its probiotic efficacy against challenges with pathogenic *S.* Typhimurium, *E. coli* and *C. perfringens* of poultry origin following standard methods. The results revealed that the probiotic-fed chickens and ducks had significantly higher ($p<0.05$)body weight gain as well as serum total protein and albumin levels than that of the control group without probiotic. The serum IgG level was also significantly higher ($p<0.05$) in the probiotic-fed pathogen infected group compared to the non-probiotic-fed pathogen infected groups. The pathogen infected birds fed with probiotic were able to prevent the occurrence of severe symptoms, reduction in weight, serum total protein and serum albumin levels as well as reduction in the serumIgG level caused by the infections, which was evident in the non-probiotic-fed pathogen infected chickens and ducks. On post mortem examination, it was observed that the pathogen infected birds had severe gross and microscopic lesions in liver and small intestine whereas no lesions were found in the probiotic-fed birds following the experimental infection with the pathogens, except for the *C. perfringens* infected chickens, where microscopic lesions were observed in liver and small intestine, although there were no gross lesions.

For exploring the possibility of using the probiotic consortium as poultry feed supplement in future, batch culture of the identified probiotic strains may be standardized and the broth culture of the consortium may be converted to powder form. Moreover, field trials can be conducted with large numbers of chicken/duck to further validate the efficacy of the probiotic consortium in terms of its growth promoting efficiency and enhancement of protective immunity against enteric pathogens.

PERFORMANCE EVALUATION OF DIFFERENT GENETIC GROUPS OF PIG AT KVK OPERATING VILLAGES

Debajit Deka

The present investigation was carried out on the performance records of three genetic groups of pigs, viz., HD-K75, HD-K75 X Ghoongroo and Ghoongroo maintained and bred in the private farms under field conditions in the Krishi Vigyan Kendra, Baksa operating villages. The records pertaining to 1780 piglets of 131 sows were studied for growth performance. The reproductive performance records of 131 sows were utilized in the present study. Effect of various genetic and non-genetic factors such as genetic group, parity of dam, system of rearing, season of farrowing and sex of the animal on various economic traits were also investigated. Economics of rearing the three genetic groups as affected by different factors under study were also estimated. Data were analyzed by using Least Squares technique of Harvey, 1990 as is appropriate for non-orthogonal data.

The objectives of the study were (i) to study the pre-weaning body weight and daily body weight gain at different periods of growth, (ii) to study the different important reproductive traits, (iii) to study the effects of genetic and non genetic factors on various economic traits and (iv) to estimate the cost of production**.**

The least-squares mean (LSM) for body weights (kg) at birth, 4thweek and at weaning in HD-K75 pigs were found to be 1.009±0.024, 5.166±0.094 and 9.642±0.196 respectively. The corresponding values for HD-K75 X Ghoongroo pigs were observed to be 0.985±0.024, 5.117±0.096 and 9.354±0.200 Kg respectively and for Ghoongroo pigs the respective LSMs obtained were 0.931±0.024, 4.901±0.095 and 9.096±0.199 Kg.

Highly significant ($P < 0.01$) effect of genetic group on body weights at birth, at 4th week and at weaning was observed. HD-K75 piglets had significantly ($P<0.01$) highest body weight at birth, at 4th week and at weaning followed by HD-K75 X Ghoongroo and Ghoongroo pigs.

Effects of parity of dam on body weight at different ages under study were also found significant ($P<0.01$). The body weight at all the three ages registered the lowest values for LSMs in the piglets born in 4th parity.

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System of rearing also exerted highly significant effect (P<0.01) on the bodyweights under study. Tethering system reared pigs had the lowest body weights, being lower than the intensive and semi-intensive systems.

It was found that the season of birth had highly significant effect (P<0.01) on body weight at 4th week and at weaning. Significantly higher body weight at 4th week and at weaning was noticed in piglets born during winter season, and the piglets born during monsoon showed lower body weight at 4th week and at weaning.

Sex effect was also significant (P<0.01) on all the three body weights, males being heavier.

The least squares means for daily body weight gain from birth to 4th week, 4th week to weaning (8week) and birth to weaning were 145.870 ± 3.202, 152.679±6.794 and 149.425±3.227 g respectively. Thus, growth rate was found higher during 4th to 8th week as compared to birth to 4th week of age.

The least squares analysis of variance indicated highly significant (P < 0.01) effect of genetic group on daily body weight gains during the periods of birth to 4th week, 4th to weaning and birth to weaning. The average daily body weight gains during birth to 4th week were 148.487±3.225, 147.371±3.272 and 141.754±3.266 g respectively in HD-K75, HD-K75 X Ghoongroo and Ghoongroo pig. The average daily body weight gains during 4th to weaning were 159.062±6.849, 148.891±6.973 and 149.084±6.649grespectively in HD-K75, HD-K75 X Ghoongroo and Ghoongroo pig. Corresponding values for overall pre-weaning daily body weight gain were 154.229±3.252, 148.794±3.305 and 145.253±3.290 g respectively. The results of DMRT showed significantly higher daily body weight gain during birth to 4th week, 4th week to weaning and birth to weaning in HD-K75 followed by HD-K75 X Ghoongroo and Ghoongroo pig.

Effect of parity of dam was also found highly significant (P < 0.01). Piglets born in 2nd parity had significantly higher daily weight gain during birth to 4th week (146.227±3.315 g). The average daily weight gains during 4th week to weaning (157.683±6.841 g) and birth to weaning (152.600±3.243 g) were significantly higher in the piglets born in 1st parity. 4th parity exhibited the lowest gains.

The results revealed that the effect of system of rearing on daily body weight gain at birth to 4th week and birth to weaning was highly significant (P< 0.01). During 4th week to weaning period, there was significant effect (P<0.05) on daily weight gain. It has been observed that the piglets born in intensive system of rearing had significantly higher daily weight gain, whereas significantly lower daily weight gain was observed in tethering system of rearing.

The least-squares analysis of variance results revealed that the season of birth had highly significant effect (P<0.01) on daily weight gain during birth to 4th week, 4th week to weaning and birth to weaning. Piglets born during post-monsoon season had significantly lower daily weight gain in 4th week to weaning stages. In the stage of birth to weaning, the piglets born during monsoon season registered lower daily weight gain. Significantly higher daily weight gain at birth to 4th week, 4th week to weaning and

birth to weaning was noticed in piglets born during winter season. Thus, winter was found to be favourable season.

The male piglets exhibited significantly (P<0.01) higher growth rate than the females.

The least-squares means for age at first heat (days), age at first fertile service (days), age at first farrowing (days), gestation period (days), farrowing interval(days), service period (days), litter index, duration of farrowing (hours) litter size at birth (number), litter weight at birth (kg), litter size at weaning (number) and litter weight at weaning (kg) in HD-K75 pigs were found to be 283.336±2.977, 306.323 ±1.976, 419.863±1.947, 113.606±0.165, 205.465±2.305, 91.779±2.301, 1.221±0.002, 3.565±0.069, 8.277±0.111, 9.252 ± 0.193, 6.586± 0.133 and 66.124 ±1.015 respectively. In HD-K75 X Ghoongroo pig, the least-squares mean for age at first heat (days), age at first fertile service (days), age at first farrowing (days), gestation period (days), farrowing interval (days), service period (days), litter index, duration of farrowing (hours) litter size at birth (number), litter weight at birth (kg), litter size at weaning (number) and litter weight at weaning (kg) were found to be 280.495±3.647, 302.877 ±2.427, 416.487 ±2.394, 113.526±0.193, 201.044±2.382, 87.600±2.392, 1.202±0.003, 3.519± 0.081, 7.895 ±0.150, 8.984±0.247, 6.318±0.157 and 61.791±1.186 respectively. The corresponding values in Ghoongroo pigs were found to be 277.656±3.692, 297.210 ±2.467, 410.503±2.431, 113.283±0.215, 199.214±2.557, 85.969±2.557, 1.187±0.003, 3.671±0.082, 7.699±0.216, 8.871 ± 0.172, 6.212± 0.215 and 61.076 ±1.201.

The genetic groups differed significantly in respect of age at first fertile service (P<0.05), age at first farrowing (P<0.01), farrowing interval (P<0.01), service period (P<0.01), litter size at birth (P<0.01), litter weight at birth (P<0.01) and litter weight at weaning (P<0.01). The HD-K75 pigs had longer age at first heat, age at first fertile service, age at first farrowing, gestation period, farrowing interval, service period followed by HD-K75 X Ghoongroo and Ghoongroo pigs. The litter size at birth, litter size at weaning and litter weight at weaning were significantly (P<0.01) higher in HD-K75 pigs followed by HD-K75 X Ghoongroo and Ghoongroo pigs.

Parity of dam was found to have highly significant effect (P<0.01) on litter index and litter size at birth and significant effect (P<0.05) on litter weight at birth and litter size at weaning.

The results of least-squares analysis of variance for reproductive traits under study indicated that system of rearing had highly significant effect (P<0.01) on farrowing interval, service period, litter size at birth, litter weight at birth, litter size at weaning and litter weight at weaning. The gilt in intensive system showed early heat and became pregnant early. So also the gilts in intensive system farrowed early as compared to the gilts in semi-intensive and tethering system. The farrowing interval and service period were found longer in sows reared in tethering system. Shorter farrowing interval was observed in sows that reared in semi-intensive system. Service period in sows rearing in intensive system was shorter. Litter size at birth, litter weight at birth, litter size at weaning and litter weight at weaning were significantly higher in sows that were

reared in intensive system. In tethering system of rearing, the gilts registered significantly lower litter size at birth, litter weight at birth, litter size at weaning and litter weight at weaning.

The results of least-squares analysis of variance for reproductive traits under study revealed that season had significant effect ($P<0.05$) only on litter size at birth and litter weight at birth.

System of rearing had highly significant effect ($P<0.01$) on pre-weaning piglet mortality and highest mortality rate was observed in tethering system. Other effects were not found important, being non-significant. The overall average pre-weaning piglet mortality (%) was found to be 23.001± 0.603.

Study involving economics of rearing fattener pigs shows that there was significant differences in variable cost, fixed cost, gross cost, total return, net return, net return per kg live weight and cost benefit ratio due to genetic group and system of rearing except in net return per kg live weight. The overall net return per kg of live weight in fattener of HD-K75, HD-K75 X Ghoongroo and Ghoongroo pigs under field condition was Rs. 42.75±4.33, 39.59±3.91 and 32.38±3.24 respectively and the overall mean net return for all the genetic groups combined was Rs. 37.55±2.22. The overall total return in intensive, semi-intensive and tethering system of rearing was found to be Rs 47.04±3.04, 38.40±3.29 and 27.28±3.33 respectively. The overall cost benefit ratio in HD-K75, HD-K75 X Ghoongroo and Ghoongroo pigs under field condition was 1.28±0.03, 1.26±0.02 and 1.18±0.02 respectively and combined over genetic groups the population mean for cost benefit ratio was 1.24±0.01. In intensive, semi-intensive and tethering system of rearing mean for cost benefit ratio were 1.31±0.02, 1.25±0.02 and 1.15±0.02 respectively.

In case of breeding unit, significant differences were found on account of genetic group and system of rearing in variable cost, gross cost, total return, net return and cost benefit ratio, except in cost benefit ratio. The overall net returns per piglet in breeding unit in HD-K75, HD-K75XGhoongroo and Ghoongroo pigs under field condition were Rs. 881.13±103.15, 717.45±134.27 and 661.19±74.62 respectively with an overall mean of Rs. 711.66±59.45. In intensive, semi-intensive and tethering system, net return per piglet was estimated as Rs 784.30±115.01, 704.84±77.25 and 645.84±87.48 respectively. The overall cost benefit ratio in HD-K75, HD-K75 X Ghoongroo and Ghoongroo pigs under field condition was 1.34±0.02, 1.24±0.01 and 1.24±0.02 respectively, combined over genetic groups the mean being 1.27±0.01. Averages for cost benefit ratio under intensive, semi-intensive and tethering system of rearing was observed to be 1.28±0.02, 1.28±0.02 and 1.25±0.02 respectively. The Cost benefit ratio as observed in the present study clearly indicates the pig rearing as a profitable and viable enterprise.

It was concluded that looking into the superiority in terms of growth, overall reproductive efficiency and also the net return and cost benefit ratio, rearing of HD-K75 may be promoted in field condition. Depending upon people's preference, rearing of Ghoongroo pigs may be advocated in localized areas. Tethering system of rearing which

was found to show poor performance, unless otherwise warranted, like poor economic condition of pig owner, may be discouraged.

COMPARATIVE EXPRESSION PROFILING OF FERTILITY RELATED microRNAs AND mse-tsRNAs IN MALE REPRODUCTIVE TISSUE OF INDIGENOUS AND EXOTIC PIGS

Meera K

The present study was conducted on the breeding boars of indigenous Ghoongroo breed, crossbred variety Rani and exotic breed Large White Yorkshire maintained at the pig farm of ICAR-National Research Centre on Pig, Rani, Guwahati.

Important fertility related miRNAs associated with male fertility in pigs were identified. A total of 92 such miRNAs were listed and catalogued according to their functional roles. From among these, 43 miRNAs have been identified in the present study which are directly involved in spermatogenesis and fertility process of boars and were chosen based on previous literature. All these miRNAs were then categorized into 4 functional groups viz, 15 miRNAs involved in Sertoli cell proliferation and function, 8 miRNAs impacting spermatogonial stem cell proliferation and apoptosis, 4 miRNAs linked to Leydig cell proliferation and functions, and 14 miRNAs affecting sperm fertility.

Out of the 43 miRNAs analyzed, 17 miRNAs were upregulated in Ghoongroo breed, 20 miRNAs in Large White Yorkshire and 6 miRNAs were significantly upregulated in the Rani pig variety. The 17 miRNAs that were upregulated in Ghoongroo pigs include miR-126-5p, miR-130 and miR-1285 which promote Sertoli cell proliferation and functioning, miR-142-3p which inhibits Leydig cell development, miR-495 and miR-191 promoting spermatogonial stem cell proliferation, miR-19b, miR-656 and miR-1248 inhibiting spermatogonial stem cell proliferation and promoting their apoptosis, miR-15b which has a positive correlation with male fertility, miR-7a, miR-7b, miR-7d, miR-19a, miR-502, miR-148 and miR-1468 which promote fertility of sperm. The 20 miRNAs that were upregulated in Large White Yorkshire breed include miR-499-3p, miR-499-5p and miR-762 which promote Sertoli cell proliferation and functioning, miR-34b, miR-34c, miR-202-3p, miR-202-5p, miR-222, miR-362-3p, miR-362-5p and miR-638 which inhibit Sertoli cell proliferation and functioning while miR-409-3p and miR-615 promote Leydig cell proliferation and functioning, miR-21-5p

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inhibiting Leydig cell proliferation and promoting their apoptosis, miR-22-5p, miR-190, miR-197 and miR-223 inhibiting spermatogonial stem cell proliferation and functioning, miR-23b promoting sperm functioning and miR-27b-5p which negatively affects spermmotility. The 6 miRNAs that were significantly upregulated in the Rani pig variety include miR-24-3p inhibiting Sertoli cell proliferation, miR-92a which cause impairment of the blood-testis barrier formation and apoptosis of pre-meiotic germ cells, miR-103-5p and miR-23a promoting sperm motility and miR-27b-3p and miR-143-3p having negative effects on sperm functioning.

In addition to miRNAs, we also characterized the presence and abundance of mature sperm enriched tRNA derived small RNAs (mse-tsRNAs) in the testicular tissue and different parts of epididymis of the pigs. A known small RNA family ‗family I' and ‗family II' of mouse mse-tsRNAs were chosen for the study to identify their characterization in male reproductive tissue of indigenous, exotic and crossbred pigs. mse-tsRNA family I was expressed in testis and epididymis of all the three breeds studied, while family–II showed negligible expression in male reproductive tissue of pigs. Our analysis identified that mse-tsRNA family I that is consistently found in male reproductive tissue, therefore this might be a future marker for early selection of fertile male animals.

The present study concluded that miRNAs and mse-tsRNAs can be used as predictive fertility marker and has important implications for improving pig breeding programs. Further studies are needed to validate the roles of the differentially expressed miRNAs and mse-tsRNAs in regulating male fertility in pigs, and to explore the potential applications of these small RNAs as biomarkers for assessing male fertility in pigs.

SUPPLEMENTATION OF NANO-IRON AS COMPARED TO ORGANIC-IRON IN BREEDING GILTS

Priyanka Konwar

The present study was conducted to investigate the properties of synthesized nano-iron and the supplementation of these in comparison with organic and inorganic iron for growth performance, nutrient utilization, reproductive performance, hematological parameters, blood biochemical parameters and bioavailability of iron in HDK-75 gilts along with hematological and blood biochemical parameters of the piglets born**.** In experiment I, a total of 24 breeding gilts (5-5.5 months of age) of HDK-75 weighed 50-54 kg body weight were selected from AICRP pig farm, College of Veterinary College, Khanapara, Guwahati, Assam. The selected piglets were assigned to four experimental groups T0, T1, T2 and T3 with 6 gilts each in a group supplemented with inorganic FeSO4 @ 100mg/kg basal diet, organic iron (methio-chelated) @ 100mg/kg of basal diet, nano iron @75mg/kg basal diet and nano iron @50mg/kg basal diet respectively. The growth performance was measured in terms of fortnightly gain in body weight. The fortnightly feed intake and feed conversion efficiency (FCE) of kids were recorded for 60 days. After 60 days of feeding experimental diet a 7 day digestibility trial was conducted on each gilt to study the digestibility of dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE) and nitrogen free extract (NFE). Then after conception of the gilts, hematological, biochemical and reproductive parameters were studied for the entire gestation period. In experiment II, the piglets born from the experiment I was checked for signs of anaemia until weaning. The piglets showing the signs of anaemia born from sows of T0 i. e. t0 was given iron injection @ 0.5 ml/piglet at 4th and 14th day of age and supplemented with creep ration containing 50 mg nano-iron/kg feed from 10th day of age until weaning. The piglets born from T1 sows was supplemented with nano-iron as udder paste @ 10 mg/day/piglet from 4th to 15th day of age and creep ration containing 50 mg nano-iron/kg feed from 10th day of age until weaning. The piglets born from sows of T2 and T3 were supplemented with creep ration containing 50 mg nano-iron/kg feed from 10th day of age until weaning. The piglets was studied for hematological and biochemical parameters from birth until weaning. The synthesized nano-iron had zeta potential of

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0.202 mV having mean diameter of 69.8±4.6 nm with PDI of 0.249. The SEM and TEM image reveals the nano-iron as nanospheres having particle size ranging from 60.18 to 88.59 nm. The SADP analyses confirmed the particles as nanoparticle having diffraction rings. The cytotoxicity study by MTT assay suggested dose rate of synthesized nano-iron as a feed supplement upto 62.5µg/ml. The chemical compositions of the basal grower diet were DM-94.18%, CP-18.91%, CF- 8.4%, EE-3.72%, NFE-61.84%, TA-6.95%, Ca-1.21% and P-0.39%. The iron content in different experimental diet was 172, 175, 159 and 130 mg/kg of diet for T0, T1, T2 and T3 groups respectively. The chemical compositions of the basal gestation diet were DM-93.56%, CP-15.31%, CF-8.1%, EE-3.12%, NFE-66.34%, TA-7.13%, Ca-1.41% and P-0.43%. The iron content in different experimental diet was 172, 175, 159 and 130 mg/kg of diet for T0, T1, T2 and T3 groups respectively. The chemical compositions of the creep ration were DM-90.56%, CP-23.5%, CF- 4.5%, EE-1.52%, NFE-63.05%, TA-7.43%, Ca-1.51% and P-0.73%. The iron content in experimental diet was 137 mg/kg of diet. The fortnightly feed intake (kg) differed significantly between the groups ($p<0.05$); between the time period ($p<0.001$) and interaction between groups and time period of experiment ($p<0.01$). The fortnightly body weight (kg) differed significantly between the groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.001$). The fortnightly body weight gain (kg) differed significantly between the groups ($p<0.001$); between time period ($p<0.001$) and there was no significant difference in interaction between different groups and time period of experiment. The feed conversionratio differed significantly between the groups ($p<0.001$); between time period ($p<0.001$) and there was no significant difference in interaction between different groups and time of experiment. There was significant difference in crude protein voided ($p<0.001$) and digestibility coefficient of crude protein ($p<0.05$) between the groups and no significant difference between crude protein intake and crude protein digested. There was significant difference in nitrogen free extract intake ($p<0.001$), digested ($p<0.01$) and digestibility coefficient ($p<0.05$) between the groups. The body weight of piglets at birth and weaning and litter weight at birth had significant difference between the groups ($p<0.001$). The Hb concentration of piglets at birth differed significantly between groups ($p<0.001$). The bioavailability of iron differed significantly between nano-iron supplemented groups ($p<0.001$) and organic or inorganic iron supplemented group. The Hb, PCV, RBC, MCV, MCH and MCHC concentration of breeding gilts differed significantly between the groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.001$). The Hb, RBC, MCH and MCHC concentration of t0 and t1 piglets differed significantly between the groups ($p<0.001$) and between the time ($p<0.001$). The Hb and MCV concentration of t2 and t3 piglets differed significantly between the groups ($p<0.001$) and between the time ($p<0.001$). The PCV and MCV of t0 and t1 piglets differed significantly between the groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.001$). The PCV, RBC and MCHC of t2 and t3 piglets differed significantly between the

groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.001$). The MCH of t2 and t3 piglets differed significantly between the groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.05$). The SOD, GPx, ferritin, transferrin and serum Fe of breeding gilts differed significantly between the groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.001$). The SOD, GPx and ferritin of t0 and t1 piglets differed significantly between the groups ($p<0.001$) and between the time ($p<0.001$). The SOD and ferritin of t2 and t3 piglets differed significantly between the groups ($p<0.001$) and between the time ($p<0.001$). The GPx of t2 and t3 piglets differed significantly between the groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.001$). The transferin and serum Fe of t0 and t1 piglets differed significantly between the groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.001$). The transferin of t2 and t3 piglets differed significantly between the groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.05$). The hemosiderin of t0 and t1 piglets had no significant difference between the groups; significant between the time ($p<0.001$) and significant ($p<0.05$) difference in interaction between different groups and time of experiment. The hemosiderin of t2 and t3 piglets didn't differed significantly between the groups; significant between the time ($p<0.001$) during the entire experiment and not significant in interaction between different groups and time of experiment. The TIBC of breeding gilts differed significantly between the groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.001$). The TIBC of t0 and t1 piglets differed significantly between the groups ($p<0.001$) and between the time ($p<0.001$). The TIBC of t2 and t3 differed significantly between groups ($p<0.001$); between the time ($p<0.001$) and interaction between different groups and time of experiment ($p<0.001$). The serum iron of t2 and t3 piglets differed significantly between the groups ($p<0.01$); between the time ($p<0.001$) and interactionbetween different groups and time of experiment was not significant. The faecal lactobacillus count in breeding gilts differed significantly between the groups ($p<0.001$) and faecal *E. Coli* count differed significantly between the groups ($p<0.001$). Thus, the present investigation can be concluded that supplementation of nano iron @50mg/kg of diet in breeding gilts performs better in growth performance, reproductive performance, hematological levels, antioxidant status and biochemical parameters when compared with inorganic and organic iron supplementation and eliminate the problem of anaemia in piglets without supplementation of iron in early postnatal life.

EFFECT OF SUPPLEMENTING SPENT MUSHROOM PADDY STRAW ON THE PERFORMANCE OF LACTATING CATTLE

Tanay Ghosh

An experiment was conducted to study the effect of feeding of spent mushroom (*Pleuroyus ostreatus*) paddy straw on the performance of lactating cattle. The whole experiment was conducted in two phases. In first phase, data on the availability of spent mushroom paddy straw (SMPS) were collected and chemical analysis and nutritive value of SMPS were evaluated (by difference method). In second phase, eighteen healthy lactating crossbred (Jersey×Holstein Friesian) cows of similar production were randomly divided into three homogenous groups *i.e.* T_0, T_1 and T_2 with six animals in each group. T_0 was control group in which, animals fed balanced ration comprising of concentrate feed, green fodder and paddy straw. In group T_1 and T_2, balanced ration comprising of concentrate feed, green fodder and 50 and 100 per cent of paddy straw was replaced by spent mushroom paddy straw respectively. The average chemical composition of SMPS were 42.65±1.33, 76.30±0.40, 7.23±0.24, 1.31±0.06, 21.25±0.76, 23.69±0.49, 46.51±0.57, 62.03±1.18 and 49.26±0.67 per cent of DM, OM, CP,EE, CF, TA, NFE, NDF and ADF, respectively. The DCP and TDN content of SMPS were 4.75 and 59.76 per cent, respectively. The digestibility coefficient of CP and CF differs significantly ($P<0.05$) among the groups. Significantly higher digestibility of CP was observed in group T_0 (60.86±0.37) and T_1 (60.71±0.51) and lowest was observed in group T_2 (58.85±0.34). Significantly highest digestibility of CF was observed in group T_1 (62.82±0.36) followed by group T_2 (61.24±0.37) and lowest was observed in group T_0 (60.62±0.29). The digestibility coefficient of DM, OM, EE, NFE, NDF and ADF did not differ significantly ($P>0.05$) among groups. No significant difference ($P>0.05$) was observed in terms of average milk production, FCM, feed intake and FCR among the groups during the experimental period. The overall average milk fat, milk protein and total solid differed significantly ($P<0.05$) among groups during the experimental period. Significantly ($P<0.05$) highest milk fat (%) was observed in group T_0 (4.51±0.07) and T_1 (4.48±0.04) and lowest observed in group T_2 (4.33±0.08). Significantly ($P<0.05$) highest milk protein (%) was observed in group T_1 (3.63 ± 0.05) and T_0 (3.57 ± 0.06) and lowest

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was observed in group T_2 (3.54 ± 0.06). Significantly ($P<0.05$) highest milk total solid (%) was observed in group T_1 (13.85±0.22) and T_0 (13.80±0.13) compared to group T_2 (13.55±0.19). The average milk lactose, ash, SNF, milk urea nitrogen did not show any significant difference ($P>0.05$) among groups during the experimental period. The average serum glucose, total protein, albumin, globulin and BUN did not show any significant difference ($P>0.05$) among groups during the experimental period. Significantly ($P<0.05$) highest feed cost (Rs.) per kg milk production was observed in group T_0 (31.37±0.16) compared to the group T_1 (30.03±0.15) and T_2 (29.83±0.05). From the results obtained, it could be concluded that Spent Mushroom (*Pleurotus ostreatus*) paddy straw could be used for feeding dairy cattle replacing paddy straw up to 50 % without any adverse effect on milk production, composition of milk, health of cows and reducing cost of feeding.

COMPARATIVE EFFICACY OF DIFFERENT DIAGNOSTIC BIOMARKERS AND TREATMENTS OF SUBCLINICAL ENDOMETRITIS IN POST-PARTUM CROSSBRED COWS

Jitu Moni Das

The present study was conducted to study the prevalence, biochemical profile and comparative efficacy of different herbal extracts in post-partum crossbred cows with subclinical endometritis (SCE) in Lakhimpur District of Assam. Clinically healthy post-partum crossbred cows (n=224) at their second to fourth lactation with no peri-parturient disorders and exhibiting oestrus in between day 45 to 90 post-partum were screened for SCE by performing endometrial cytology, white side test (WST) and pH of the oestrual cervico-vaginal mucus (CVM). Endometrial cytology using cytobrush technique with ≥5% threshold level of polymorphonuclear cells was considered as the gold standard for diagnosis of subclinical endometritis. Forty crossbred cows with SCE (Group A) and 10 (ten) normal cows without SCE (Group B, control) were selected for the present study. Further, Group A cows (n=40) were divided randomly into four (4) equal treatment groups *viz*., T-1 (intra uterine 30 ml 15% *Azadiracta indica* extract), T-2 (intra uterine 30 ml 24% *Curcuma longa* extract), T-3 (intra uterine 30 ml Cephalexin for 3 days after dissolving 4 g Cephalexin with 60 ml distilled water) and T-4 (sexual rest).

Serum and endometrial samples were collected at first (before treatment) and second (after treatment) post-partum estrus to estimate serum biochemical parameters *viz*., Total protein, Albumin and Gamma-Glutamyl transferase (GGT) in Analytica 705, Semi-Auto Biochemistry Analyzer, Recorders and Medicare Systems (P) Ltd., using commercially available diagnostic kits. Tumor necrosis factor alpha (TNF-α), Interleukin (IL-8) and Haptoglobins (Hp) were estimated in serum and uterine flush by ELISA method.

All the cows of different treatment groups were examined at subsequent estrus following treatment to evaluate the recovery rate based on pH, WST of oestrual cervico-vaginal mucus and endometrial cytology (% PMNs). Recovered cows of group A and all the cows of control group were inseminated at 2nd post-partum oestrus and pregnancy

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diagnosis was carried out 60 days post A.I. The efficacy of various interventions was calculated based on recovery rate and first service conception rate.

The prevalence of SCE in post-partum crossbred cows at first post-partum oestrus (day 45 to 90) in Lakhimpur district of Assam was found to be 17.86 per cent based on endometrial cytology and alkaline (>7.4) pH in CVM, whereas by WST 15.65 per cent (35/224) cows were positive for SCE, indicating 87.50 (35/40) per cent relative efficacy.

In the present study mean serum total protein, albumin, globulin and GGT levels were in normal physiological range in SCE and control groups with no significant variations in their levels both before and after treatment. The mean TNF-α levels before treatment in SCE groups T1, T2, T3 and T4 in serum (264.76±13.96, 251.30±16.05, 257.90±16.20 and 264.76±13.96 pg/ml, respectively) and in uterine flush (292.14±26.29, 290.52±27.50, 250.78±22.73 and 305.85±24.07 pg/ml, respectively) were significantly ($P<0.05$) higher than control group (101.69±5.89 and 244.88±17.79 pg/ml in serum and uterine flush, respectively. Significantly ($P<0.05$) higher IL-8 levels were also recorded before treatment in serum and uterine flush in T1 (53.94±3.16 and 571.44±33.66 pg/ml), T2 (52.50±3.71 and 573.15±32.17 pg/ml), T3 (54.32±3.52 and 570.84±36.65 pg/ml) and T4 (53.07±3.61 and 572.76±35.03 pg/ml) groups than control (30.48±2.29 and 375.61±48.34 pg/ml). Before treatment significantly higher serum and uterine flush Hp levels were also observed in different treatment groups *viz*., T1 (38.29±2.37 and 42.84±2.38 µg/ml), T2 (36.81±2.08 and 41.52±2.36 µg/ml), T3 (37.19±1.95 and 41.89±2.87 µg/ml) and T4 (37.14±1.84 and 41.89±2.87 µg/ml) than control (23.31±0.76 and 25.75±0.92 µg/ml).

Post treatment estimation of serum TNF-α levels were significantly ($P<0.05$) lower in all the treatment groups T1, T2, T3 and T4 (169.57±16.19, 146.52±14.23, 106.80±8.01 and 211.09±17.31 pg/ml, respectively) while in uterine flush significant ($P<0.05$) drop was recorded in T1, T2 and T3 group (292.14±26.29, 290.52±27.50 and 250.78±22.73 pg/ml, respectively). Significantly ($P<0.05$) lower IL-8 levels following treatment were recorded both in serum and uterine flush in group T1 (44.43±2.86 and 455.49±43.65 pg/ml respectively), T2 (43.11±2.67 and 451.35±47.52 pg/ml, respectively) and T3 (32.83±3.91 and 395.33±48.11 pg/ml, respectively). Post-treatment estimation of Hp levels were recorded significantly ($P<0.05$) lower in groups T1, T2, T3 and T4 in serum (28.05±1.86, 27.18±1.48, 23.69±1.57 and 30.07±2.24 µg/ml, respectively) as well as in uterine flush (33.38±1.52, 32.04±2.59, 28.64±2.17 and 33.78±2.11 µg/ml, respectively).

The recovery rate in the present study in subclinical endometritic cows following treatment were found to be higher in intrauterine (IU) cephalexin treated cows (80.00%) followed by IU Turmeric extract (50.00%) and IU Neem extract (40.00%) as compared to untreated (sexual rest) cows (20.00%). The first service conception rate in the subsequent oestrus was found to be 80.00, 75.00, 80.00, 87.50 and 50.00 per cent in control, T1, T2, T3 and T4 groups, respectively.

From the present study, it may be concluded that the prevalence of subclinical endometritis in post-partum crossbred cows at first post-partum oestrus (day 45 to 90) was 17.86 per cent, subclinical endometritic cows have higher TNF-α, IL-8 and Hp concentrations in serum and uterine flush compared to that in healthy cows, Hp appears to have better applicability and diagnostic value as compared to TNF-α and IL-8, and the therapeutic efficacy of IU cephalexin was higher than that of IU turmeric and IU neem extract.

PURIFICATION OF BUCK SEMEN USING MAGNETIC NANOPARTICLE FOR CRYOPRESERVATION

Souvik Dhara

Present study was conducted to determine the optimal amount and best incubation time of magnetic iron oxide nanoparticle-conjugates (MNP-Annexin V and MNP-Lectin) to reduce apoptotic and acrosome reacted sperm followed by freezability and fertilizing potential of nanopurified Beetal buck semen. A total 48 pooled ejaculates comprising 12 pooled ejaculates for each of four experiments were evaluated for sperm motility, concentration, live sperm, HOST-reacted sperm and sperm abnormalities. Each pooled ejaculate was split into two parts and one part was used for assessment of SOD, CAT, GST, GPx, GR, ALT, AST and LDH activities, total antioxidant capacity (TAC) and MDA level in the seminal plasma. The other part of pooled semen was centrifuged with Tris buffer and the centrifugate was initially extended with pre warmed (37ºC) Tris-Egg yolk-Glycerol (TYG) extender @600 million sperms per ml. The initially extended semen was split into four parts and mixed with various amounts (0, 5, 7.5 and 10 µl) of MNP-Annexin V and MNP-Lectin in expt. I and expt. II respectively followed by incubation at 37ºC for 15 minutes. In experiment III, initially extended semen was split into five aliquots and each aliquot was mixed with 10 µl of MNP-Annexin V (optimum of expt. I) and 7.5 µl of MNP-Lectin (optimum of expt. II) and then incubated for 0, 10, 15, 30 and 60 minutes. In experiment IV, initially extended semen split into two parts and one part kept as control and other pat was mixed with 10 µl of MNP-Annexin V and 7.5 µl of MNP-Lectin and co-incubated at best time 10 minutes (best of expt. III). After incubation each semen sample was kept under a magnetic field at 37ºC for 15 minutes in all four experiments. After 15 minutes fresh supernatant of each incubated semen sample was transferred in a new sterile tube and evaluated for sperm concentration, motility, live sperm, HOST-reacted sperm and intact acrosome using conventional methods. The purified semen was then filled and sealed in 0.25 ml French mini straws and subjected to equilibration followed by cryopreservation. Frozen semen was thawed in warm water at 37ºC for 30 seconds. At pre-freeze and post-thaw stage each semen sample was evaluated using conventional methods. Fluorescence

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microscopic seminal attributes, sperm kinematic parameters and biochemical parameters in extracellular fluid were also assessed at post-thaw stage. The efficiency (%) of nanopurification was determined based on sperm concentration at post-purification stage, sperm motility, live sperm, HOST-reacted sperm and intact sperm at post-purification, pre-freeze and post-thaw stages, and post-thaw fluorescence microscopic seminal attributes and sperm kinematic parameters. The fertility rate of frozen semen on the basis of doe kidded per insemination was also studied in experiment IV. In Beetal bucks all the seminal attributes studied immediately after collection and pooling were within normal ranges. Among different amounts, 10 µl of MNP-Annexin V and 7.5MNP-Lectin provided significantly ($P<0.05$) higher seminal attributes and extracellular biochemical parameters as compared to rest of the groups. Among different co-incubation time 10 and 15 minutes provided significantly ($P<0.05$) higher seminal attributes and extracellular biochemical parameters compared to rest of the co-incubation times. Efficiency (%) of nanopurification found significantly ($P<0.05$) higher in 10µl of MNP-Annexin V and 7.5 and 10 µl of MNP-Lectin bioconjugates compared to rest of the groups. In final experiment, nanopurified semen provided significantly ($P<0.05$) higher seminal attributes and extracellular biochemical parameters mentioned previously compared to non-purified counterpart. Ultrastructure of sperm MNP-bioconjugates interaction under SEM showed variable amount of multipoint attachment of sperm and MNP-bioconjugates. Although the chi square test showed kidding rate did not differed significantly ($P>0.05$) between non-purified and nanopurified groups, the overall kidding rate were found to be the highest in nanopurified group (58.46) than non-purified group (43.47). The findings revealed that among different amount of MNP-Annexin V and MNP-Lectin bioconjugates, and different co-incubation times, 10 µl of MNP- Annexin V and 7.5 µl of MNP-Lectin and 10 minutes of co-incubation time found to be superior. It was also found that nanopurification of Beetal buck semen efficiently reduced apoptotic and acrosome reacted spermatozoa thereby improved the freezability and fertilizing potential of purified Beetal buck semen.

EFFECT OF ANTIOXIDANTS ON QUALITY AND RELATIVE EXPRESSION OF FERTILITY RELATED GENES OF CRYOPRESERVED BEETAL BUCK SEMEN

W. Lomen Singh

A total of 120 ejaculates from six Beetal bucks, 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 0.8 ml or more, mass activity (0 to 4+ scale) 3+ or more and initial sperm motility 70 per cent or more were pooled. A total of 48 pooled ejaculates comprising 12 pooled ejaculates for each experiment were evaluated for sperm motility, live sperm, intact acrosome, sperm concentration, HOST-reacted sperm and sperm abnormalities. Each pooled ejaculate was split into two parts and one part was used for assessment of glutathione–S-transferase (GST), superoxide dismutase (SOD), catalase (CAT), glutathione reductase (GR), glutathione peroxidase (GPx), alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and malondialdehyde (MDA) level in the seminal plasma. The other part of pooled semen was split into four parts, then centrifuged and the seminal plasma was discarded. The centrifugate of the first three parts was extended separately in Tris extender containing vitamin E @ 1, 2 and 3 mM in experiment I; IGF-1 @ 100, 125 and 150 ng/ml in experiment II; crocin @ 1, 2 and 3 mM in experiment III; and vitamin E @ 2 mM (best of expt. I), IGF-1 @ 125 ng/ml (best of expt. II) or crocin @ 1 mM (best of expt. III) in experiment IV while the fourth part was kept as control in each experiment. Semen was frozen in 0.25 ml French straws using static horizontal vapour freezing. Frozen semen was thawed in warm water at 37ºC for 30 seconds for evaluation. Each semen sample was evaluated after freezing in experiment I, II and III for sperm motility, intact acrosome (Giemsa stain), HOST-reacted sperm and intact DNA (AO stain) and in experiment IV for sperm motility, intact acrosome (FITC-PSA stain), HOST-reacted sperm, viability (CFDA + PI stain), high mitochondrial potential (JC-1 stain) and intact DNA. Semen after freezing in all the experiments was evaluated for GST, SOD, CAT, GR, GPx, ALT, AST, LDH and MDA levels in the extracellular fluid by standard methods. In experiment IV, the relative

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expression of certain fertility related genes and their correlation with seminal attributes in frozen-thawed Beetal buck spermatozoa as well as fertility rate of frozen semen was also studied.

In Beetal bucks all the seminal attributes studied immediately after collection and pooling were within normal ranges. Semen samples extended with Tris extender containing vitamin E @ 1, 2 and 3 mM or no additive (control) and with Tris extender containing IGF-1 @ 100, 125 and 150 ng/ml or no additive differed significantly ($P<0.001$) in respect of sperm motility, intact acrosome, HOST-reacted sperm, intact DNA, GST, SOD, CAT, GR, GPx, ALT, AST, LDH and MDA after freezing. Semen samples extended with Tris extender containing crocin @ 1, 2 and 3 mM or no additive differed significantly ($P<0.05$) in respect of sperm motility and intact acrosome after freezing. While HOST-reacted sperm, intact DNA, GST, SOD, CAT, GR, GPx, ALT, AST, LDH and MDA differed significantly ($P<0.001$) after freezing in Tris extender containing crocin @ 1, 2 and 3 mM or no additive. In semen extended using Tris extender containing best concentration of vitamin E (2 mM), IGF-1 (125 ng/ml) and crocin (1 mM) or no additive differed significantly ($P<0.001$) in respect of sperm motility, intact acrosome, HOST-reacted sperm, viability, MMP+, intact DNA, GST, SOD, CAT, GR, GPx, ALT, AST, LDH and MDA after freezing.

NFE2L2, GPx4, CAT and *SOD2* gene expression was significantly ($P<0.05$) higher in IGF-1 group compared to that in vitamin E and crocin groups, however, no significant ($P>0.05$) differences were recorded between vitamin E and crocin groups. Correlation study revealed that sperm motility showed a significant ($P<0.05$) positive correlation with all the four target genes, irrespective of the antioxidant treatment. The target genes also showed a positive correlation with all the seminal attributes in different antioxidant groups. Although the kidding rate (doe kidded per inseminated doe) did not differ significantly ($P>0.05$) between groups, the values were found to be the highest in the IGF-1 @ 125 ng/ml group.

Based on the semen parameters studied it was concluded that IGF-1 @ 125 ng/ml, was found to be superior to other additives studied in maintaining post-thaw semen quality.

DEVELOPMENT OF MUCOSAL VACCINE AGAINST *RIEMERELLA ANATIPESTIFER* BASED ON MEMBRANE ANTIGEN CONJUGATED WITH NANOPARTICLE

Naba Jyoti Deka

Duck plays a significant role to mitigate the poverty by upgrading the socio-economic condition of farmers. *Riemerella anatipestifer* infection is a contagious bacterial disease of ducks and causes a significant economic loss to duck rearers.

The present study was carried out to develop a mucosal vaccine against *Riemerella anatipestifer* based on membrane antigen which was conjugated calcium phosphate nanoparticle. The outer membrane vesicle (OMVs) was extracted and conjugated with calcium phosphate nanoparticle. The average OMVs yield in terms of protein concentration was found to be 122.33 ± 3.48 mg per litre of BHI broth. In SDS-PAGE analysis, isolated OMVs exhibited presence of 16 distinct protein bands with molecular weight ranging from 142.1 to 12.1 kDa in SDS-PAGE. Among them, seven protein bands of 74.1, 69.3, 55.5, 50.6, 45.6, 25.1 and 13.1 kDa were found relatively more distinct. The major bands detected in our findings were 42 kDa, 37 kDa and 16 kDa that corresponds to OmpA, OmpH, P6 respectively. The mean size (± SD) of nanoparticle was found to be 246.20 ± 0.53 nm and the mean zeta potential (± SD) was found to be -25.60 ± 5.97. The mean size of the nanoparticles was found to be 129.80 ± 11.10 nm in size and spherical morphologies in transmission electron microscopy analysis. The optimum conditions for conjugation of OMV and calcium phosphate nanoparticles were found to be pH=6.00, amount of OMV=1.5 mg, conjugation temperature=10°C and period of conjugation=1 hour. The PD50 or the median protective dose of CAP-OMV nanoparticle was found to be 1881.10 µg of protein. For the bacterin vaccine, the concentration of the vaccine dose was taken as 2 × 109 cfu/ml. The immunization trial was carried out in ducks. Group I birds received 3762 µg of protein (entrapped protein in CAP-OMV nanoparticle) preparation *via* intra nasal route and it showed the highest serum IgG and secretory IgA level than the other immunized group. Group V which was administered 0.5 ml of inactivated bacterin vaccine by subcutaneous (s/c) route elicited strong immune response after Group I. All the

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experimental birds were challenged with 10× LD50 (~2 .1×1010 CFU per bird) on 35 days of post primary immunization. Group I and group V showed 100 % survivability, while other vaccine groups showed 0 % survivability. From the present study it can be concluded that CAP-OMV nanoparticle can act as suitable mucosal vaccine delivery system for *Riemerella anatipestifer.*

IMMUNOGENIC POTENTIAL OF A THERMOSTABLE MESOGENIC NEWCASTLE DISEASE VIRUS (GENOTYPE XIII) ISOLATE FROM ASSAM

Pubaleem Deka

Newcastle disease (ND) is a devastating viral disease affecting poultry and has a substantial economic impact on production because of the high morbidity and mortality rates. Only biosecurity measures and adequate vaccination can effectively reduce the economic threat posed by ND. To prevent ND outbreaks, many effective live vaccines are still routinely used. But the use of these vaccines, which are phylogenetically divergent and thermolabile, remains a constraint for controlling ND outbreaks. Therefore, addressing the need for a thermostable genotype-matched vaccine, the present study was undertaken to thermoadapt and attenuate a mesogenic (Genotype XIII) NDV isolate in Vero cells and evaluate its immunogenic potential in chickens.

In the present study, the thermostability profile of the NDV isolates was assessed by subjecting them to various temperatures at different time intervals. Of the five NDV isolates, AS/KM/18/32 retained the highest thermal stability based on HA (Log2) titer and infectivity (Log TCID50/ml) at 560C for 30 minutes. The isolate was selected for thermoadaptation and attenuation in Vero cells.

In the present study, the selected NDV isolate AS/KM/18/32 was adapted and attenuated in the Vero cells by serial passaging 50 times. The cytopathic effects (CPE) were observed from the 3rd passage onwards. At every 5th passage, the confirmation of adaptation of NDV isolates in Vero cells was done by performing RT-PCR targeting the *F* gene (363bp). The HA titer (Log2/50µl) and infectivity (Log TCID50/ml) of the NDV isolates increased with progressive passages up to the 50th passage (8.750 ± 0.250 and 9.15 log TCID50 /ml). Simultaneously, thermoadaptation of the AS/KM/18/32 was done by selective heat treatment by exposing the isolate to 560C for 30 minutes before each passage in Vero cells. After thermoadaptation, the NDV isolate AS/KM/18/32 was stable for 120 minutes at 400C and 15 minutes at 560C. The half-life of HA activity and infectivity of the isolate at 560C was 99.72 minutes and 100.92 minutes, with a rate constant of -0.0069 min-1 and -0.0068 min-1, respectively.

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Department: Veterinary Epidemiology and Preventive Medicine

Major Adviser: Dr. G. Mahato

In the present study, molecular variations of the *F* gene between the unadapted NDV and 50th passage Vero cell adapted mesogenic NDV isolate AS/KM/18/32 revealed only a single nucleotide substitution (C to T) at position 75 of the *F* protein and no amino acid changes retaining the amino acid motif 112RRQKRF117 at the cleavage site. Analysis of nucleotide and deduced amino acid sequences of the HN gene (426bp) revealed the positional nucleotide and amino acid substitution of the amino acid Glutamic acid (E) with glycine (G) at position 11(A→G) and 12(G→A), proline (P) with leucine (L) at position 275(C→T), Serine (S) with Leucine (L) at position 368(C→T) and Cystine (C) with Tyrosine (Y) at position 374(G→A). The study revealed that the positional nucleotide changes observed in the HN gene of the 50th passage thermoadapted NDV might have contributed to the stability of the virus at a higher temperature.

The biological characterization of the 50th passage thermoadapted NDV isolate revealed an increase in MDT value (in hours) from 79.33±0.33 to 88.67±1.33 and a decrease in the ICPI value from 1.42±0.01 to 0.96±0.03 indicating its mesogenic pathotype. An increase in MDT values, and a reduction in ICPI values after fifty (50) consecutive passages, showed a gradual loss of virulence as the passage level increased. Still, it warrants more passages up to complete attenuation to render the isolate safer to be used for immunization.

The immunogenic potential of the 50th passage thermoadapted NDV AS/KM/18/32 was compared with the conventional NDV R2B vaccine strain by administering a standard dose of 106 EID50 by intramuscular route to experimental birds. The HI log2 antibody titers in the serum samples of the experimental birds at different days post-immunization revealed no significant difference ($P<0.01$) between the immune response of thermoadapted AS/KM/KM/18/32 and the conventional R2B vaccine strain. The present study revealed that the mesogenic NDV isolate AS/KM/18/32 was thermostable and equally immunogenic in eliciting immune response with conventional R2B vaccine strain.

DEVELOPMENT OF ORAL CLASSICAL SWINE FEVER BAIT VACCINE AND EVALUATION OF ITS IMMUNOGENIC POTENTIAL IN PIGS

Pankaj Deka

Classical swine fever (CSF), also known as hog cholera is a highly contagious and economically devastating viral disease of domestic, pigmy hog and wild swine. Control and eradication of CSF in countries with a high proportion of backyard pigs is a challenge due to difficulty in systematic implementation of conventional parenteral vaccines thereby impacting vaccination coverage in rural settings. Alternative vaccine delivery methods may be a suitable option to control CSF virus (CSFV) infection in backyard production systems. The objective of this study was to evaluate the stability of a live attenuated cell culture adapted CSFV C-strain in liquid and freeze-dried forms using four combinations of stabilizers at 4°C, 25°C and 37° C for use as an oral vaccine for CSF. The stabilizers were (1) trehalose + gelatin (TG), (2) trehalose + LAH (TL), (3) trehalose + pullulan (TP) and (4) trehalose + gelatin + pullulan (TGP). Further, the study was designed to evaluate various attractants (sweet corn/anise oil/dry shrimp fish) to document pig's bait flavor preferences and design suitable bait for the oral delivery of vaccine preparation. Later, the most preferred oral bait was employed with the CSFV vaccine and antibody response to the prepared bait vaccine in sows and their offspring was evaluated using ELISA and VNT.

In the present study, *in-vitro* growth kinetics of CSFV C-strain was studied in PK-15 cells to predict suitable harvesting time (hours post infection) for maximum virus yield. CSFV C-strain in PK-15 cells showed highest titre of progeny virus on 72 hrs post infection at an MOI 0.1 which could be the appropriate time of virus harvesting during propagation.

Additionally, the efficacy of several methods of virus harvesting (freeze-thaw cycle/enzymatic treatment/hypotonic burst) was evaluated. The infectious virus particle yield at 72 hrs post infection was determined separately in both cell-free virus supernatant and cell lysates. Two freeze-thaw cycles and enzymatic treatment using trypsin (50 µg/ml) were effective methods for harvesting cell-associated CSFV. Nevertheless, investigation of potential harmful consequences of residual trypsin on the pathobiology of CSFV is crucial.

Abstract of Ph.D. thesis

Department: Veterinary Microbiology

Major Adviser: Dr. N. N. Barman

A novel formulation containing 10% (w/v) trehalose, 2.5% (w/v) gelatine, and 10% (w/v) pullulan (TGP) was found to be the most efficient stabilizer formulation based on lyophilization loss and thermal stabilization of CSFV in both liquid and freeze-dried form. TGP freeze-dried CSFV C-strain maintained stability for up to 3 months at 40C, without any loss of virus titre with an estimated half-life of 18.54 months.

Dry shrimp fish (DSF) bait was found to be the most preferred and accepted bait by pigs of all age groups followed by anise oil and sweet corn. Baits (hemisphere shape, 4.5 cm diameter and 1.5 cm thickness) were prepared using a cereal-based matrix composed of piglet feed, sacarose, paraffin, wheat flour, peanut butter, turmeric oil extract, sodium chloride and DSF attractant with gelatin capsules dipped into the matrix to introduce vaccine formulation. Physical stability test demonstrated that baits were stable at least for three days at 370 C. However, moist environments affected stability after 48 hrs. Hence, the designed baits are stable and suitable for oral delivery of vaccine formulations in field condition..

Vaccination of sows with CSFV C-strain oral vaccine during pregnancy elicited CSFV-specific neutralizing antibodies. The antibody titer of sows that received double doses of oral CSFV vaccine with booster was significantly higher at farrowing and was comparable to those that received the parenteral vaccine. In contrast, vaccination with single dose of CSFV vaccine resulted in low level of antibody titer. The persistence of maternally derived antibody titer in piglets has been found to be directly proportional to the corresponding antibody titer of dams at farrowing.

The oral CSF vaccine virus induced limited immune response at lower virus concentration (log103.0); however, a double oral dose with booster vaccination triggered a protective antibody titer up to 180 days post primary immunization. The results of this study will aid in establishing an effective oral immunization regimen as a substitute of parenteral imuunization for CSF control in backyard settings.

IMMUNOGENIC POTENTIAL OF BACTERIN AGAINST *Riemerella anatipestifer* INFECTION IN DUCKS

Shiney George

Riemerellaanatipestiferinfection is a highly contagious disease which causes huge economic losses to the duck farmers and has no standard prevention and control strategies available. The present study was conducted for isolation and molecular characterization of Riemerellaanatipestifer from domesticated ducks of Assam and to evaluate the protective efficacy of R. anatipestiferbacterin vaccine, prepared from the most prevalent pathogenic
genotype in Assam.

During the study period, a total of 278 field samples were collected from apparently healthy/in-contact, ailing and dead duck/ducklings with suspected form of R. anatipestifer infection and were subjected to bacteriological screening. Field samples comprised of pharyngeal/throat swab, ocular/nasal swab from apparently healthy/ailing birds, and postmortem samples from dead ducklings. Bacteriological screening of the samples on Tryptone Soy blood agar (TSBA) plates at 370C under micro-aerophilic environment revealed 67 (24.10%) samples to be phenotypically positive for R. anatipestifer. Also, five R. anatipestifer repository isolates were revived and they also exhibited similar phenotypic characters. All the 72 (67 fresh and 5 repository) morphologically identified R. anatipestiferisolates were subjected to the PCR based molecular confirmation and a total of 43 (15.47%)fresh field isolates and all the five repository isolates could be confirmed as R. anatipestiferby the species specific PCR. The recovery percentage of R. anatipestifer was highest from ducklings died due to suspected form of RA infection compared to ailing and apparently healthy birds. Among the clinical samples collected from the dead birds, the brain and lungs revealed comparatively more recovery of R. anatipestiferisolates, followed by trachea, spleen, liverand heart in descending order. R. anatipestifer could be isolated in pure form from the brain samples of dead birds showing nervine symptoms. The distribution of R. anatipestiferin ailing birds was recorded in both pharynngeal swab and ocular/nasal swabs but in apparently healthy ducks, R. anatipestifercould berecovered only from the

Abstract of Ph.D. thesis

Department: Veterinary Microbiology

Major Adviser: Dr. Rajeev Kumar Sharma

pharyngeal swab.The biochemical profiles of the test isolates exhibited variable results and were not conclusive for confirmative identification.

The confirmed isolates (n=48) were further subjected to 16s ribosomal RNA (16s rRNA) PCR analysis, using universal primers.Sequence and the phylogenetic analysis of randomly selected amplified products of three representative isolates revealed that the R. anatipestifercirculating in Assam is closely related to the Chinese strains of the organism.At least two different strains werefound to be prevalent in the study area. All the 48isolates subjected for molecular screening for virulence associatedgenesexhibitedtheconservedompA gene (Outer membrane protein A),while virulence associated protein D gene (vapD) was detected onlyin eightisolates.TheCAMP cohemolysinassociated cam gene could not be seen in any of R. anatipestiferisolates. The evolutionary relationship of the sequence of a randomly selectedlocalR. anatipestiferassociated ompA gene revealed a close similarity to the Chinese strains of R. anatipestifer(99 percent) while the Kerala isolates showed 97 % similarity with the Assam isolates. ERIC- PCR analysis revealed accommodation of all the 48 R. anatipestiferisolates of Assam in two different clusters. The large cluster was composed of 39 R. anatipestiferisolates, while a small cluster accommodated the remaining nine isolates. Following further analysis, two more sub-clusters consisting of 21 and 18 strains, respectively could be explored in the large cluster. Based on the ERIC-PCR, three different genotypes (RI, RII and RIII) of R. anatipestiferisolates were found to be circulating in places of Assam.

Based on pathogenicity trial of eight R. anatipestiferisolates, bearing both ompAand vapDgene,a most pathogenic isolate was selected for formulation of inactivated bacterin vaccine, and its immunogenic potentialwas evaluated. The immunized serum, following vaccination with bacterin formulation revealed a gradual rising trend of IgG level from 0 day onward up to 40th day of post primary immunization (ppi) which was maintained till 50th day ppi. Thereafter, there was a gradual fall in the mean serum antibody titer till 70th day ppi. Following challenge trial in the immunized ducklings on 14th, 42nd and 70thdpv with homologous strain of R. anatipestifer, 100 percent protection against homologous challenge was conferred by the mean serum antibody level developed in ducklings from the 42nd day of ppi. In spite of fall in serum IgG level from 50thdayonwardof primary immunization, the mean serum antibody level of 70thday of ppi(4149.8±337.3) was found to be protective, conferring protection in 83.33 percent immunized ducklings against homologous challenge.

TICKS, TICK-BORNE HAEMOPARASITES AND ACARICIDAL RESISTANCE IN DOG IN AGARTALA, TRIPURA

Pratik Bhowmik

A study was conducted to determine the prevalence and molecular identification of ticks and tick-borne haemoparasites and status of acaricidal resistance in dogs in and around Agartala, the capital city of the state of Tripura for one calendar year from March 2022 to February 2023. Ticks and blood samples were collected from dogs which were brought to the Veterinary Clinical Complex (VCC), C.V.Sc. & A.H., R. K. Nagar, Tripura, different veterinary hospitals, veterinary dispensaries, stray dogs in NGO‟S and private clinics etc. in and around Agartala city. The results revealed that among 1776 dogs screened, 1104 dogs were found to be infested with ticks, with overall prevalence of 62.16 per cent. *Rhipicephalus sanguineus* was the only tick species found in the present study. Breed-wise, prevalence of tick infestation was recorded highest in German Spitz (81.72%) and least in Pomeranian (18.18%) breed of dog. Sex-wise, prevalence was more in males (66.06%) compared to female dogs (57.10%). Age-wise, prevalence of tick infestation was higher in young dogs (74.80%) than the adult dogs (54.84%). Tick infestation was recorded throughout the year with the highest prevalence in monsoon (66.97%) and least in winter (53.06%) season. Category-wise, highest prevalence of tick infestation was recorded in stray dogs (64.88%) and least in pet dogs (58.79%). Molecularly, PCR as well as sequencing analysis confirmed the characterization of *R. sanguineus* tick from dog. The overall prevalence of tick-borne haemoparasites was found to be 59.45 per cent (1056/1776). Five different species of tick-borne haemoparasites were identified microscopically and confirm through PCR where highest prevalence was recorded against *Babesia gibsoni*, 814 (45.83%) followed by *Hepatozoon canis*, 115 (6.47%), *B. canis*, 67 (3.77%), *Anaplasma platys*, 54 (3.04%) and *Ehrlichia canis*, 6 (0.33%). Present study revealed a total of 11 cases of mixed infection i.e. *B. gibsoni* with *B. canis* (n=6) was found to be the highest followed by *B. gibsoni* with *H. canis* (n=4) and *B. gibsoni* with *A. platys* (n=1). Breed-wise, prevalence of tick-borne haemoparasites was recorded highest in German Spitz (77.20%) and least in Siberian Huski (16.66%). Sex-wise, male dogs had higher prevalence of tick-borne

Abstract of Ph.D. thesis

Department: Veterinary Parasitology

Major Adviser: Dr. Saidul Islam

haemoparasites, 63.57 per cent than in females 54.13 per cent. Age-wise, prevalence of different tick-borne haemoparasites was found slightly higher in adult dogs (60.71%) than the young ones (57.29%). Tick-borne haemoparasitic infection was recorded throughout the year with the highest prevalence in monsoon (73.83%) and least in winter season (37.18%). Category-wise prevalence of tick-borne haemoparasites was found to be highest in stray dogs (68.45%) followed by pet dogs (59.20%) and working dogs (51.92%). The status of acaricidal resistance in Agartala, Tripura was done with two bioassays, i.e. Adult Immersion Test (AIT) and Larval Packet Test (LPT) by selecting two acaricidal compound (Deltamethrin and Fipronil) against *Rhipicephalus sanguineus* tick. In the present AIT study for deltamethrin, the LC50 was 47.801 ppm and LC95 was 406.477 ppm. Similarly, for fipronil, the LC50 was 23.972 ppm and LC95 was 128.473 ppm. For LPT study against deltamethrin, the LC50 was 37.482 ppm and LC95 was 430.579 ppm. Similarly, for fipronil, the LC50 was 27.099 ppm and LC95 was 88.915 ppm. The results revealed that both deltamethrin and fipronil produces lower mortality of ticks from its market recommended doses which clearly supports that there is development of resistance in tick against those drugs. However in the present study, the effectiveness of fipronil was found more in comparison to deltamethrin.

TOXICOPATHOLOGICAL STUDIES OF FLUBENDIAMIDE AND IRON INTERATION LABORATORY ANIMALS

Binita Baruah

The present study was undertaken to investigate the acute and subacute toxicity of flubendiamide, iron and their combine interaction in rats and a feeding trial conducted on rabbits by feeding flubendiamide sprayed leafy greens. In acute toxicity, rats were divided into three groups of five animals each. Group A served as control, group B & C administered with flubendiamide and iron (Fe) as $FeSO_4.7H_2O$ salt @ 2000mg/kg B.W. as a single dose orally and observed for 14 days. In sub-acute toxicity, rats were divided into four groups of 12 animals each (6 male and 6 female). Group A served as control, group B &C administered flubendiamide and iron (Fe)as $FeSO_4.7H_2O$ salt @ 200mg/kg B.W and group D administered with a combined dose of 100mg/kg b.wt. flubendiamide along with 100mg/kg b.wt. iron (Fe) as $FeSO_4.7H_2O$ salt orally daily for a period of 28days. In the feeding trial, rabbits were fed with flubendiamide sprayed leafy greens for a period of 28 days. Animals were divided into three groups of six animals each i.e. control, T1 (Low dose) and T2 (High dose). In acute toxicity of flubendiamide, clinical signs recorded were restlessness, circular movement& huddling where as in iron toxicity labored breathing, abnormal posture and hyperaemia of the ear. In the feeding trial, treated rabbits showed hunched-over posture, diarrohea, haematuria and cachexia. Body weights were found to be significantly decreased in all the treated groups except the acute flubendiamide group. Relative organs weights were found to be significantly increased in all the treated groups of all the experiment. There was significant alteration in different haematological parameters (Hb, PCV, TEC, Thrombocytes and TLC), biochemical parameters (ALP, GGT, creatinine and Urea) and antioxidant parameters (MDA, CAT, SOD and GPx). Necropsy revealed various gross alterations in many organs *viz.* liver, kidneys, brain, lungs, urinary bladder and heart with varying intensity in all the experiment. Histopathological examination of liver, kidney, brain, heart and lungs revealed various microscopic alterations *viz*. degenerative changes, necrosis, biliary epithelial hyperplasia, congestion, haemolysis, fatty changes, haemorrhages, atrophy of the glomerulus and glomerular loss, homogenous

Abstract of Ph.D. thesis

Department: Veterinary Pathology

Major Adviser: Dr. Sarojini Mahanta Tamuli

proteinaceous deposits, tubular necrosis, neuronal degeneration, satelitosis, gliosis, perivascular cuffing, neuronophagia, hyperplasia of the bronchiolar epithelium, cellular infiltration, interstitial pneumonia ,haemorrhagic pneumonia, collagen deposition, emphysema, thrombus formation, calcification and myocardial necrosis in the treated groups of all the experiment. Histopathological scoring of liver, kidney and brain revealed significant difference only for kidney of sub-acute toxicity group. In the feeding trial, significant difference exists for histopathological scoring of the liver and also for kidney between treated groups. Special stains Masson's trichome stains collagen blue colour, Kossa's stains calcium salts black and iron particle stains blue colourin Prussian blue stain. The immunohistochemical analysis of the liver, kidney and brain sections revealed decreased expression of Nrf-2 where as increased expression of Keap-1 in the liver and kidney sections incase of treated groups compared to control. For Gfap expression in brain sections, increased expression were noted in treated groups compared to control. Flubendiamide residues were detected in feeding trial of rabbits where both qualitative and quantitative assessment were carried out in the liver homogenates, urine and leaf samples and the highest residues was detected from leaf samples. Present study revealed hepatotoxic, nephrotoxic and neurotoxic potential of flubendiamide and iron might be due to associated with oxidative stress. The present study showed additive or synergistic effect on the various toxicological parameter of the two toxicants.

TOXICITY EVALUATION OF DIMETHOATE & QUINALPHOS IN KAMRUPA CHICKEN

Arjun Kafle

The present investigation was aimed to examine the acute and chronic toxic effects of Dimethoate and Quinalphos on Kamrupa chickens. The study consisted of 50 Kamrupa chickens divided into three groups (Groups A, B, and C). Group A consisting of 20 chickens in which 10 chickens received Dimethoate @ 48mg/kg BW and 10 chickens received Quinalphos @ 22.5 mg/kg BW (acute toxicity). Group B consisting of 20 chickens in which 10 chickens received Dimethoate @4.8mg/kg BW and 10 chickens received Quinalphos @2.25mg/kg BW (chronic toxicity). Group C consisted of 10 chickens which served as control for group B and Group C. In the acute toxicity study, Group A chickens displayed rapid onset of symptoms within hours of Dimethoate and Quinalphos administration, such as depression, anorexia, diarrhea, excessive salivation, and incoordination followed by recumbency and death. In contrast, Group B showed milder symptoms viz, sitting on the hock posture, leg weakness and diarrhea during the latter part of the experiment. Hematological parameters exhibited significant alterations in both treated groups compared to the control, including increased levels of blood parameters (Hemoglobin, Total Erythrocyte Count, Total Leucocyte Count, and Heterophil) and decreased lymphocyte levels. Furthermore, both treated groups showed elevated serum enzyme activities (Alanine Amino Transferase, Aspartate Amino Transferase, Alkaline Phosphatase, Total Cholesterol, and Uric Acid) while Serum Cholinesterase levels were notably reduced in comparison to the control. Postmortem examinations revealed gross changes in organs such as the liver, kidney, and brain with findings of congestion, hemorrhaging, and enlargement in various organs in both groups. Liver histopathology indicated degeneration and pyknosis with dilation of sinusoid space. Necrotic tissue was replaced by Mononuclear Phagocytic Cells. Kidney analysis revealed Perivascular aggregation of Mononuclear Phagocytic cells, degeneration of tubules. Meningitis with presence of inflammatory cells, vasodilation in section of brain tissue were observed. The residue levels of Dimethoate and Quinalphos were maximum in brain in acute toxicity while liver and kidney contained maximum residue in chronic toxicity. All were below the MRL. Gene expression analysis

Abstract of Ph.D. thesis

Department: Veterinary Pharmacology and Toxicology

Major Adviser: Dr. D.C. Roy

demonstrated maximum downregulation of AvBD1 gene followed by AvBD7 and AvBD6.

Overall, this study demonstrated severe toxic effects of Dimethoate and Quinalphos in Kamrupa chickens.

PHARMACODYNAMIC ROLE OF *BUTEA FRONDOSA* AND *ZANTHOXYLUM ARMATUM* DC WITH RESPECT TO ANTI-TREMATODAL ACTIVITY AGAINST *PARAMPHISTOMUM CERVI*

Snigdha Hazarika

The study aims to evaluate the anthelmintic potential of ethanolic extract of seed of *Butea frondosa* and hydro-ethanolic extract of seed of *Zanthoxylum armatum* DC against *Paramphistomum cervi*, a rumen fluke prevalent in North-East India. A complete and detail *in-vitro* and *in-vivo* experiments have been carried out to evaluate the anthelmintic property of seed extracts of both the plants as well as to establish the mechanism of action against *P. cervi*. For *in-vitro* studies, ethanolic extract of seed of *B. frondosa* and hydro-ethanolic extract of seed of *Z. armatum* DC @ 100, 300, 1000 and 3000 µg/ml have been taken against the standard drug Oxyclozanide @ 10^{-5} M. Both biochemical and neuro-pharmacological mechanisms were studied to understand the actual cause of death and paralysis of *P. cervi* by these two seed extracts. Neuro-pharmacological experiments were carried out in isolated tissue bath using various standard substances of specific adrenergic, cholinergic, dopaminergic, serotonergic, GABAergic, Ca^{++} channel potentiators, K^{+} channel potentiators, NO channel modulators and most importantly ethanolic extract of seed of *B. frondosa* and hydro-ethanolic extract of seed of *Z. armatum* DC on spontaneous muscular activity of *P. cervi*. Ethanolic extract of seed of *B. frondosa* was found to be inhibitory in nature and caused complete paralysis and death of worms @ 3000 µg/ml, while hydro-ethanolic extract of seed of *Z. armatum* DC was excitatory in nature. During this study, involvement of various excitatory and inhibitory neurotransmitters and their combination with both the seed extracts were evaluated. Again, the worms were incubated at 38 ± 1^{0} C for 4 hrs in a Petri-plate to study the *in vitro* motility and biochemical mechanism of action of both the extracts. Ethanolic extract of seed of *B. frondosa* @ 1000 and 3000 µg/ml while *Z. armatum* DC @ 3000 µg/ml showed complete death of worms within 1 hr of exposure which was comparable with the standard drug Oxyclozanide @10^{-5} M. Glucose uptake was reduced significantly ($P<0.05$) by the ethanolic seed extract of *B. frondosa* @ 1000 and 3000 µg/ml and by the hydro-ethanolic seed extract of *Z. armatum* DC @ 300, 1000

Abstract of Ph.D. thesis

Department: Veterinary Pharmacology and Toxicology

Major Adviser: Dr. C.C. Barua

and 3000 µg/ml. Similarly, glycogen content was found to decrease significantly ($P<0.05$) by the ethanolic seed extract of *B. frondosa* @ 1000 and 3000 µg/ml and by the hydro-ethanolic seed extract of *Z. armatum* DC @ 300, 1000 and 3000 µg/ml. Again, Lactic acid production was found to increase significantly ($P<0.05$) by the ethanolic seed extract of *B. frondosa* @ 1000 and 3000 µg/ml and by the hydro-ethanolic seed extract of *Z. armatum* DC @ 300, 1000 and 3000 µg/ml while compared with the control. Likewise, AChE activity of the *P. cervi* was considerably reduced at almost all concentrations (100, 300, 1000 and 3000 µg/ml) of ethanolic seed extract of *B. frondosa.* However, AChE activity of *P. cervi* was significantly ($P<0.05$) inhibited by hydro-ethanolic seed extract of *Z. armatum* DC only @ 3000 µg/ml. *In vivo* experimentation was carried out in naturally infected goats with *P. cervi* of different villages of Lakhimpur District. Both the seed extracts of *B. frondosa* (100 and 200 mg/kg body weight) and *Z. armatum* DC (150 and 250 mg/ kg body weight) were found effective against naturally infected *P. cervi* which is comparable with the standard drug. During this experimentation, EPG count, body weight, different haematological and biochemical analysis at 0, 7^{th} , 14^{th} , 21^{st} and 28^{th} days of interval were carried out to establish the effectiveness of the extracts against *P. cervi*.

PERFORMANCE OF ASSAM HILL GOAT UNDER DIFFERENT HOUSING MANAGEMENT SYSTEMS

Shafiqul Islam

An experiment was conducted to study the effect of housing and system of rearing on the growth performance of castrated Assam Hill goat under the climatic condition of Assam. The experimental materials consisted of 40 castrated kids of 3 months of age, divided into 4 groups of 10 animals in each according to a factorial design with 2 types of housing *i.e.* traditional shed (TH) and modified shed (MH) and 2 types of rearing systems i.e. intensive (I) and semi intensive(SI). Kids placed under treatment T1 (TH-I) and T2 (TH-SI) were housed in traditional shed and kids of group T3 (MH-I) and T4 (MH-SI) were housed in a modified shed, but under intensive and semi intensive system of management, respectively. The experiment was carried out for a period of 9 months from January, 2022 to September, 2022. Macro and microclimatic parameters were recorded on daily basis. Fortnightly data on body weight gain, average daily body weight gain and morphometric measurements were recorded for 6 months and average two fortnights in each month was done to analyze the data. Slaughter studies were conducted in animals at 9 and 12 months of age.

The overall average minimum temperature in the outside (OS), TH and MH was 18.23±0.27, 21.91±0.26 and 22.36±0.25 0C, respectively and overall average maximum temperature was 29.22±0.20, 28.66±0.19 and 29.50±0.20 0C, respectively. The outside minimum and maximum temperature was significantly ($p<0.01$) lower than the inside. But the minimum and maximum temperature between two sheds did not differ significantly from each other.

The overall average dry bulb temperature was 25.11±0.28, 26.15±0.26 and 26.70±0.26 0C in the OS, TH and MH, respectively. The overall average wet bulb temperature was 22.46±0.24, 23.82±0.25 and 23.61±0.24 0C in the OS, TH and MH, respectively. There was highly significant effect of position on the dry bulb and wet bulb temperature. The average wet bulb and dry bulb temperature was significantly higher inside than the OS. But TH and MH did not differ significantly. The overall average relative humidity was 75.46±1.02, 76.68±1.03 and 75.99±1.03 per cent in the OS, TH and MH, respectively. The relative humidity was significantly ($p<0.05$) higher

Abstract of Ph.D. thesis

Department: Livestock Production and Management

Major Adviser: Dr. Adib Haque

in the TH than the OS and MH. The overall average THI was 74.85±0.37, 76.58±0.36 and 76.82±0.35 in the OS, TH and MH, respectively. The THI in OS was significantly ($p<0.01$) lower than TH and MH.

The average body weight of kids in Assam Hill goat at 3 and 9 month of age were 5.10±0.07, 5.11±0.07, 5.09±0.08 and 5.11±0.07 kg; and 11.38±0.06, 10.66±0.06, 11.12±0.07 and 10.61±0.05 kg in TH-I (T1), TH-SI (T2), MH-I (T3) and MH-SI (T4) groups, respectively. There was significant effect of shed, system and age on the body weight. The overall monthly body weight gain) was 34.67±0.92, 30.59±0.74, 32.60±0.85 and 30.42±0.79 g in T1, T2, T3 and T4 groups, respectively. The effect of treatments (shed x system) and shed was significant ($p<0.05$) and effect of system and age was highly significant ($p<0.001$). In regards to the morphometric traits, there was significant effect ($p<0.01$) of age on all the morphometric traits and highly significant effect of system was observed on body length and height at wither. The types of shed showed significant effect ($p<0.05$) on heart girth only.

The overall mean values of respiration rate in Assam Hill goats were 33.10,±0.12, 35.21±0.13, 33.12±0.11 and 35.31±0.13 breaths/min for T1, T2, T3 and T4 groups. The overall average daily pulse rate of castrated Assam Hill goat reared under T1, T2, T3 and T4 treatment groups was 73.73±0.08, 75.38±0.08, 73.78±0.08 and 75.44±0.09 (beats/min), respectively. The average rectal temperature of castrated Assam Hill goats placed under T1, T2, T3 and T4 treatment was 101.46±0.01, 101.65±0.02, 101.47±0.01 and 101.69±0.02 0F, respectively. There was highly significant effect ($p<0.01$) of rearing system on respiration rate, pulse rate and rectal temperature, respectively.

The average values of full stomach weight, pre-slaughter weight, slaughter weight, hot carcass weight, carcass length and dressing percentage at 9th month old goats were 12.04±0.08 , 11.18±0.07 , 10.72±0.06 & 5.07±0.05 kg, 48.10±0.46 cm and 44.57±0.27 per cent for T1 group; 11.28±0.10, 10.48±0.07, 10.06±0.05 & 4.64±0.07 kg, 48.00±0.35 cm and 43.45±0.49 per cent (%) for T2 group; 11.74±0.15, 10.84±0.07, 10.28±0.09 & 4.88±0.06 kg, 46.20±0.25 cm and 44.24±0.92 per cent for T3 group and 11.24±0.08, 10.46±0.07, 9.94±0.07 & 4.60±0.06 kg, 45.60±0.48 cm and 43.15±0.51 per cent for T4 groups, respectively. There was significant effect of shed, system and age on all the above parameters and effect of treatment groups (shed x system) was significant ($p<0.05$) on full stomach weight only and it was highest in T1. The average pre-slaughter weight, slaughter weight, hot carcass weight, carcass length and dressing percentage were apparently higher in T1 group followed by T3, T4 and T2 groups for both 9th month and 12th months of age. The average weight of different primal cuts *i.e.* neck, shoulder, rack, brisket, loin and flank and legs of carcasses of Assam Hill goats slaughtered at 9th month of age were 0.41±0.01, 0.99±0.01, 0.65±0.01, 0.96±0.01, 0.44±0.01, 0.24±0.01 and 1.38±0.01 kg, respectively for T1 group; 0.36±0.01, 0.88±0.01, 0.61±0.01, 0.86±0.01, 0.41±0.01, 0.19±0.01 and 1.28±0.01 kg. respectively for T2 group; 0.38±0.01, 0.95 kg±0.01, 0.62±0.01, 0.89±0.02, 0.42±0.01, 0.21±0.01 and 1.32±0.02 kg, respectively for T3 group and 0.36±0.01, 0.89±0.01, 0.60±0.01,

0.85±0.02, 0.41±0.01, 0.19±0.01 and 1.28±0.03 kg, respectively for T4 group. There was highly significant effect ($p<001$) of system and age on all the primal cuts. Treatment groups did not differed significantly ($p>0.05$). The average content (%) of moisture, crude protein, ether extract and total ash of meat of goat slaughtered at 9 month of age was 76.10±0.13, 18.74±0.11, 3.86±0.07 and 1.32±0.03 for T1 group; 77.34±0.10, 18.82±0.12, 2.54±0.11 and 1.30±0.03 for T2 group; 76.22±0.12, 18.70±0.09, 3.78±0.09 and 1.32±0.03 for T3 group and 77.44±0.11, 18.78±0.13, 2.48±0.06 and 1.31±0.03 for T4 group whereas the corresponding values at 12 month of age was 74.82±0.11, 19.06±0.10, 4.80±0.09 and 1.32±0.04 for T1 group; 76.22±0.09, 19.02±0.10, 3.44±0.10 and 1.31±0.04 for T2 group; 74.90±0.11, 19.04±0.11, 4.74±0.10 and 1.32±0.04 for T3 group and 76.32±0.14, 19.00±0.24, 3.38±0.09 and 1.33±0.03, respectively for T4 group. There was highly significant effect of age on moisture, CP and EE only. The average blood, heart, liver and kidney weight was 0.46±0.02, 0.13±0.0, 0.29±0.01 and 0.05±0.01 kg, respectively for T1 group; 0.42±0.02, 0.14±0.01, 0.26±0.01 and 0.04±0.01 kg, respectively for T2 group; 0.44±0.02, 0.13±0.01, 0.28±0.01 and 0.04±0.01 kg, respectively for T3 group and 0.41±0.02, 0.13±0.0, 0.34±0.01 and 0.05±0.01 kg, respectively for T4 group for 9th months old goats. The corresponding average values at 12 month old castrated male Assam Hill Goat were 0.60±0.03, 0.17±0.01, 0.33±0.01 and 0.07±0.01 kg, respectively for T1 group; 0.57±0.03, 0.43±0.27, 0.34±0.01 and 0.06±0.01 kg, respectively for T2 group; 0.59±0.02, 0.19±0.01, 0.32±0.02 and 0.06±0.01 kg, respectively for T3 group and 0.55±0.02, 0.18±0.01, 0.33±0.01 and 0.07±0.01 kg, respectively for T4 group, respectively. The average weight of blood after bleeding for the 9 month age group (0.43±0.01 kg) was significantly lower than that of goats for the 12 month age group (0.58±0.01 kg), $p<0.001$. But, the same for goats reared in traditional shed (0.51±0.02 kg) did not differ significantly than that of goats housed in modified shed (0.5±0.02 kg). But, the same for goats reared under intensive system (0.52±0.02 kg) was significantly higher than that of goats reared under semi intensive system of management (0.49±0.02 kg).

Out of total, 20 animals (5 from each group) was found positive for strongyle infestation in the month of January and February. The maximum EPG (egg/g) count was found in goats reared under semi-intensive system of management in T2 (269.50±6.4) and T4 (273.00±4.57) groups in the month of June which may be due to grazing in the field. The cost of goats in T1 was found to be lower than other treatment groups. The total cost, cost per kg body weight and cost per kid in T4 group was higher due to inclusion of high depreciation value the modified shed, a permanent type of structure and engagement of more number of hired labour for maintenance of the goat flock.

Low cost TH shed under intensive system of management found to be better in respect of production of Assam Hill goats. Therefore, traditional shed under intensive system may be used by the farmers in the field condition to earn more profit from goat rearing.

AMELIORATION OF HEAT STRESS THROUGH CERTAIN MANAGEMENTAL INTERVENTIONS IN LACTATING DAIRY COWS

Venus Das

The present experiment was executed in the Instructional Livestock Farm (Cattle) and Sahiwal Cattle Farm under in the Livestock Farm Complex, College of Veterinary Science, Assam Agricultural University, Khanapara,Guwahati-22 to observe the heat stress amelioration capacity of body cooling and bypass fat feeding during summer season (1St May to 31st August, 2022) in lactating dairy cows.

A total of twenty four (12 Holstein-Friesian crossbred and 12 pure Sahiwal) lactating cows were divided into three groups with eight animals in each group with similar parity, stage of lactation and average daily milk production and with equal number of each breeds. The experimental animals were offered feed twice daily individually @ 4 percent of body weight on DM basis to meet up the optimum nutritional demand (NRC, 2001). Out of total DM 1/3rd was given standard concentrate feed (CP: 18% & TDN: 68.00%) prepared in the farm and 2/3rd was given roughages. Out of total roughage 1/3rd was given as paddy straw and 2/3 mixed green fodders such as Para (*Brachiaria mutica*), Napier (*Pennisetum purpureum*) and Guinea (*Panicum maximum*) grasses in equal parts. In the treatment group bypass fat was fed along with concentrate mixture @ 100 g in the morning and 100 g in the afternoon daily. The experiment was followed by a 7 days of digestibility trial.

The average daily milk yield for T1, T2 and T3 group was 5.94±0.09, 8.26±0.12 and 9.58±0.20 kg, respectively and for Holstein-Friesian crossbred and Sahiwal cow, it was 8.57±0.23 and 7.37±0.13 kg, respectively. The average daily milk yield was significantly ($p<0.01$) higher in T2 and T3 group than the T1 group. The average fat, protein, SNF, lactose, ash, specific gravity and freezing point depression of milk in T1, T2 and T3 group was 3.07±0.11, 3.62±0.13 and 4.31±0.20; 3.46±0.02, 3.53±0.02 and 3.59±0.02; 9.26±0.04, 9.34±0.04 and 9.34±0.04; 5.38±0.03, 5.41±0.03 and 5.48±0.02; 0.75±0.01, 0.78±0.01 and 0.79±0.00; 1.0348±0.0001, 1.0349±0.0002 and 1.0352±0.00 and - 0.63, - 0.64 and - 0.63 percent, respectively and for Holstein-Friesian crossbred and Sahiwal cow, it was 3.74±0.11 and 3.58±0.14; 3.53±0.02 and 3.53±0.0; 8.06±0.19

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Major Adviser: Dr. Jakir Hussain

and 9.3±0.03; 5.42±0.02 and 5.42±0.02; 0.77±0.00 and 0.76±0.00; 1.0348±0.001 and 1.0351±0.0001 and - 0.63and - 0.64 percent, respectively. The analysis of variance showed that there was highly significant ($p<0.01$) effect of treatment on the average fat, protein, ash and non-significant ($p>0.05$) effect on SNF, lactose, specific gravity and freezing point depression. The average fat, protein and ash content (%) was significantly ($p<0.01$) increased in T2 and T3 groups.

The average daily dry matter intake (DMI), dry matter intake per 100 kg body weight and feed conversion efficiency (FCE) for T1, T2 and T3 groups was 11.93±0.21, 14.66±0.19 and 15.42±0.22 kg; 2.43±0.03, 2.98±0.02 and 3.10±0.03 percent and 0.50±0.01,0.51±0.01 and 0.51±0.01, respectively. The average daily DMI, DMI per 100 kg body weight and FCE of Holstein-Friesian crossbred and Sahiwal cow was 15.40±0.19 and 12.61±0.16 kg; 2.76±0.03 and 2.91±0.03 percent and 0.51±0.00 and 0.49±0.01, respectively. There was ($p<0.01$) significant increase in DMI in T2 and T3 groups compared to T1 group.

The overall average Temperature Humidity Index (THI) was 78.01±0.65, 74.89±0.39, 76.26±0.39, 76.26±0.39, 80.7±0.61, 85.04±0.64, 82.80±0.53 and 79.17±0.22 for 1st fort night (FN), 2nd FN, 3rd FN, 4th FN, 5th FN, 6th FN, 7th FN and 8th FN, respectively. The average THI value for ILF(C) was 78.14±0.97, 74.99±0.56, 76.26±0.56, 77.69±0.70, 80.90±0.93, 85.25±0.96, 82.93±0.77 and 79.52±0.28 and For Sahiwal cattle farm, it was 77.87±0.90, 74.79±0.56, 76.26±0.56, 76.26±0.56, 80.5±0.81, 84.83±0.88, 82.66±0.74 and 78.82±0.33 during 1st FN, 2nd FN, 3rd FN, 4th FN, 5th FN, 6th FN, 7th FN and 8th FN. There was significantly ($p<0.05$) highest THI was found during 6th FN.

The average respiration rate, pulse rate, rectal temperature and rumination time in T1, T2 and T3 groups was 26.84±0.54, 26.22±0.39 and 26.22±0.39 per min; 80.33±2.02, 67.52±1.31, 65.17±1.30 per min; 102.1±0.17, 101.4±0.10 and 100.69±0.08 ºF and 405.7±3.30, 425.59±4.45 and 438.88±4.45 min/day, respectively and for Holstein-Friesian crossbred and Sahiwal cows, it was 27.00±0.31 and 25.85±0.41per min; 74.44±1.45 and 68.11±1.41per min; 101.38±0.11 and 101.48±0.12 ºF and 422.92±3.33 and 423.85±3.21 min/day, respectively. There was highly significant ($p<0.01$) decrease in pulse rate, rectal temperature and increase in rumination time in T2 and T3 groups than the T1 group. But respiration rate was not affected by treatment in the present study.

The average blood albumin, globulin and A: G ratio in T1, T2 and T3 groups was 5.28±0.21, 7.36±0.27 and 8.47±0.48 g/dl; 5.36±0.21, 6.91±0.32 and 7.97b±0.33g/dl and 1.01 ±0.03, 1.19±0.07 and 1.09±0.05, respectively and for Holstein-Friesian crossbred and Sahiwal, it was 6.56±0.29 and 7.51±0.32 g/dl, 6.35±0.25 and 7.13±0.26 g/dl and 1.12±0.04 and 1.07±0.04, respectively. There was highly significant ($p<0.01$) increase in blood albumin and globulin content in T2 and T3 group compared to T1 group in the present study. The average superoxide dismutase (SOD) level of plasma for T1, T2 and T3 groups was 8.06±0.10, 7.48±0.13 and 7.27±0.22 unit/mg of protein, respectively and for Holstein-Friesian crossbred and Sahiwal, it was was 7.69±0.15 and

7.52±0.11 unit/mg of protein, respectively. In the present study, it was found that there was significant ($p<0.05$) reduction in superoxide dismutase level of blood in T2 and T3 group compared to T1 group.

The overall mean digestibility coefficient of DM, OM, CP, EE, CF and NFE in T1, T2 and T3 group was 67.05±0.15, 68.26±0.16 and 68.48±0.15; 68.46±0.17, 65.11±0.24 and 68.88±0.15; 64.89±0.24, 65.11±0.24 and 64.70±0.28; 53.69±1.19, 53.57±0.76 and 56.61±0.39; 59.67±0.20, 59.94±0.24 and 60.04±0.21 and 73.74±0.25, 74.74±0.25 and 76.71±0.15 percent, respectively and for Holstein-Friesian crossbred and Sahiwal cows, it was 68.10±0.14 and 67.76±0.17; 68.61±0.12 and 68.47±0.14; 65.01±0.13 and 64.79±0.26; 56.27±0.39 and 52.98±0.87; 60.10±0.18 and 59.67±0.17 and 75.02±0.25 and 75.11±0.27 percent, respectively. The analysis of variance showed non-significant ($p>0.05$) effect of treatment, breed and fortnight on digestibility coefficient of DM, OM, CP, CF and NFE. But in case of EE, there was highly significant ($p<0.01$) effect of treatment and breed on digestibility coefficient of EE.

There was highly significant ($p<0.01$) effect of treatment and breed on the average daily cost of feeding and cost of feeding per kg milk yield. The mean cost of feeding and cost of feeding per kg milk yield for T1, T2 and T3 group was Rs. 212.27±3.70, 262.37±2.82 and 302.25±3.31 and Rs. 36.13±0.78, 31.43±0.27 and 32.17±0.58, respectively. Though the total cost of feeding for T3 group was found to be significantly ($p<0.01$) higher due to feeding of bypass fat, but cost of feeding per kg milk yield was significantly ($p<0.01$) lower in T2 and T3 group compared to T1 because of higher milk production. In respect of breed, the daily cost of feeding and cost of feeding per kg milk yield in HF crossbred was significantly higher than pure Sahiwal cows.

The present experiment validated that heat stress can be ameliorated significantly by body cooling and feeding bypass fat during summer season for improvement of milk production and maximize the income from rearing of dairy cattle.

EFFECT OF RICE BEER AND PHYTO-INGREDIENTS OF CERTAIN QUALITY CHARACTERISTICS OF DUCK MEAT PRODUCT

Pompi Rani Boro

The study was conducted in the Department of Livestock Products Technology, Assam Agricultural University, Khanapara, Guwahati-22 to develop a duck meat product incorporating rice beer, phyto-ingredients and spices as marinating ingredients along with control without affecting the physico-chemical, microbial, organoleptic qualities and shelf life of the meat.

A total of five batches of marinated duck meat comprising of 4 different treatments in each batch were prepared. Ducks were collected and slaughtered hygienically and marinated. The marinades were prepared by using rice beer, spice paste and phyto-ingredients. The marinated samples are grouped into following treatments for control (meat and spice paste), Treatment 1 (meat and rice beer), Treatment 2 (meat, phyto-ingredients and spice paste) and Treatment 3 (meat, spice paste, rice beer and phyto-ingredients). The marinated samples were vacuum and aerobically packed and stored in refrigeration temperature for 24 hrs. After these periods, the samples were subjected to various quality assessments. Shelf life studies conducted at interval of 5 days for vacuum packed samples, whereas, aerobically packed samples were assessed for shelf-life studies at an interval of 3 days. The results of the investigation are as follows:

The alcohol content (%) of rice beer found to have 6.02±0.2. The pH value was 3.58±0.09 and the antioxidant activity (%) was found to have 16.12±0.13.

The results with respect to pH, tyrosine and TBA of marinated duck meat were found to be significantly ($P<0.01$) higher when compared to control samples. Mean cooking yield was found to be higher in control samples as compared to the treated samples. The cooking yield was significantly lower in treated samples as compared to that of control samples.

The mean percent of proximate composition of products showed similar trend for both aerobic and vacuum packaging systems. Moisture was high in the Treatment 3

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samples as compared to that of control samples, whereas, crude protein, ether extract and total ash was high in control samples. The mean values of moisture, crude protein, ether extract and total ash showed significant differences among the control and treated samples but no significant effect could be seen in both the packaging conditions.

The mean values of colour profile showed no significant differences between the control and treated samples and also no significant effect in both the packaging conditions. The data generated for aerobic packaging method revealed marginally higher L* values. The L* value was lower for treated products than that of control products. Redness (a*) followed a decreasing trend in all the treated products as well in control products. Slight decrease in yellowness in vacuum packaged duck meat products.

The mean values of texture profile also showed similar trend in both the packaging systems. The hardness values showed a decreasing trend in treatment 3 as compared to control samples in both the packaging systems. However hardness values were marginally lower in vacuum packaged samples when compared to aerobically packaged samples. Significant differences ($P<0.01$) could be observed in the control and treated samples for springiness and chewiness, whereas, cohesiveness followed an increasing and decreasing trend and no significant ($p>0.05$) differences among all the treated samples. The resilience followed uniformly decreasing trend from control to T3 samples.

The sensory evaluation showed no significant differences (Appearance, colour, flavour and tenderness), whereas, significant differences were observed for juiciness and overall acceptability.

The microscopic study in both (scanning electron microscope and light microscope) revealed swelling of muscle fiber and decrease in inter fibrillar spacing between the muscle fibers and disruption of connective tissue membranes due to use of marinating ingredients. The microbiological quality studies revealed that there is a significant increase ($P<0.01$) in control samples compared to treated samples during the entire storage periods in both the packaging systems, whereas, total psychrophilic count could not be detected on 1stand 5th day of storage in vacuum packaging but on 10th and 15th day it increases in the storage periods. Similarly for aerobically packaging systems, TVPBC were not detected on 1st day of storage but on 3rd, 5th and 7th day of storage it increases in the storage periods. The Yeast and Mould count and Coliform count were absent in all the storage periods in both the packaging systems. The Sulphite Reducing *Clostridial* organisms and salmonella were also found to be absent in all the samples for both the packaging systems.

The shelf life studies of marinated duck meat were studied on the basis of pH, tyrosine, TBARS value, microbiological quality and visible colour and odour changes of the products at refrigeration temperature. Vacuum packaging system was found to be better than the aerobic packaging system.

Based on the investigation, it can be concluded that an acceptable marinated duck meat product can be developed for future commercial exploitation.

Ph.D (Community Science)

- **Extension and Communication Management**
- **Family Resource Management**
- **Food Science and Nutrition**
- **Human Development and Family Studies**
- **Textile and Apparel Designing**

Status of Agricultural Entrepreneurs of Assam with reference to Dairy Farming

Dhruba Jyoti Mudoi

Research studies in dairy farming in Assam can lead to improved practices and policies, increased productivity, better animal health and welfare, and enhanced food safety for consumers. This will contribute to the overall wellbeing of the farmers, the local economy, and the wider community. Therefore, it was decided to undertake a research study on "Status of Agricultural Entrepreneurs of Assam with reference to Dairy Farming" with the objectives a) To develop the complete understanding of the entrepreneurs with reference to dairy farming. b) To find out the influencing factors for the selecting dairy farming as an enterprise. c) To assess the knowledge of the respondents regarding dairy farming as an enterprise. d) To identify the problems faced by the respondents in operating the enterprise. e)To elicit the suggestions from the respondents regarding improving the enterprise. The present study was carried out in purposively selected 5 districts of Assam where the highest number of registered dairy cooperative societies were found under Directorate of Dairy Development, Government of Assam. Districts were Jorhat, Nagaon, Lakhimpur, Golaghat and Morigaon. One (1) block from each district was selected purposively having the highest number of registered cooperative societies under D.D.D, Government of Assam. Four (4) Dairy Cooperative Societies (D.C.S) from each block were selected using simple random sampling. The selection of respondents (dairy farmers) was done using equal allocation technique under stratified sampling from each Dairy Cooperative Societies. From each Dairy Cooperative Society, 10 dairy farmers were selected randomly. Thus a total number of two hundred (200) respondents were selected. The findings shows that majority of the farmers (40.00 %) belonged to the middle aged (31 – 45 years) with majority of the farmers belonged to the male category (54.50 %) with educational qualification up to higher secondary (29.50 %), 39.50 per cent belonged to the ST/SC category and nuclear family with medium family size (45.00 %). Majority of the farmers had medium level of experience in dairy farming and a mixed of all cattle in livestock possession along with mixed type of animal shed with local soil as their flooring in the animal shed. A large number of the farmers (32.50 %) obtained information from TV /

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Radio / Internet / Media and most of them kept vaccination records of their cattles and prepared packed milk and used bike for milk transportation. Dairy farmers are mostly influenced by social factors, followed by psychological, economic and technical and lastly by market related factors for selecting dairy farming as their enterprise. Overall majority of the farmers (74.00 %) had medium level of knowledge and the highest level of knowledge was seen in reproductive management (Mean score 13.86). Majority farmers faced problems with scientific breeding practices (Mean score 7.43). Almost cent per cent of the farmers (99.00 %) suggested that there should be improvement in the farmer's access to institutional credit or loan through simplification of procedures and reduction in interest rates and financial agencies should also increase the quantum of loan amount to enable the farmers to purchase quality and high yielding milch animals.

Optimization of processing method and value addition of Chunga chawl and Chunga pitha

Mansi Tiwari

The present investigation entitled "Optimization of processing method and value addition of Chunga chawl and Chunga pitha" aims to optimize the traditional processing techniques involved in preparation of Chunga chawl and Chunga pitha which is a traditional rice-based products prepared mainly after harvesting during Magh Bihu. The study also included value addition of the optimized products followed by their physico-chemical and shelf-life evaluation using standard protocols. Prior to optimization, the traditional practices prevailing at local level was identified and information regarding preparation of chunga chawl and Chunga pitha was gathered using an open-ended pre-set interview schedule, pertaining to the ingredients used, preparation techniques, associated beliefs, mode of consumption etc. Based on the information sought, Aghuni bora rice was used for preparation of Chunga chawl and Kajoli chakua variety was used for preparing Chunga pitha. The paddy varieties obtained were evaluated in terms of their milling, physical and nutritional characteristics. Three processing variables-soaking time (6-12 h), cooking time (10-25 min) and water quantity (10-40 ml/100g) were selected which varies generally during preparation of the products. The range of these variables were fitted into an RSM model to obtain an experimentation design with 20 different combinations against response variables colour, overall sensory acceptability, degree of gelatinization (%) and swelling index. The best predicted solution for Chunga chawl was obtained with 0.80 desirability at soaking time 10.81 h, cooking time-16.51 min and water quantity of 34.10 ml/100g. In the similar manner the best predicted solution for Chunga pitha was obtained with 0.99 desirability at soaking time 11h, cooking time 19.19 min and water quantity of 27.39 ml/100g. The optimized products when compared with the native ones, a higher sensory acceptability of the optimized products in terms of colour, texture and appearance was obtained. The optimized products were then value added to improve their nutrient contribution. The value addition of Chunga chawl was done by partially replaced polished rice with germinated brown rice (GBR) at different proportions (C1: 25%, C2: 50%, C3: 75% and C4: 100%). When exposed to the sensory test by semi-

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trained panelist using 9-point hedonic scale, C1 bagged highest acceptability and was at par with the control (CC: 100% polished rice). The value-addition of Chunga pitha was done by replacing with finger millet flour at varied proportion (P1:10%, P2:20%, P3:30% and P4:40%). The highest acceptability was obtained by the Chunga pitha prepared with 10.00 per cent incorporation of finger millet flour and was at par with the control (CP: 0% millet flour). With the partial replacement with germinated brown rice, an increase in nutrient composition was seen. The protein content increased from 12.54±0.36 to 14.09±0.30%, fat content from 1.11±0.04 to 1.43±0.05%, ash content increased from 0.27±0.05 to 1.03±0.08% and fibre content from 0.84±0.02 to 1.24±0.03%. A reduction in amylose content was seen from 2.40±0.03 to 1.92±0.03% was recorded. The mineral content also increased with increasing the level of GBR to Chunga chawl. The calcium content increased from 24.76±0.08 to 26.98±0.04 mg/100g, iron content from 0.55±0.04 to 1.16±0.03 mg/100g, phosphorus from 84.58±1.13 to 202.19±0.39 mg/100g and zinc from 0.47±0.02 to 0.73±0.03 mg/100g on value addition. Likewise, an increasing trend of nutrient content was also observed in case of Chunga pitha prepared by value addition of finger millet flour.

Assessment of Nutritional Status of the Bodo tribes of Assam

Urmimala Baruah

The present investigation was undertaken to assess the nutritional status of the Bodo tribes of Assam with the objectives to assess the socio-demographic profile and the nutritional status of the study population in terms of anthropometric indices, food consumption pattern, clinical and biochemical parameters along with the traditional/etnic food processing and preservation practices of the target population. Three hundred eighty eight households were selected by multistage proportionate probability sampling from four districts of Assam, namely- Baksa, Chirang, Kokrajhar and Udalguri. Food consumption pattern of the population revealed that four meals a day was practiced which mainly comprises of the traditional food items prepared from rice, meat, dry fish, pulses. The frequency of consumption of food groups by the Bodo households revealed that cent per cent of the respondents consumed cereals, other vegetables, fats and oils and sugar and jaggery on a daily basis. The mean value for household dietary diversity is 6 which indicate on an average the Bodo households consumed ≤7 food groups out of 12 food groups over the preceeding 24-hour. This indicates inadequate dietary diversity of the Bodo households. The percentage distribution revealed that 56 per cent of the Bodo households had inadequate household dietary diversity and 44 per cent of the Bodo households had adequate household dietary diversity. The household food security status of the Bodo households revealed that 62.27% were food secure, 27.73% were mildly food insecure, 7% were moderately food insecure and 3% were severely food insecure. Food intake pattern as analyzed in terms of Balanced Diet recommended, it was found that the mean daily intake of cereals among 4-6 years was (93.36-95.44%) of the BDR. The average daily intake of pulses was 71.93%-74.40% of the BDR. The mean daily intake of meat, fish and poultry 84.32%-86.96% of the BDR. It was noteworthy to mention that the mean daily intake of milk and milk products, fruits and green leafy vegetables by 4-6 years boys and girls was 30.85%-36.52%, 39.22%-42.20% and 60.32%-64.12% respectively which was much lower than the BDR. The mean daily intake of cereals was 115.43% of the BDR among 13-15 year adolescent girls. The mean daily intake of pulses among 13-15

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adolescent girls was 73.70% of the BDR. The mean daily intake of meat, fish and poultry among 13-15 years adolescent girls was 85.52% of the BDR. The mean daily intake of milk and milk products, fruits and green leafy vegetables was 33.05%, 43.06%, 60.66% respectively among 13-15 years adolescent girls. Mean daily intake of cereals by the 16-18 year adolescent girls was 131.61% of the BDR. The mean daily intake of milk and milk products, fruits and green leafy vegetables among 16-18 year adolescent girls was 18.02%, 38.46%, 66.16% of the BDR respectively. The mean daily intake of meat fish and poultry among 16-18 year adolescent girls was 88.96% of the BDR. The mean daily intake of cereals among the pregnant women and lactating women was 167.48% and 125.05% of the BDR respectively. It was found that the mean daily intake of milk and milk products, green leafy vegetables and fruits among the pregnant women was 17.74%, 65.68% and 35.13% of the BDR respectively. The mean daily intake of milk and milk products, green leafy vegetables and fruits among the lactating women was 20.28%, 39.66% and 64.34% of the BDR respectively. While analyzing the mean daily nutrient intake of 4-6 years boys and girls, it was found that the mean daily intake of energy, protein, carbohydrate and fat was 87.51%, 91.40%, 178.53% and 87.36% of the EAR respectively among 4-6 years boys. The average daily intake of iron, calcium, vitamin A and vitamin C was 73.25%, 76.88%, 62.16% and 70.48 % of the EAR respectively by 4-6 year boys. The mean daily intake of energy, protein, carbohydrate and fat was 83.83%, 93.35%, 183.42%, 87.36% of the EAR respectively among the 4-6 year girls. The average daily intake of iron, calcium, vitamin A and vitamin C was 77.62%, 75.40%, 75.26% and 74.14% of the EAR among the 4-6 years girls. The mean daily intake of energy, protein, carbohydrate and fat was 88.81%, 92.93%, 199.7%, 80.42% of the EAR respectively among 13-15 year girls. The mean daily intake of iron, calcium, vitamin A and vitamin C was 70.11%, 77.07%, 74.33% and 69.30% of the EAR respectively among 13-15 year girls. The mean daily intake of energy, protein, carbohydrate and fat was 84.42%, 91.74%,195.36%and 86.20% of the EAR respectively among 16-18 year girls. The mean daily intake of iron, calcium, vitamin A and vitamin C was 62.88%, 73.20%, 77.03%,74.58% of the EAR respectively among 16-18 year girls. The average daily intake of energy, protein, carbohydrate and fat was 105.54%, 91.68%, 239.37%, 87.33% of the EAR among pregnant women. The mean daily intake of iron, calcium, vitamin A and vitamin C 69.21%, 71.51%,76.88% and 74.23% of the EAR respectively among pregnant women. The average daily intake of energy, protein, carbohydrate and fat was 100.47%, 104.25%, 284.03% and 85.43% of the EAR respectively among lactating women. The mean daily intake of iron, calcium, vitamin A and vitamin C was 79.06%, 75.20%, 73.36% and 76.04% of the EAR respectively among lactating women. Comparison of calculated macronutrient with Acceptable Macronutrient Distribution Range (AMDR) for 4-6 years revealed that the distribution of energy from carbohydrate, protein and fat was 60%, 8% and 15.16% respectively. The distribution of energy from carbohydrate, protein and fat for 13-15 year girls was 60.10%, 7.00% and 12.00% respectively. While comparing with AMDR, it was found that the distribution of energy from carbohydrate was 75%, protein was 9%

and fat was 13% among 16-18 year adolescent girls. The distribution of energy from carbohydrate, protein and fat was 79.30%, 9.10% and 11.12% respectively among pregnant women. The distribution of energy from carbohydrate, protein and fat was 78%, 10%, 10.20% respectively among lactating women. The distribution of energy from carbohydrate, protein and fat was 72.13%, 8% and 9.10% respectively among non pregnant non lactating women. The anthropometric assessment of the 4-6 year boys and girls in terms of height revealed that the height measurements were significantly lower than the 95th centile values of height (ICMR).

Assessment of Nutritional Status of Mising Tribe in Assam

Yashmin Nongrum

The present investigation entitled "Assessment of Nutritional status of Mising tribe in Assam" was carried out to examine the socio-demographic profile of the Mising tribe, assess their nutritional status through various anthropometric measurements, dietary patterns, biochemical markers and clinical parameters, and implement a targeted nutrition education intervention. To achieve these objectives, a cross-sectional study design was employed and 384 households were selected for the study. Socio-demographic data was collected through structured questionnaires, while anthropometric measurements, including Height, Weight, MUAC and Body Mass Index (BMI) were recorded. Dietary assessments were conducted to evaluate the consumption patterns, assess the food and nutrient intake of the target groups. Biochemical marker, such as hemoglobin levels were measured to identify any nutritional deficiencies. Clinical examinations were performed to identify any signs of malnutrition, anemia or related health issues. The Mising tribe's socio-demographic profile reveals a majority of individuals belong to small families (65.10%) who reside in traditional Chang ghar houses (66.41%). They heavily rely on agriculture as their main income source (90.40%) and face challenges such as high illiteracy rates and lack of proper toilet facilities. The dietary assessment among the Mising tribe revealed various consumption patterns and nutritional deficiencies. The Household Dietary Diversity Score (HDDS) showed that the mean score was 6.5 out of 12, with 59.7% of households having inadequate dietary diversity. In terms of food and nutrient intake, deficits were observed in the consumption of eggs, fruits, milk and milk products, fats and oils, as well as micronutrients like vitamin A, vitamin C, and calcium. Additionally, there was a high intake of energy derived from carbohydrates whereas poor intake from fat indicating an imbalance in macronutrient distribution as per the Acceptable Macronutrient Distribution Range (AMDR). The anthropometric assessment of the Mising tribes, when compared to Indian Council of Medical Research (ICMR), National Centre for Health Statistics (NCHS), and World Health Organization (WHO) guidelines, in the case of height, both ICMR and NCHS standards were not met, indicating a significant deficit at

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P< 0.05 in all target age groups . Moreover, the WHO Z-scores of height-for-age classified a significant proportion of preschool boys and girls as stunted, and the mean weight of preschool boys and girls, as well as adolescent girls, were consistently lower than the ICMR and NCHS standards further emphasizing the nutritional challenges faced by this population. The deficits ranged from 7.3% to 30.2% compared to the ICMR standard and from 4.8% to 43.1% compared to the NCHS standard. This suggests an overall underweight status among the Mising tribe, particularly among adolescent girls. The prevalence of undernutrition based on BMI-for-age was also notable, with percentages ranging from 14.7% to 26.08% for preschool children and from 6.5% to 40% for adolescent girls. However, overweight and obesity were not prevalent among this population. The MUAC classification indicated that the majority of preschool boys and girls were well-nourished, with only a small prevalence of acute and moderate malnutrition ranging from 6.05% to 15.15%.Various clinical manifestations associated with nutrient deficiencies.In preschool children, adolescent girls and pregnant women , clinical signs and symptoms such as dull and dry hair, pale and dry conjunctiva, cheilosis, dental caries, and dry and flaky skin were observed due to deficiencies in vitamins A, C, and iron. Anemia was also prevalent among both adolescent girls and pregnant women. The mean hemoglobin level (g/dl) of adolescent girls (13-18 years) and pregnant women of Mising tribe reported to be 10.9 g /dl and 9.3 g /dl with prevailing symptoms including pale skin, fatigue, weakness, dizziness, and rapid heartbeat. Statistical analysis revealed a strong significant positive correlation between height and micronutrient intake, including iron, calcium, vitamin C, and vitamin A (p < 0.05). This suggests that the intake of these micronutrients may have an impact on the height of the target population. Additionally, a strong significant positive correlation was found between weight and fat intake among the target age groups. Significant positive correlation was also obtained between hemoglobin level, iron intake and vitamin C. These statistical findings underscore the significant nutritional challenges faced by the Mising tribe, encompassing inadequate dietary diversity, micronutrient deficiencies and macronutrient imbalance impact leading to stunting, underweight status, and prevalent anemia.

Study on downstream processing for utilization of banana waste for fibre extraction, fibre based products and other value added end uses for sustainable livelihood

Dibyashree Saikia

Natural fibers are biodegradable and do not persist in the environment for extended periods, unlike synthetic fibers, which can take hundreds of years to decompose.The best way to bring about the changes in the environment is to make use of or find innovative uses for agricultural waste. Agricultural waste refers to the residue, byproducts, and unused materials generated from various agricultural practices and activities. Agricultural waste can have both positive and negative implications, depending on how it is managed and utilized. Improper management of agricultural waste can lead to environmental pollution. Banana waste, specifically the byproducts and residues generated from banana cultivation and processing, is a significant component of agricultural waste. The fibrous part of banana plants can be extracted from the pseudostem and used for making textiles, paper, ropes, and handicrafts. It has potential as a sustainable alternative to synthetic fibers due to its biodegradability and renewable nature. The utilization of banana waste depends on local conditions, availability, and processing capabilities. Proper waste management practices and innovative approaches can maximize the potential value of banana waste, contributing to sustainable agricultural systems and reducing environmental impact. The present investigation was carried out on "Study on downstream processing for utilization of banana waste for fibre extraction, fibre based products and other value added end uses for sustainable livelihood" with the following objectives. Objectives Extraction of fibers from banana pseudostem.• Processing of banana fibres for quality improvement.• Assessment of effect of quality improvement on physico-chemical properties of• fibres. Development of market viable products from banana fibers.• Development of Training module.• Impact assessment.• For conducting the experiment, two varieties of banana plant were selected namely Musa balbisiana commonly known as bhimkol and Musa

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acuminata commonly known as jahajikol based on availability, pre-testing and recommendation from the Department of Horticulture, AAU, Jorhat.The morphological properties of the banana plant such as length, diameter and moisture content were studied. Extraction of Musa balbisiana and Musa acuminata was carried out by both water retting and mechanically extraction method. Based on yield and fibre quality, 28 days of water retting method was considered as optimum duration for extraction of fibre for Musa balbisiana and 24 days of water retting method was considered as optimum duration for extraction of fibre for Musa acuminata. The chemical composition of both pond retted and mechanically extracted Musa balbisiana and Musa acuminata fibre like moisture, ash, lignin, alpha cellulose and cellulose were determined. The chemical composition were found out to be highest in all the retted fibres and bleached fibres were recorded as the lowest chemical composition. The bleached fibre revealed with maximum solubility in cold water, hot water and dilute alkali solutions and raw fibres was observed with minimum solubility for both the fibres. The physical properties such as length, diameter, wall thickness, tensile strength, elongation and density followed a decreasing trend from retted to bleached fibre for both pond retted and mechanically extracted Musa balbisiana and Musa acuminata fibre. In case of fibre fineness, highest fineness was observed in bleached fibre for both pond retted and mechanically extracted Musa balbisiana and Musa acuminata fibre. Characterization of both the fibres (untreated and treated) were evaluated through FTIR and SEM. The Infra-red spectra depicted that Musa acuminata fibre was found to be less strong as compared to Musa balbisiana fibre. Scanning electron microscopic view depicted that more extraneous substances were present in retted fibre as compared to bleached fibres. The results obtained from colour measurement, that there was an increasing trend from retted to bleached fibre in whiteness and brightness index but for yellowness index it showed a decreasing trend for both the fibres. Regarding colour strength (k/s) an increasing trend from retted to bleached fibre were observed. Bleached fibres were subjected to softening treatment (Ammonium Oxalate) and the results showed changes in the physical properties of the fibre when subjected to different concentrations(1%, 2%, 3% and 4%) of softening. After softening, improvement was observed in fineness and tensile strength as well as in colour measurement properties of both the fibres. Thus, 4% concentration was found to be optimum conc. for softening of banana fibres. Softened banana fibre showed decreasing in the peaks, clear ridges and clean rupture than untreated fibres which was examined through FTIR and SEM. Considering the evaluated properties of both the banana fibres, mechanically extracted Musa balbisiana fibre was choosen for diversified product development. Different utility products such as shopping bag, purse, wall hanging and coin purse were prepared. Woven fabric (banana fibre as weft and cotton as warp) was used to prepare yoga mat, bottle cover and shopping bag. Subjective evaluation of the prepared products were carried out in regard to fabric appearance, texture, lustre, handle and suitability and found suitable by the respondents. As per the objective of the study intervention programmes were organized among the farm women of different SHG of Tamulbari Panchayat under Titabor subdivision to make them aware

regarding utilization of banana waste and to enhance their knowledge, attitude, ideas for making diversified products out of banana fibre which in turn uplift their livelihood. The training encouraged rural farm women to take up simple and remunerative income generating enterprises from where they can earn additional income which improves its self confidence and socio- economic status having an overall impact on farm families. A training module on "Utilization of banana psuedostem fibre for product development" was developed during the course of study intended to help the rural women regarding downstream processing of banana psuedostem from extraction of fibre to value added end products. They were able to follow the training module, extracted the fibres, prepared products for marketing. They were also able to answer the questions asked after every lesson of the module and they found the module very effective. Thus, the training module was standardized. An exhibition cum sale was arranged to showcase the products prepared by the trainees at training centre, Mohanating, Titabor and the viewers found the products very attractive and useful. The impact of the intervention programme was assessed in terms of pre and post awareness, skill and knowledge through a developed questionnaire and statistically it could be concluded that there was a highly significant difference between the pre and post intervention. From the above study it could be concluded that there was a highly significant difference between the pre and post intervention.

Study on Insulation Properties of Developed Nonwoven Fabrics from Okra and Banana Blends

Lenindy Devi Soraisham

Textile plays an important role in every part of our day today life and alsoconsidered as the second fundamental unit of life. In this field of textile, agricultural wastenatural fibres plays a vital role and are alternative resource to synthetic fibres for its bio-degradable and environmental friendly nature. Okra and banana fibres are also one of thenatural source of fibre which have been considered as an agricultural waste which havestarted using predominantly in various applications of technical textiles. For this presentstudy okra fibre was extracted through water retting from the okra plant (*Albelmoschusesculentus* var. *Pusa Sawani*) stem and banana fibre was by mechanical extraction processfrom the banana pseudo-stem (*Musa acuminata*). The present study is an attempt to explorethe insulation properties of the developed nonwoven fabrics from okra and banana blends.Blending of natural fiber poses a valuable properties and in this present study, okra andbanana fibres were blended with jute fibre and various nonwoven fabrics are developed withdifferent GSM which acquires tremendous scope for preparing various types of insulationitems. Further from the developed controlled (100%) nonwoven fabrics, layered sampleswereprepared for thedifferent GSM.

Forthispresentinvestigation,variousphysical,chemicalandsolubilityproperties of the fibres were evaluated. Morphological properties such as length, diameterand wall thickness were also assessed. The banana fibre was revealed with the highestdiameter (0.1676mm), wall thickness (6.17µm). Maximum fineness was observed in jutefibreanddensitywasfoundinokrafibre.Themechanicalpropertiesliketensileandelongation,flexuralrigidityandfrictionoftheokra,bananaandjutefibreswerealsoanalysed. Under the scanning electron microscopy view, the fibres were observed in tubularshape and EDS were also analyzed and carbon and oxygen were found in all the three fibres.The infra-red (IR) spectra of okra, banana and jute fibres were investigated and observed that the frequency bandsofthefibreswerefoundinthefingerprintregion.AndtheX-Ray Diffraction Analysis (XRD) of the fibres were also revealed that the fibres are crystalline innature. Okra fibre has reported with the highest degradation temperature from that of thebanana and jute fibre.

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The okra,banana andjute fibreswere carriedoutfor blending processinthree different proportions such as OJ 50:50, BJ 50:50 and BJO 25:50:25. The blendingprocess was carried out in carding stage and further nonwoven fabrics were developed withthree different GSM (300,400 and 500), which was kept constant. And further for moreanalysisonthe insulationproperties,the controllednonwovenfabricswere utilizedfordeveloping layered nonwoven fabric for the three GSM. To characterize the morphologicalfeatures of the prepared non-woven fabric, SEM was conducted and observed that the fibresretained their original individual structure and 100% banana nonwovenfabric was foundwith larger void as compared with the other fabrics. Mechanical properties such as densityand the thickness of the nonwoven fabric were also assessed and layered samples (L1,L2 andL3) were found with the maximum density and thickness for all the GSM. The functional properties of the nonwovenf abrics werealsoevaluated.TensilestrengthwasfoundhighestinBJ1,BJ2andBJ3blendednonwovens amplesforboththemachineandthecrossdirection.

Theelongationofthenonwovenfabricexhibitedhighervaluesonthecross direction than that of the machine direction. It was revealed that increasing trend of tearingstrength was found from the lowest GSM (300) to the highest GSM (500) for both themachine and the cross direction. For 300 GSM, highest loss percentage after conductingabrasion test was O1 (9.99%) and for both the 400 and 500 GSM, B2 and B3 was observedwith the maximum loss percentage. Wicking and water absorption test were also analyzed onthe nonwoven fabrics. It was also found that the fabric stiffness was increased with theincrease of the fabric GSM. For all theGSM, the controlled nonwovenfabric,B1,B2 andB3wereobserved with themaximum flammability.

Insulationpropertiesofthenonwovenfabricwerealsoanalyzedandfoundout that the air permeability was found highest in OJ1 (300 GSM), OJ2 (400 GSM) and O3(500 GSM) and all the layered samples (L1, L2 and L3) were observed with the lowestvalues. Thermal insulation was found maximum in all the layered samples L1 (3.75 tog), L2(4.05tog)andL3(4.28tog).ThesoundabsorptionCo-efficientofalltheGSMwereobserved with the maximum value in all the layered nonwoven samples, L1 (0.40), L2 (0.45)and L3 (0.50), respectively. The highest porosity for 300 GSM was shown in BJO1 blendednonwoven sample, for 400 GSM maximum was observed in O2 controlled nonwoven fabricand BJ3 blended nonwoven fabric was revealed with the highest porosity percentage for the500 GSM samples. Further it was also revealed that the two developed products were foundtobesatisfied aspreferred bytherespondentsthrough thevisual inspectionanalysis.

The findings of the study revealed that the okra and banana fibres were foundto be suitable for thermal and acoustic insulation and were also blended successfully withjute fibre. The nonwoven fabric developed from the fibres were found with good functionalproperties which further helps in enhancing the insulation properties of the nonwoven fabricandall the layered nonwovenfound with thebestinsulation properties.

Application of bio-extract from plant sources on cotton fabric for Antimicrobial finishe

Manashree Saikia

The present study entitled "Application of bio-extract from plant sources on cotton fabric for Antimicrobial finishes" focused on investigating the antimicrobial efficacy and UV protection properties of woven and knitted cotton fabric treated with Psidium guajava and Terminalia chebula leaves extracts and synthesized silver nanoparticles (AgNPs) from both the leaves extract as well as chitosan polymer. All the treated and untreated samples were analyzed against bacterial strains such as S. aureus and E. coli, as well as the fungus Candida albicans and Aspergillus niger, further qualitative and quantitative analysis of leaves extract; toxicity, characterization of silver nanoparticles, physical properties of fabrics, UV protection properties and wash durability of antimicrobial and UV resistance properties of fabrics by using standard methods. Biochemical analysis revealed the presence of alkaloids, flavonoids, saponins, phenols, tannins, terpenoids, resin and steroid in the leaves extracts. The total phenolic contents (TPC) were found to be 101.791 mg/ml and 133.795 mg/ml for Psidium guajava and Terminalia chebula respectively, while the total flavonoid contents (TFC) were higher in Psidium guajava (42.2869 mg/ml) compared to Terminalia chebula (36.4787 mg/ml). Psidium guajava leaf extract exhibited excellent antioxidant activity, with 93.44% inhibition at 250 µg/ml, while Terminalia chebula showed maximum inhibition (93.44%) at a concentration of 350 µl/ml. UV-Visible absorption spectra of the synthesized AgNPs showed sharp bands at 380 nm for Psidium guajava AgNPs (P.AgNPs) and at 420 nm for Terminalia chebula AgNPs (T.AgNPs). Dynamic Light Scattering analysis revealed average sizes of 173 nm and 140 nm for P.AgNPs and T.AgNPs, respectively. XRD patterns confirmed the crystalline nature of both AgNPs, and Energy Dispersive X-ray analysis demonstrated 55% and 65% silver content in P. guajava AgNPs and Terminalia chebula AgNPs, respectively. TEM analysis of the P.AgNPs and T.AgNPs revealed that nanoparticles are round and spherical in nature. The AgNPs showed varying levels of toxicity against shrimps, with P. guajava AgNPs being less toxic (50% mortality rate at 100µg/ml) compared to T. chebula AgNPs (56% mortality rate). The leaves extract of P. guajava was moderately toxic (56% mortality

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rate at 100µg/ml), and T. chebula extract showed similar toxicity (50% mortality rate). The antimicrobial activity of the extracts and AgNPs was tested against S. aureus, E. coli, Candida albicans, and Aspergillus niger. T. chebula and T.AgNPs exhibited the highest inhibition zones against S. aureus and E. coli 17 mm and 22 mm, respectively, while P. guajava and P.AgNPs showed the lowest inhibition zones. Against Candida albicans, T. chebula and T.AgNPs showed the highest inhibition zones 15 mm and 24 mm, respectively, while P. guajava and P.AgNPs displayed lower inhibition. Terminalia chebula leaves extract and T.AgNPs exhibited the highest inhibition zones against Aspergillus niger 14 mm and 21 mm, respectively, while Psidium guajava leaves extract and P.AgNPs had lower inhibition. The antimicrobial activity of the treated woven and knitted cotton fabrics was also evaluated. Fabrics treated with P. guajava AgNPs and P.AgNPs with chitosan polymer showed the highest antimicrobial activity against S. aureus, E. coli, C. albican and A. niger. T. chebula AgNPs and T.AgNPs with chitosan polymer also exhibited significant antimicrobial effects while fabrics treated with the leaves extracts and AgNPs showed noticeable antimicrobial activity. FTIR analysis confirmed the presence of various functional groups in the treated fabrics. SEM analysis revealed different surface morphologies, with AgNPcoated fabric displaying dispersed nanoparticles and chitosan polymer-coated fabric showing homogeneous distribution and smaller particle sizes. The wash performance of the finished fabric demonstrated that AgNPs with Chitosan-treated fabrics had the highest durability against S. aureus, E. coli, C. albicans and A. niger even after multiple washes. Psidium guajava and Terminalia chebula leaf extract-treated fabrics showed varying degrees of durability. Fabric properties such as cloth count, cloth weight (GSM), thickness, crease recovery angle, bending length, wicking height, tensile strength, and elongation were also evaluated. The results showed that the treated fabrics exhibited improved antimicrobial properties but had varying effects on fabric properties compared to the control fabric. Therefore, Psidium guajava and Terminalia chebula leaves extract and their silver nanoperticle as well as chitosan polymer coated fabrics can be used in the field of functional clothing such as medical textile, inner garments, sports textiles and also in dying purpose.

Development of nonwoven fabric using lignocellulosic fiber extracted from jute and okra plant

Minakshi Hazarika

Natural fibers, with their rich history and sustainable attributes, continue to be a significant player in various industries. As global awareness shifts towards sustainability, the potential of natural fibers as eco-friendly alternatives to synthetic materials is gaining momentum, paving the way for innovative applications and research avenues. This present investigation was carried out on the "Development of nonwoven fabric using lignocellulosic fiber extracted from jute and okra plant" with the following objectives: To extract the fibers from the jute and okra plants• To evaluate the physicochemical properties of extracted fibers• To prepare the nonwoven fabrics with different blend proportions of the extracted fibers• To assess the properties of developed nonwoven fabrics.• Both jute and okra are abundant in many regions and are often considered waste products after primary usage, making them potential sustainable resources. Initially, the lignocellulosic fibers from jute and okra were extracted using a series of mechanical and chemical processes. The extracted fibers were characterized for their physical, mechanical, and chemical properties. The results indicated that both jute and okra fibers possessed suitable characteristics for nonwoven fabric production, including adequate tensile strength and flexibility. In this investigation, fibers from jute and okra plant was extracted by using retting method i.e. water retting where maximum yield (11.5%) was found in water retted jute fibers. Various physical and chemical properties as well as solubility percentage of okra and jute fibers in different solvents were evaluated. The bleached fiber revealed with maximum solubility in cold water, hotwater and dilutes alkali solutions than retted fibers. Solubility (%) of raw fibers of both okra and jute was more in dilute alkali as compared to cold water and hot water. All the physical properties showed satisfactory results in water retted for both okra and jute fibers. On the other hand, chemical constituents like lignin, hemi-cellulose, alpha-cellulose, ash, fat and wax of water retted fibers were found to be more in raw okra and jute fibers except cellulose and moisture content in raw jute fiber. Later, fibers were

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subjected to different wet processing treatments such as degumming, bleaching and preparation of nonwoven fabrics. Retted fibers were evaluated for their different physical properties such as length, diameter, wall thickness, bundle strength, elongation and density. In all the properties, fiber showed a decreasing trend except density, which was higher in water, retted bleached jute fibers (1.40g/cm3). Color measurements of water retted fiber in regards to whiteness index (13.8), brightness index (21.2) and yellowness index (33.4) showed higher in raw okra fiber than in raw 1 jute fiber. On the other hand,(k/s) color strength was found maximum (5.68) in raw jute fiber and minimum (5.32) was found in raw okra fiber respectively. The Fourier Transform Infrared (FTIR) spectroscopy and Scanning Electron Microscope (SEM) tests were conducted on both okra and jute fibers. The IR spectrum revealed a significant decrease in the peak of bleached okra fibers, possibly due to the removal of noncellulosic material during wet processing treatment. The SEM view of raw okra fiber showed rodlike structures with a serrated outer wall and visible gummy substance on the surface. In degumming okra fiber, a more uniform, cylindrical structure with a thinner cell wall was observed. The bleached fibers also displayed a smoother surface than the raw and degummed fibers. In raw jute fiber, more extraneous substances were present compared to bleached jute fiber, which had a more refined, smooth, clean, and consistent texture due to the removal of impurities. The XRD analysis of jute fibers showed more crystalline structure than okra fibers due to the presence of cellulose. After wet processing stage, the fibers were blended in different ratios (75:25, 50:50 and 25:75%) to prepared needle punched nonwoven fabrics and evaluated for physical and mechanical properties. Considering the evaluated properties of both the fibers it was found that okra-jute blended nonwoven fabrics of different proportions were found to be better in strength as compared to controlled nonwoven fabrics. Additionally, the fabrics displayed efficient moisture absorption capabilities, thermal stability and showcased a potential for enhanced breathability compared to synthetic counterparts and could be utilized successfully in making household, furnishing items, filtration, agricultural cover and apparel to some extent. Therefore, from the above study it could be accomplished that the potential of lignocellulosic fibers extracted from jute and okra plants in the development of nonwoven fabrics elucidates a pathway towards a greener, more sustainable future in the realm of nonwoven materials.

Study on softening of banana (*Musa balbisiana*) pseudo stem fibre and evaluation of its physico-chemical properties for textile application

Pankaj Bharali

Promoting eco-friendly fashion and textile options is crucial for preserving resources and the environment. This involves addressing the carbon footprints from textile production. Even though there is abundance of agricultural waste and residues, they are often underutilized, despite being sustainable and environmentally friendly. Utilizing these materials can contribute to a more sustainable and responsible fashion industry. India, with its diverse soil and climate, has the potential to produce various natural fibres to meet the demand for textile and industrial products. Banana, a widely cultivated fruit crop, generates a significant amount of waste in the form of pseudostem, leaves, fruit peel, and inflorescence. Banana pseudo-stem, the stem of the banana plant, is usually discarded after harvest, resulting in environmental contamination. However, utilizing this waste for fibre extraction can benefit the environment and increase its economic value. Softening treatments can enhance its properties and make it suitable for apparel and home furnishings. Thus, keeping in view present study is an attempt to explore the softening effect of Banana (Musa balbisinia) psuedo-stem fibre with commercial grade and bio softener and evaluating its physical properties for textile application. For this present investigation, extraction of banana (Musa balbisiana) pseudostem was carried out by both water retting and mechanically extraction method and physical properties, colour measurement properties and surface characterization of both fibres were evaluated. Various efforts have been made for softening of water retted and mechanically extracted banana pseudo-stem fibre by commercial grade cationic softener (SaZeaux C-PS, SaZeaux CAT SOFT C-SPL) and bio softener (Castor oil) and evaluation of its physical properties and preparation of value-added product. The softening treatment were optimized considering three different concentrations (3%,5% and 7%) based on various physical properties and colour measurement properties of the water retted and mechanically extracted banana pseudo-stem fibres and found that 7% concentration of SaZeaux CAT SOFT C-SPL more satisfactory in respect to physical

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properties and colour measurement properties as compared to the other two softener. The surface characterization of fibre such as SEM and F-TIR test were also assessed for 7% concentration of SaZeaux CAT SOFT C-SPL. Later fabric was prepared by twisting the softened banana fibre and used as weft while weaving the fabric in a loom using cotton yarn as warp thread. Accordingly different products were prepared from the fabric. The opinions and preferences of the respondents were also drawn regarding the general appearance texture and suitability of the fabric and found out to be suitable for preparing its end uses. The findings of the study revealed that softened fibre can be utilized for making different value-added products with distinct characteristics. The mechanically extracted banana pseudo-stem fibre softened treated with C-SPL cationic softener is found to be good in all aspects as it enhances the fibre properties such as tensile, elongation fineness and colour measurement properties. And further the present study concludes that agricultural waste cannot be considered as a waste but appeals a new dimension in the world of textile.

Ph.D (Fishery Science)

- **Aquaculture**
- **Aquatic Environment Management**
- **Fish Processing Technology**
- **Fisheries Resource Management**

Current Status and Management Practices of Carp Culture System in Assam

Manas Pratim Dutta

The present study was conducted in the state of Assam, laying between 24^{o} to 28^{o}18' north latitude and 89^{o} 50' to 97^{o}4' east longitudes.For the present study, three agro-climatic zones are purposefully selected viz. North Bank Plain Zone, Central Brahmaputra Valley Zone and Lower Brahmaputra Valley zone.A purposive random sampling procedure was employed in the present study to select the districts, blocks and the respondents.To fulfill the objectives of the study was carried out in two different phases and were carried out simultaneously.The first phase consisted of finding out the socio-economic condition of 100 fish farmers each from Sonitpur, Nagaon and Nalbari Districts of Assam.The second phases consisted of a study of management practices of carp farming adopted by fish farmers and constraints of production and marketing of fish in adoption of composite fish culture as perceived by the fish farmers in the three districts.A total of 300 numbers of fish farmers were selected and 100 farmers from each districts. A preliminary survey was done data from 60 fish farmers were collected from each district who were selected through judgment sampling. After that the final questionnaire was prepared for the present study. In each of the selected districts, two blocks were selected in consultation with fishery officials where more numbers of fish farmers adopting composite carp culture. A total of 50 numbers of fish farmers from each blocks were selected using random sampling technique. It was observed that 32% and 22% respondents belong to age group 41-50 years and above 50 years respectively. The highest no. of respondents belong to general category. Joint family was more prominent accounting for 81% of the total respondents. 53% of the respondents were found to be having land holding of 2 – 4 ha whereas 46% and 38% were LIG and MIG respectively. Majority of the respondents have fish culture and agriculture (61%) as major occupation, live in semi-pucca house (53%), 1-2 no. of ponds (44%), fish ponds of size between 6.6-8.0 bigha (52%), composite fish culture (69%), single stocking multiple harvesting (51%), annual fish production of 200-400 kg/bigha/year (40%), experience in fisheries (65%) and beneficiary of govt. schemes (68%). The findings also shows fish farmers have adopted scientific management practices, there is a lack of adherence to proper schedules for various aspects of fish farming. It was observed that

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socio-economic parameters have significant effect on the annual fish production. Majority of the respondents involved in composite fish farming follow single stocking and multiple harvesting where 26 respondents were found to get production between 200-400 kg/bigha/year as compared to 50 respondents involved in multiple stocking and multiple which comprises of only 13 % of the total respondents. Experience in fish farming and fund support are found to be of significance to annual fish production. The present study identifies 20 constraints that hinder the adoption of scientific fish farming and the majority of fish farmers strongly agreed (67 %) that the low selling price at the farm gate andoutbreaks of diseases are significant constraints in the adoption of scientific fish culture. Furthermore, a considerable percentage (58 %)of respondents expressed concern over the high cost of feed, while a similar proportion (57%) identified the occurrence of floods as a major constraint.

Effect of Dietary Lipid Sources on Reproductive Performance of *Cirrhinus reba* and Interventions of Biofloc Meal-Based Diet on Its Larval Growth and Survival

Kaustubh Bhagawati

The present study was carried out to investigate the effect of dietary lipid sources on reproductive performance of *Cirrhinus reba* and interventions of biofloc meal-based diet on its larval growth and survival. Under the first experiment, an eight months study was conducted at the cemented tanks (5 m×3 m×2 m) of College of Fisheries, AAU, Raha where adults of *C. reba* of size 11.00-12.00 cm (total length) and weighing 66.00-67.86 g were selected and distributed among five treatment groups in triplicate. Five iso-nitrogenous and iso-lipidic diets were prepared with different proportions of fish oil and soybean oil inclusion at levels 0% FO (T_0), 33.3% FO (T_1), 50% FO (T_2), 66.7% FO (T_3) and 100% FO (T4). The results of the study revealed that the breeding response and fertilization percentage of the brooders of *C. reba* increased with dietary inclusion of fish oil in the experimental diets up to the level of 66.7% FO in treatment T_3 and decreased thereafter. The other parameters of reproductive performance such as relative fecundity, relative spawn recovery and hatchability percentage considerably showed higher response in the fish oil supplemented diets in treatment T_3 (66.7% FO). Under the second experiment, fry of *C. reba* weighing 2.05-2.45 g were reared for a period of 90 days in the 100 L capacity aquarium tanks where incorporation of different levels of biofloc meal-based diet was assessed on growth, survival and biochemical responses of the experimental fish. Five iso-nitrogenous diets were prepared with different proportions of fish oil and soyabean oil inclusion at levels T_0= 0% Biofloc Meal (BFM), T_1= 15% BFM, T_2= 20% BFM, T_3= 25% BFM, T_4= 30% BFM. Growth performances were evaluated on the basis of average body weight, weight gain percentage, feed conversion ratio, protein efficiency ratio, specific growth rate and survival percentage. The biochemical responses were observed by the activity of different enzymes viz. amylase, lipase and protease at the end of the experiment. Serum biochemical profile and whole-body biochemical composition of *C. reba* fry were

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Major Adviser: Dr. Dipak Kumar Sarma

analyzed at the end of feeding trial. The study indicated that 25% inclusion of biofloc meal in the experimental diets showed optimum growth and biochemical responses in *C. reba* fry during the 90 days feeding trial. The results of the present study suggested that dietary lipids with higher incorporation of fish oil in diets enhance reproductive performance in *C. reba* and utilization of biofloc meal as a potential feed ingredient for its larval growth and survival. Development of brood stock diets and formulated feed for juveniles of *C. reba* will be helpful for promotion of its mass seed production and culture technology as a prioritized species in carp culture system.

The Potentiality of Boro Rice-Based Aquaculture Production System of Nagaon District of Assam

Dhiren Ch. Nath

The present study was planned to evaluate the potentiality of boro rice-based aquaculture production system of Nagaon district, Assam. The farmers practicing boro rice-fish based farming system in the villages of Juria, Dagaon and Singari under Juria Development Block, Nagaon District, Assam, therefore selected for the present study. Data collection for a period of 2 months and field research for a period of 12 months was conducted from October, 2021 to November, 2022. A combination of participatory, qualitative and quantitative methods was used for primary data collection. A total of 60 farmers (30 boro rice-fish and 30 only boro rice farmers) were selected for in-depth data collection. The interviews, lasting about an hour, focused on rice-fish farming systems, cultural practices, productivity, production constraints, and socioeconomic benefits including food security.

Another 12 nos. of farmers were selected based on the average plot size (0.14 ha) recorded during the survey as reference culture system and farming practice was carried out following the average inputs found on the surveyfor a period of 12 months during December, 2021 – November, 2022. The paddy plot preparation was done during the month of December and harvested paddy during April-May and the plot was ploughed to facilitate rotting of paddy straw along with cow dung, mustard oilcake and single super phosphate that produces swarm of zooplankton in rising water as fish food. Preparatory works for fish culture were started during February- March, synchronously with boro rice cultivation. Advanced fry with a combination of rohu (*Labeo rohita)*, mrigal (*Cirrhinus mrigala)*, common carp(*Cyprinus carpio)* 50%, gonius (*Labeo gonius)*, bata (*Labeo bata)*, puntius (*Puntius javanicus)* 25% and catla (*Labeo catla)*, grass carp (*Ctenopharyngodon Idella)* and bighead (*Hypophthalmichthys nobilis)* 25% per 0.14 ha were stocked at four different stocking densities with three replicates for each, *viz;* Treatment I as reference culture with 106 kg (8,918 nos.) as control, Treatment II with 80 kg (4,770 nos.), Treatment III with 117 kg (12,695 nos.) and Treatment IV with 141 kg (16,611 nos.). Harvesting commenced after 60 days of rearing

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when rohu, mrigal and common carp attained an average weight of 105.25 g and puntius, bata and gonius attained an average weight of 75.30 g. Harvesting of catla, grass carp and bighead started after 150 days of rearing when they attained an average weight of 937.22 g. Fish maintained increasing growth trends during the culture period in all the treatments. At the end of 210 days trial, the weight gain (WG) was found to be highest in treatment II which was significant ($P<0.05$) from other groups and lowest in treatment IV group. The weight gain was significantly affected by the stocking densities. Similarly, specific growth rate (SGR) of treatment II group was significantly ($P<0.05$) higher than the other groups and treatment IV group had the lowest values. The highest gross and net yield recorded at treatment IV group followed by treatment III, treatment I and treatment II and were found to have significant ($P<0.05$) effect on the stocking density.

The values of the water quality parameters such as temperature, transparency, pH, nitrate-nitrogen and total alkalinity were not found to be significantly ($P>0.05$) differing in different stocking densities except in the case of dissolved oxygen, carbon-di-oxide, total ammonia nitrogen, nitrite-nitrogen and phosphatewhich was found to fluctuate significantly ($P<0.05$) in different stocking densities.

Descriptive statistics of socio-demographic characteristics including average age, average farming experience, house hold size and percentage of own land of boro rice farmers was higher than that of integrated boro rice-fish farmers ($p>0.05$). Education level, number of hired labourers employed and average annual household income were significantly higher ($p<0.05$) in integrated boro rice-fish than in boro rice farmers. In boro rice farming and integrated boro rice-fish farming, respectively, approximately 80% and 70% of farmers had an alternative occupation, with crop farming being the dominant secondary profession. There was no significant difference ($p>0.05$) between the farmers in terms of farm size and number of school-going children.

The Cobb-Douglas production function analysis was done to worked out the input output relationship of the integrated boro rice-fish farming system. Among the six variables studied, the “t” value of fertilizer and fish feed were significant (at 1%) and lime were significant (at 5%) indicating the decisive influence of these variables on production.The coefficient of multiple determinations (R^2) for integrated boro rice-fish farming systems was 0.73, which indicates that 73% of the total variation in production of rice-fish farms can be explained by the six independent variables included in the model.

Assessing Impact of Aquaculture Management and Production System of Assam Agribusiness and Rural Transformation Project (Apart)-Fishery in Assam

Parag Saikia

An impact study entitled"Assessing impact of aquaculture management and production system of Assam Agribusiness and Rural Transformation Project (APART)-Fishery in Assam"conducted. The study was conducted in 5 agro-climatic zones of Assam covering five districts in each zone with a total 270 numbers of fish farmers. Out of eighteen numbers of APART districts in Assam, viz Jorhat, Nagaon, Sonitpur, Kamrup & Cachar selected for study based on agro- climatic zone of Assam. The study examined the determinants of adoption of recommended technologies under APART-fishery among beneficiaries and non-beneficiaries respondents of the state. Data for the study were obtained from 180 beneficiary respondents and 90 non-beneficiary respondents selected through multi-stage purposive cum random sampling design. Data pertaining to the study were collected through personal interview method during the period October, 2021 to January, 2022.The present study included two dependent variable, namely extent of adoption of recommended technology of APART – fishery and attitude of farmers towards recommended technology of APART – fishery, 16 independent variable namely age, educational level, size of operational land holdings, average annual family income, primary source and secondary source of income, labour availability within household, land situation, risk orientation, distance to market, management orientation, socio-economic profile, extension contacts, social participation, communication channel used for collecting information (mass media participation), extension participation, source of credit and two descriptive variable namely appropriateness of recommended technologies of APART-fishery and problems faced by farmers to adopt recommended technologies of APART-fishery. The result of the research clearly indicated that majority of the respondent beneficiaries and non-beneficiaries were middle age (66.11%) and (60 %) respectively. In the case of education level of the majority beneficiaries and non-beneficiaries were higher secondary (28.9 %) and HSLC (26.66 %) passed respectively. Around 40 % of respondent beneficiaries and non-beneficiaries were small category (1-2 ha) land

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Major Adviser: Dr. Dipak Kr. Sarma

holdings, average mean score for annual family income of respondent beneficiaries and non-beneficiaries were Rs. 5,57,200.00 and Rs. 3,80,755.60 respectively and 54.45% and 47.78% of the respondent's beneficiaries and non-beneficiaries were full time fish producer. Only, 8.33% and 6.67% of beneficiaries and non-beneficiaries had high family labour (above 7 person). Majority of the beneficiaries possessed medium level of risk orientation (61.67%), planning orientation (64.45%), production orientation (47.78%), marketing orientation (66.11%), extension contact (58.88%), social participation (75.56%), communication channel & mass media participation (66.67%) and Extension participation (67.2%). On the other hand, non-beneficiaries respondents possessed medium level of risk orientation (75.55%), planning orientation (74.44%), production orientation (74.45%), marketing orientation (63.34%), extension contact (52.22%), social participation (51.11%), communication channel & mass media participation (64.44%) and Extension participation (77.77%). Majority of the respondents (68.33%) under APART fishery beneficiary had a market distance of 3.64 – 6.52 kilometer from their locality. The source of credit acquisition revealed that majority of the both APART fishery beneficiary and non-beneficiary farmers had no credit facility. The findings related to the appropriateness of recommended technologies of APART-fishery revealed that most of the recommended technologies under the APART fishery programme were found to be appropriate in the study area. The recommended technologies were acceptable, affordable, accessible and attractive as opined by the respondents. The adoption of APART Fishery recommended technologies amongst the beneficiaries farmers, technologies related to site selection, fish health management, fish seed and stocking practices and fish feed management had very good adoption level among the farmers whereas harvesting and post-harvesting management technologies were somewhat less adopted. In the case of non-beneficiaries farmers of APART fishery the pattern of adoption implies that farmers voluntarily adopt the practices that were crucial for the success of crops but less adopted that technologies related to the pond preparation, fish seed and stocking practices, water quality and pond management and harvest and post-harvesting technologies. It could be concluded that the overall impact of the APART-fishery project was positive. "Seeing is believing" technique of extension method fruitful was in the study area among the non-beneficiaries of APART-fishery which reduced the extent of adoption gap of recommended technologies from around 68% to 39.39% and 26.73% in the case of non-beneficiaries and beneficiaries respectively.It could be concluded that all the farmers had most favorable to moderately favorable attitude towards recommended technologies of APART-fishery.To identify the constraints to adoption of APART fishery recommended technologies factor analysis was carried out to reduce the number of variables and found that among 32 variables few were more related to each other. The factor analysis revealed that 8 factors extracted together account for 67.12 percent of the total variance. The Eigen values greater than 1 (Kaiser's criteria) were considered for retaining the 8 variables. On the basis of factor loading greater than 0.5, 8 factors have emerged. It was combination of eight original variables, which had factor loading greater than 0.5 (derived from rotated component

matrix) – lack of fish feed at cheaper rate (0.857), lack of cold storage facilities (0.891), cost of medicine (0.800), Lack of institutional credit (0.869), selling price of fish at farm site is low (0.850), acidic soil (0.812), water retention capacity of soil is low (0.845), occurrence of flood (1.020).

Toxicity Quantification of Synthetic Pyrethroid Pesticide 'Fenpropathrin' in Adult and Embryo Stages Ofzebrafish (*Danio rerio*)

Raktim Sarmah

Pyrethroids, a class of pesticides have been increasingly used in agriculture and household pest control because of their outstanding potency and environmental stability. Fenpropathrin,a Pyrethroidhas long-lasting effects on aquatic environments and can be extremely toxic to non-targeted aquatic animals, like fish. Prior studies have focused on the lethal and sub lethal toxicity of analytical grade pesticides, but not enough attention has been paidincomparing the toxicity of the active ingredientswith its commercial formulation. In addition, there is also a gap pertaining to toxicity of Fenpropathrin in Estimated Environmental Concentrations. The present study evaluatedlethal and sublethal toxicityin zebrafish, as well as the biomarker responses induced by Fenpropathrin and its commercial formulations, Meothrin and Danitol. Moreover, it also assessedthe toxic response of Surface water Estimated Environmental Concentrationof Fenpropathrinto developing Zebrafish embryo.Our findings revealedthat LC50values of Fenpropathrin, Meothrin and Danitol were0.002520 (0.001765-0.003596), 0.003871(0.002521-0.005750) & 0.004659(0.00327-0.00670) mg/L,respectively for adult zebrafish. Based on these values, following standard ranking for hazards of fish, Fenpropathrin, Meothrin and Danitol were found to beSuper toxic in nature. LC50 values of 0.156, 0.953, and 1.168 mg/L, and EC50values of 0.016, 0.152, and 0.369 mg/L for Fenpropathrin, Meothrin, and Danitol, respectively were calculated forzebrafish embryotoxicity test. More than 1 Teratogenic Index of Fenpropathrin (9.75), Meothrin (6.26) and Danitol (3.16) indicated their higherteratogenicityto non-targeted organisms. Lower toxicity ofcommercial formulations may be due to Control Release Systems. The current investigation revealed thatmalformations, teratogenic potential, behavioural abnormality, cardiotoxicity, and neurotoxicity are more pronounced in developing Zebrafish embryosexposed toFenpropathrin than its two formulations. Integrated Biomarker Response Index for Acute Estimated Environmental Concentration of Fenpropathrin exposure was greater than the Chronic Estimated

Abstract of Ph.D thesis

Department: Aquatic Environment Management

Major Adviser:Dr. Rajdeep Dutta

Environmental Concentration.The damages areintensivein organisms' morphology. Fenpropathrin pose a serious threat to aquatic biota and hence for continued use of these pesticides in agricultural sector, advanced commercial formulation technologies ensuring reduced toxicity should be explored. Stringent application policy of such pesticides for a healthy and sustainable environment is utmost need of the hour.

Ecosystem Integrity and Fish Diversity of River Kopili, Assam, India

Dipanka Nath

The current study was conducted to assess the ecosystem integrity and ichthyofaunal diversity of River Kopili, which is a major south-bank tributary of River Brahmaputra. It originates in the Saipong Reserve Forest and passes through the borders of Meghalaya, North Cachar hills and Karbi Anglong and enters the plains in the Nagaon district of Assam before its confluence with the Brahmaputra. During the present study, the river was studied for two consecutive years i.e. from September 2020 to August 2022 covering a total river distance of 212 km for a better understanding of its ecosystem integrity and fish diversity. Water parameters like Surface Water Temperature, Turbidity, pH, Dissolved Oxygen, Electrical Conductivity, TDS, COD, BOD3, fecal coliform, Nitrate, Nitrite, Total Ammonia, Soluble Inorganic Phosphate; sediment parameters namely pH, Organic Carbon, Organic Matter, N, P & K were determined by using different standard methods. Biological parameters both plankton and fish diversity was also recorded using standard keys. The range of some important parameters were Surface Water temperature (18.67-31.50 ºC), Turbidity (0.46-121.41 NTU), Dissolved oxygen (4.17-10.22 mgL-1), pH (6.32-7.81), Total Dissolved Solids (46.38-150.50 mgL-1), Total Alkalinity (12.67-76.00 mgL-1), Total Hardness (40.31-72.20 mgL-1), BOD3 (0.47-19.61 mgL-1), COD (0.78-32.82 mgL-1) Nitrate (0.048-0.637 mgL-1), Phosphate (1.2-3.64 mgL-1), Sediment pH (6.02-7.55), Sediment Organic Carbon (0.29-2.67%), Sediment Organic Matter (0.64-4.60 %.), Available Sediment Nitrogen (364-425 kgha-1), Available Sediment Phosphorus (4.90-9.28 kgha-1) and Available Sediment Potassium (71.25-337.78 kgha-1). The MPN index in the River Kopili ranged from 5 to 1468+ per 100 ml. The highest value found during the Monsoon, and the lowest during the Winter. A total of 46 different genera of plankton were recorded from the river. Among these, 17 genera belong to Chlorophyceae (36.96%), 10 was Bacillariophyceae (21.74%), 7 genera of Cyanophyceae (15.22%), Euglenophyceae 1 genera (2.17%), Rotifera 5 genera (10.87%), 3 genera of Cladocera and Copepoda (6.52%) respectively. Biodiversity study of the river revealed a rich fish

Abstract of Ph.D. thesis

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faunal diversity of 108 fish species belonging to 12 orders, 31 families and 63 genera. Among them, Cypriniformes (52%) is the dominant order followed by Siluriformes (27%). Among the collected fish species only one species was exotic i.e. *Cyprinous carpio* var *communis*, while one fish species (*Pethia stoliczkana*) was reported for the first time from Brahmaputra drainage during the present study. The IBI score based on the fish abundance data in Kopili river ranged from 18 to 45 in case of traditional scores and 29 to 85 in case of continuous score. As station 12 was taken as reference site, it scored maximum score, i.e., 45 and 85. The present study revealed that out of the 12 stations studied, three are impaired, six are moderately impaired and three in acceptable class. According to the IUCN (2021) out of the total 108 species, three species are assessed as endangered (2.78%), 10 are near threatened (9.26%), three are vulnerable (2.78%) and other 90 species are least concerned (83.33%). One additional species is not evaluated and one species is data deficit. Among the collected fish species, 55% were identified using molecular tools, and the corresponding genetic sequences were submitted to the National Center for Biotechnology Information (NCBI). This submission resulted in the acquisition of 59 unique NCBI accession numbers. To assess the suitability of river water, an *in*-vivo embryo toxicity test was carried out. Based on the analysis, no developmental deformities were observed among the fish embryos across different water samples, which indicates a favourable aquatic environment for fish reproduction and highlights the overall quality of the river water in relation to fish habitat. Different anthropogenic activities namely (i) dam construction, (ii)sand mining, (iii) construction of bridge piers, (iv) high turbidity and (v) coal mining activities were also recorded during the present investigation. The outcomes of the current investigation strongly suggest that the ecological integrity of River Kopili is maintained, providing a conducive environment for the thriving existence of fish and diverse aquatic organisms.

Assessment of Ichthyofaunal Diversity and Identification of Suitable Fish Habitats of River Diyung, Dima Hasao District, Assam

Abdul Malik Ahmed

The present study was conducted to assess theichthyofaunal diversity and toidentify suitable fish habitats ofRiver Diyung, the largest river of Dima Hasaodistrict, Assam, for a period of two years from January 2019 to December 2020.During the study period, fish, plankton and water samples were collected at monthly intervals and river sediment sample were collected seasonally from 8 selected sampling stations.A total of 82 fish species belonging to 53 genera under 24 families and 10 orders were recorded from the river during the study period. The order was mainly dominated by Cypriniformes (51.21%) followed by Siluriformes (21.95%) and Anabantiformes (10.97%). The fisheries of River Diyung are mainly dominated by the genus, *Garra*, *Opsarius, Psilorhynchus, Channa*, *Labeo* and *Mystus*.No exotic fish species were recordedfrom the river during thestudy period.About 70% of the recorded fish species of the river have ornamental values with international importance.Margalef's richness index (d), species diversity index (H'), Simpson diversity index (1-D) of the river found to vary between (3.04-7.15), (2.78-3.74) and (0.93–0.97), respectively.During the present study,mitogenome sequences were generated for 50% (41 sequence) recorded fish species of the river which was submitted to NCBI & accession number obtained. Deep pools recorded the maximum species richness followed by small pool, riffles, raceways and runs, respectively. The range of some water qualityparameter were characterized by water velocity (0.46-1.62 $msec^{-1}$), water turbidity (3.92-110.03 NTU), water pH (6.82-7.67), dissolved oxygen (5.69-8.25 mgl^{-1}), total alkalinity (43.13-72.80 mgl^{-1}), total hardness (57.32-88.66 mgl^{-1}), total dissolved solids (62.69-116.33 mgl^{-1}), electrical conductivity (99.82-173.64 μScm^{-1}). The BOD_3(0.90 to 17.54 mgl^{-1}) and COD (COD 1.46-25.36 mgl^{-1}) value revealed unpolluted states of the studied stretch of the river.Sediment quality of Diyung river was characterized by slightly acidic to alkaline pH (5.85-7.26), Organic Carbon (0.58-1.90%), Sediment Organic Matter (0.79-3.72%). Among the plankton population phytoplankton was dominated by class Chlorophyceae with 12 genera (34%), Bacillariophyceae with 7 genera (20%), Cyanophyceae with 6

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genera (17%) and Euglenophyceae with 1 genera (3%) and Zooplankton population was dominated by class Rotifera with 4 genera (11%), Cladocera with 2 (9%) genera and Copepoda with 3 genera (6%).Conservation status of fish germplasm of River Diyung as per IUCN (2021) was: - Endangered (1.23%), Vulnerable (2.43%), Data deficient (2.43%), Not evaluated (6.09%), Near threatened (10.97 %) and Least concern (76.82 %).

Master of Science (Agriculture)

- **Agricultural Biochemistry**
- **Agriculture Biotechnology**
- **Agricultural Economics and Farm Management**
- **Agronomy**
- **Agrometereology**
- **Crop Physiology**
- **Entomology**
- **Extension Education**
- **Horticulture**
- **Nematology**
- **Plant Breeding and Genetics**
- **Plant Pathology**
- **Sericulture**
- **Soil Science**
- **Tea Husbandry and Technology**

Nutritional and anti-nutritional composition of few finger millet [*Eleusine coracana* (L.) Gaertn] genotypes

Bharath. S

Finger millet (Eleusine coracana) is a tetraploid (2n=36) crop that belongs to the family 'Poaceae' of monocotyledon group. This crop is widely cultivated and consumed as a staple food in several Asian & African countries. 'Ragi' and 'Madua' are the other common names used for finger millet in India. The nutritive profile of ragi is great and it is comparable with cereals. It has a considerable amount of carbohydrates, protein, fat, fibre and minerals. Besides, it is the richest plant source of calcium. The objectives of the research programme were to analyze the nutritional and anti-nutritional composition of a few finger millet genotypes and to evaluate the effect of malting on the nutritional and anti-nutritional parameters. Eight different genotypes were collected from two different locations viz. ICR farm, AAU, Jorhat, and AAU - Zonal Research Station, Gossaigaon, Assam. Thirteen parameters viz. moisture, crude protein, crude fat, crude fibre, total ash, total carbohydrates, starch, reducing sugars, total phenols, phytic acid and minerals such as calcium, iron and zinc were studied during this study. The results of this investigation revealed that the raw seeds of finger millet genotypes had a moisture content in the range of 9.37-10.57%. There was no significant variation has been observed in the moisture content among the genotypes. On the other hand, the crude protein content varied from 8.36 to 9.88% while the crude fat content found in the range of 1.14-1.71%. The results also showed that these genotypes had 2.98-3.58% crude fibre, 2.09-2.49% total ash, 73.37-75.60% total carbohydrates, 63.10-65.01% starch and 0.37-0.49% reducing sugar content. The results further revealed a content of 295.5-380.7mg/100g calcium, 9.62-15.51mg/100g iron and 1.86-2.52mg/100g zinc in the raw seeds of finger millet genotypes. The total phenol content in the raw seeds of the finger millet genotypes ranged from 1.01 to 1.60g/100g as GAE. The anti-nutrient phytic acid content varied from 0.42 to 0.61g/100g. After malting, the genotypes had 11.90-12.64% moisture, 8.63-10.10% crude protein and 0.80-1.38% crude fat. Moreover, the malted seeds had a content of 2.78-3.25% crude fibre, 1.86-2.23% total

Abstract of M.Sc. thesis

Department: Agricultural Biochemistry

Major Adviser: Dr. Ranjan Kandali

ash, 71.31-73.03% total carbohydrates, 46.69-51.83% starch, and 3.21-5.22% reducing sugar content. The results also showed a content of 241.4-310.9mg/100g calcium, 5.98-9.61mg/100g iron and 1.42-1.84mg/100g zinc in the malted seeds after 96 h of malting. The total phenols in the malted seeds ranged from 0.29 to 0.46g/100g (GAE) while the anti-nutrient phytic acid content varied between 0.18 and 0.27g/100g in the malted seeds. Malting caused an increasing effect in moisture, crude protein and reducing sugars content while it caused a decreasing effect in crude fat, crude fibre, total ash, total carbohydrates, starch, calcium, iron, zinc and total phenol content. Further, it caused a decreasing effect in phytate content too. The genotype FMAVT-4001 had high levels of moisture, protein, fat, and fibre content. The genotype FMAVT-4012 had the highest crude protein and crude fibre content of 9.11% and 3.58% respectively. The genotypes Gossaigaon local and AAU-GSG-Maruadhan-1 had higher mineral contents viz. calcium, iron and zinc than the others.

Processing of rice bran for human consumption

Darshana Baruah

The present investigation on "Processing of rice bran for human consumption" revealed that the processed rice bran products had the following range of nutritional and anti-nutritional factors: moisture content (0.31-2.80 %, f.b.), crude fat (16.51-17.59%), crude protein (14.54-14.56%), total ash (10.08-10.15%), water soluble ash (34.34-34.70% of total ash), acid insoluble ash (3.45-3.59% of total ash), crude fibre (8.8-9.54%), total carbohydrates (48.91-49.30%), acid value (5.90-21.08 mg KOH/g crude fat), total phenols (183.25 -185.63 mg GAE/ 100g) and phytic acid (1.95-2.40 %) on dry weight basis. Drying at 80°C showed better reduction of moisture and acid value whereas exogenous phytase treatment was more effective in reducing the phytic acid treatment. However, the analysis of raw rice bran (control) revealed 9.33%, f.b. moisture content, 16.46% crude fat, 14.54% crude protein, 10.16% total ash, 34.75% water soluble ash of total ash, 3.52% acid insoluble ash of total ash, 9.65% crude fibre, 49.19% total carbohydrates, 39.87 mg KOH/g crude fat as acid value, 185.86 mg GAE/100g total phenols and 3.46% phytic acid on dry weight basis. Microbial analysis of the product exhibited absence of both bacterial and fungal growth. Organoleptic evaluation showed average overall acceptability of the products to be in the order "kheer" (8.03), "khichdi' (7.80) and soup (7.53). The present investigation revealed that processing may reduce the content of acid value by 85% and phytic acid by 43.6%. Considering decreased value for the content of free fatty acid and phytic acid, together with total absence of microbes and the better score for organoleptic evaluation, the rice bran processed product developed through treatment of 0.2% citric acid solution at ambient temperature for 18 hrs followed by drying at 80°C was found to be suitable for human consumption.

Abstract of M.Sc. thesis

Department: Agricultural Biochemistry

Major Adviser: Dr. Priyanka Das

Effect of cooking on nutritional profile of white grub beetle, Lepidiota mansueta Burmeister

Sudarshan Prasad

The study was undertaken to estimate the nutrient content of white grub species Lepidiota mansueta Burmeister in different cooking methods. L. mansueta is a delicacy in the tribal regions of Majuli river island and are prepared by different cooking methods. Cooking, one of the last processes before eating determines the nutritional value of food, although they have some negative impact on nutritional profile but it also increases the taste, flavour and self-life of the food. In the present investigation, four different cooking methods viz., boiling, roasting, sautéing and deep frying were followed for edible insect, L. mansueta. The cooked samples were than evaluated for proximate content using standard procedure. The results showed that the moisture content was found to be 4.25, 62.64, 2.90, 3.19 and 1.22 in control, boiling, roasting, sautéing and deep frying, respectively. Crude fat content was found to be 10.68, 9.13, 9.78, 21.92 and 34.84 in control, boiling, roasting, sautéing and deep frying, respectively. Crude protein content was found to be in 72.91, 68.24, 67.30, 58.03 and 38.32 in control, boiling, roasting, sautéing and deep frying, respectively. Carbohydrate content was found to be 10.35, 18.25, 20.72, 15.72 and 24.39 in control, boiling, roasting, sautéing and deep frying, respectively. Ash content was found to be 6.05, 4.36, 5.19, 4.31 and 2.43 in control, boiling, roasting, sautéing and deep frying, respectively. Energy content was found to be 429.23, 428.21, 440.15, 492.33 and 564.47 in control, boiling, roasting, sautéing and deep frying, respectively. Considering this insect as an important source of protein, there was no significance difference in crude protein content among the cooking processes. However, other parameter shows significant difference among the cooking process. The present study showed that boiling and sauteing would be the most advised approach for cooking this insect because there is lower protein losses compared to the other cooking process. It was also observed that this insect has a well-balanced nutritional profile and can be a possible source for human nutrition.

Abstract of M.Sc. thesis

Department: Agricultural Biochemistry

Major Adviser: Dr. Kritideepan Sarmah

Expression analysis of pathogenesisrelated (PR) genes in *Brassica rapa* upon *Alternaria brassicicola* infection

Aryasree R

Alternaria blight caused by Alternaria brassicicola is the most widespread fungal disease of oilseed Brassicas. Conventional breeding to develop Alternaria resistant cultivars has not been successful due to non-availability of suitable resistance sources. For the development of resistant cultivars, identification of important defense or resistance-related genes is needed. Plants activate different biological pathways upon infection by pathogens and a large number of defense-related genes are modulated during such interactions locally as well as systemically. In a previous study, RNAseq of a wild relative of Brassica, Sinapis alba, was carried out in which several defense related genes were found to be highly upregulated during Alternaria infection. Based on the results of this study, the present research was undertaken to investigate and validate the gene expression patterns of selected gene candidates in the susceptible cultivar B. rapa var. Toria (TS-38) in order to check the function of these genes in conferring resistance. To initiate the study, infected tissues of a highly susceptible Toria variety TS-38, showing characteristic symptoms of Alternaria blight were collected for isolation and purification of the pathogen. On the basis of conidial morphology as observed through microscopic studies, the pathogen was identified to be Alternaria brassicicola. Molecular detection of the fungus was carried out by amplification using ITS primers followed by sequencing. Pathogenicity test was done through detached leaf assay and seedling inoculation test and confirmation was done by testing the Koch postulates. After pathogen inoculation, ROS generation and proline accumulation were detected during the biotic stress. Staining with trypan blue helped to visualise necrosis in response to A. brassicicola infection in the leaf tissues. Finally, total RNA was isolated from the B. rapa inoculated (and control) leaf tissues followed by cDNA preparation for real time qRT-PCR analysis of gene expression. Primers available from the previous study, which were designed using S. alba sequences of some important gene candidates, including PR and resistance-related genes were used for the expression analysis. The

Abstract of M.Sc. thesis

Department: Agricultural Biotechnology

Major Adviser: Dr. Priyadarshini Bhorali

results depict that all the PR genes were upregulated at lower levels at 24 hpi. Later, although the expression increased towards 48 hpi, it gradually decreased. The resistance related genes also showed upregulation with peak expression at 48 hpi, but later downregulated. Interestingly, one disease resistance (DR) gene showed downregulation across all the time points in the susceptible cultivar and and could be an important gene responsible for resistance. Thus, all the genes are clearly implicated to have a role in active defense responses. As a future prospect, complete functional characterization of such genes could be done as they would serve as important potential candidates for developing disease resistant varieties of Brassica.

Molecular basis of non-host resistance to Helicoverpa armigera

Deepak Ranjan Kanth

The complex molecular mechanism underlying resistance in non-host crops against Helicoverpa armigera is yet to be elucidated. Non-host resistance exhibits remarkable efficacy and broad-spectrum capabilities in countering potential pests, hence, has proven to be a valuable resource for understanding the basis of resistance. Our lab previously studied the molecular mechanism of legume (chickpea and pigeon pea) interactions with H. armigera using transcriptomic and proteomics approaches. Several cell receptor-like kinases (RLKs)/receptor-like proteins (RLPs) and defense-related genes were identified in these studies. In this present investigation, an effort has been made to understand the changes in expression patterns of a few selected cell receptor-like kinases (RLKs)/receptor-like proteins (RLPs), and defense-related genes in response to simulated herbivory (Oral Secretions/OS) and exogenous application of hormones such as Jasmonic acid (JA), Salicylic acid (SA) and Ethephon (ET). The generation of Reactive Oxygen Species (ROS) in samples after 12 h of oral secretion (OS) treatment confirmed that various elicitors were present in OS for effective induction of defense in groundnut. Gene expressing analysis showed significant (>5-fold) upregulation of the Proline-rich RLK PERK 15 gene due to the application of OS. Moreover, the expression of defense-related genes such as Endoglucanase 8-like, PR10, ABA-responsive protein ABR17, Galactosebinding lectin, and Cytochrome P450 90B1 also showed upregulation after 24 h of OS treatment. However, the expression of the above genes was downregulated after 48 h of treatment. It was also observed that the expression of lysM domain RLK 3, ABAresponsive ABR17, and PR10 genes was regulated by JA and ET pathways while galactose-binding lectin gene expression was mediated by the SA pathway. The expression of the endoglucanase 8-like gene showed an antagonistic regulation by JA and SA. Moreover, the trypsin inhibition (TI) assay revealed the expression of TI in the treated samples. Thus, the above results suggest that during the interaction H. armigera, elicitors present in OS are perceived by lysM domain RLK3 receptor in a non-host, groundnut, which activated the downstream signaling

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Department: Agricultural Biotechnology

Major Adviser: Dr. Sumita Acharjee

pathways to upregulate the expression of various defense-related genes. It would be interesting to study the role of galactose-binding lectin in the non-host defense against H. armigera. The present study shed light on the non-host resistance mechanism using the groundnut-Helicoverpa interactions as a model, which revealed changes in the groundnut gene expression pattern due to simulated herbivory.

Exploring the diversity and functionality of nitrifying microorganisms in tea ecosystem

Jitul Bora

Soil microbiomes are pivotal for ecosystem functioning, particularly in acidic soils prevalent in Assam's tea plantations. Nitrification and denitrification are essential microbial processes in the tea ecosystem, playing crucial roles in nutrient cycling and soil health. Nitrification is critical for converting organic nitrogen compounds, such as those from decomposing organic matter or organic fertilizers applied while, denitrification is the microbial process by which nitrate (NO3-) is reduced to nitrogen gas (N2) or nitrous oxide (N2O) under anaerobic conditions that help mitigate nitrogen loss from the soil, particularly in waterlogged or oxygen-limited conditions. This study aimed to assess nitrifier abundance, diversity, and functional attributes across tea ecosystem. Soil samples were collected from different plots viz., Organic, fallow and inorganic in the Cinnamara Tea Garden. Analysis of soil edaphic factors revealed superior soil physicochemical and biological properties under organically managed plots compared to fallow and inorganic plots. Culture-dependent and independent approaches to studying the microbial population structure revealed a higher abundance of nitrifiers in soil collected from organic plots, emphasizing the influence of soil management practices on microbial communities. Organic amendments can increase soil porosity and provide a more diversified food source, fostering conditions conducive to microbial diversity. The PCoA analysis indicated that a fraction of fallow soil microbiota was found in both organic and inorganic land management plots, suggesting a lasting soil legacy effect over the preceding years. Disparities in soil physicochemical properties, particularly in EC and pH, likely underlie the dissimilarities among plots, influencing microbial community beta diversity. Despite the indication of an existence of reasonable abundance of nitrifiers as revealed from culture-independent studies, many nitrifiers remained uncultured from these soils, indicating the challenges associated with their isolation in lower pH soils. Out of the 43 isolates obtained from enrichment studies, 7 were selected for further studies based on their biochemical traits consistent with known characteristics of nitrifying bacteria. The nitrification process, crucial for nitrogen cycling, is influenced by soil pH, with lower rates observed in acidic conditions.

Abstract of M.Sc. thesis

Department: Agricultural Biotechnology

Major Adviser: Dr. Madhumita Barooah

Molecular characterization via 16S rRNA gene sequencing revealed the taxonomic diversity of the seven isolates, belonging to genera such as Staphylococcus, Bacillus, Neobacillus, Acinetobacter, and Shinella. Previous reports indicate the involvement of bacteria viz., Shinella zoogloeoides and Staphylococcus spp. in the nitrification and denitrification processes. This study provides valuable insights into the complex interactions between soil physicochemical properties, microbial diversity, nitrification rocesses in tea plantations and directions towards land management practices within the tea plantations.

Morphological and Molecular Characterization of Vesicular Arbuscular Mycorrhiza Associated with Legumes

Rajkumar Laxman kudve

Plant health and soil fertility are largely influenced by nos. of associations between plant and microbes. Among these, the association between Vesicular Arbuscular Mycorrhiza (VAM) and the plant is well-known. VAM fungi create symbiotic association with the roots of plants and increase plant growth largely through phosphorus nutrition. The International Collection of Vesicular Arbuscular Mycorrhiza (INVAM), University of Kansas, U.S. reported that around 160 species of Arbuscular Mycorrhizal Fungi (AMF) have been described by spore morphology. However, in nature there may be great variation of spore‟s morphology within a VAM species. Hence, it is necessary to conduct research on VAM to analyze genus diversity in the soil and for their use as biofertilizer. However, VAM have not been studied extensively at morphological and molecular level by regional diversity like other beneficial microorganisms. Again, the molecular level identification is necessary due to most of the mycorrhizal species are structurally similar, and hence they cannot be differentiated on the basis of their morphological observations. Therefore, in this present study an attempt had been made to isolate and characterize VAM indigenous to Assam, at morphological and molecular levels. For this, VAM spore had been isolated from the rhizospheric soil of two legume crops, Dhaincha (Sesbania bispinosa) and Subabul (Leucaena leucocephala) from ICR farm AAU, Jorhat. At first, morphological identification of the isolated VAM fungi was done under microscope. Spore, sporocarps and hyphal structure were observed by mounting with polyvinyl alcohol-lactic acidglycerol (PVLG). On the basis of morphological observations (spore color, spore shape and hyphal color) they are supposed to come under the genus, Glomus, Gigaspora, Acaulospora and Scutellospora. For molecular characterization, the isolated VAM fungal spores inoculated with maize as the trap plant in pot culture technique. Further, the presence of arbuscule, vesicle and hyphae of VAM in infected roots of maize seedling were studied under microscope after staining with trypan blue. The study

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Major Adviser: Dr. Tankeswar Nath

was further extended to molecular characterization by using both universal fungal primers [NS1(F) and NS2(R)] as well as mychorrhyza specific primers [AML1 (F) and AML2 (R)]. Finally, the mycorrhizal isolates were identified as Glomus, Gigaspora, Acaulospora and Scutelospora species. Thus, the tentative classification of AMF done on the basis of morphological characteristics was supported by the molecular characterizations. This was a preliminary study of rhizospheric AM fungi associated with legumes. However, this study can further be extended to study the diversity of plant associated mycorrhizal fungi in Assam soils which will help to develop mycorrhiza based biofertilizer specific to this region. Furthermore, it will give a picture of mycorrhizal diversity of Assam, understanding of which is important to maintain productivity and stability of ecosystem of this region.

Study on genetic fidelity in tissue cultured raised plantlets of citrus limon (Assam lemon)

Ratnakishore Das

Citrus lemon, a highly significant species both economically and nutritionally, is extensively cultivated in Assam. The demand for this valuable crop has led to the development of efficient methods for large-scale multiplication to meet the increasing requirements of the market. Micropropagation, an advanced tissue culture technique, offers a promising approach for the rapid production of genetically identical plants. In this study, Citrus lemon was micropropagated to assess its potential for large-scale multiplication, and the genetic fidelity of the micropropagated plantlets was evaluated using Simple Sequence Repeat (SSR), Inter-Simple Sequence Repeat (ISSR), and long Retrotransposon (LTR) markers. SSR markers are highly polymorphic, consisting of short repetitive DNA sequences, while ISSR markers target the regions between microsatellites. LTR markers, on the other hand, focus on retrotransposon dispersed throughout the genome Healthy and vigorously growing shoot-tip were excised from donor plants and placed on the medium. Within a few weeks, these shoots successfully developed into multiple plantlets through the process of organogenesis. The micropropagated plantlets were then acclimatized to the greenhouse environment, and their growth performance was monitored. To determine the genetic stability and fidelity of the micropropagated plantlets. Fifty plant samples including the mother plant and rest in vitro regenerated plantlets are used for testing the genetic fidelity. Total genomic DNA was extracted from both the mother plants and the micropropagated plantlets using standard protocols, and the SSR, ISSR, and LTR markers were employed to assess genetic variation, if any, between the two sets of samples. The results of the genetic fidelity analysis demonstrated no detectable variation between the micropropagated Citrus lemon plantlets and their mother plants. All the SSR, ISSR, and LTR markers revealed identical banding patterns, indicating the absence of any somaclonal variation during the micropropagation process. The amplified fragments of the micropropagated plantlets precisely matched those of the donor plants, confirming the maintenance of genetic uniformity in the micropropagation protocol. In conclusion, this study demonstrates that, successful micropropagation of Citrus lemon with retained genetic

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Department: Agricultural Biotechnology

Major Adviser: Dr. Priyabrata Sen

fidelity is of immense significance for large-scale multiplication and commercial production.

Gene expression studies for low temperature tolerance at the booting stage in rice

Smriti Shyamolee Bora

Rice (*Oryza sativa* L.) is a staple food crop for half of the world's population and it has been grown as major cereal crop in three distinct seasons in Assam. Out of various constrains of rice production, abiotic stresses such as drought, low temperature (LT), salinity adversely affect crop growth and development. Low temperature stress at the early growth and reproductive stages in rice are critical, and the present study was conducted to screen low temperature tolerant genotypes at the booting stage (intermediate stage of reproductive phase) and study gene expression for cold responsive genes in tolerant and susceptible rice genotypes. A total of 30 rice cultivars collected from Regional Agricultural Research Station, Karimganj, AAU were -°subjected to low temperature stress at the booting stage in a growth chamber maintained at 12 C for seven days. The recovery and low temperature tolerance of plants after stress were°12.5 evaluated based on pollen fertility, number of panicle emerged, number of seeds set and grain yield. The results revealed that the phenotypes of C-59 and IET-9097 were superior for all the traits under study whereas Costco and IET-8687 showed lowest trait values, indicating varied levels of low temperature tolerance at the booting stage. These four cultivars, C-59 and IET9097 as low temperature tolerant; Costco and IET-8687 as low temperature susceptible were chosen to study gene expression analysis using six cold responsive genes (OsCOLD1, OsDREB2A, OsCTB1, OsLTT1, OsAPX1, OsNAC9) through real time quantitative reverse transcriptase polymerase chain reaction (RT-qPCR). The results showed that all the genes were up-regulated in the cold tolerant cultivars, C-59 and IET-9097 and down regulation in the other two cold susceptible cultivars, Costco and IET-8687. After performing qRT-PCR analysis, correlation between the gene expression data and phenotypic observations followed by path analysis was performed to detect associations between the genes and phenotypes. Path analysis revealed that out of six genes used in the study, three genes showed direct positive effect over grain yield (OsDREB2A, OsCTB1 and OsNAC9) and three genes showed indirect effect for grain yield (OsCOLD1, OsLTT1 and OsAPX1). The study is preliminary with respect to low temperature tolerance at the booting stage using rice collection of AAU and hence, further validation is required.

Abstract of M.Sc. thesis

Department: Agricultural Biotechnology

Major Adviser: Dr. Akhil Ranjan Baruah

Evaluation of finger millet genotypes as climate smart crop under the agroclimate of Jorhat

Angita Boruah

A field experiment was conducted during kharif, 2022-23 at Instructional cum Research (ICR) Farm of Assam Agricultural University, Jorhat to study crop weather relationship and genetic diversity among five finger millet genotypes viz. Gossaigaon Maruadhan (V1), FMAVT 4001 (V2), FMAVT 4006 (V3), FMAVT 4007 (V4) and FMAVT 4012 (V5) grown under three microclimatic regimes: 6th August (D1), 22nd August (D2) and 6 th September (D3), following split plot design with three replications. The weekly mean maximum (Tmax) and minimum temperature (Tmin), rainfall (RF), morning (RH-I) and evening relative humidity (RH-II), bright sunshine hours (BSSH), pan evaporation (EVP) and wind speed (WS) ranged from 22.1oC to 34.9oC, 7.9oC to 25.6oC, 0 to 104.4 mm, 91 to 100%, 51 to 85%, 1.9 to 9 hours, 1.1 to 3.8 mm and 0.8 to 3.1 kmph respectively during the period of experimentation. Biometric observations, viz. plant height, leaf area index (LAI), biomass, number of effective tillers/m2, number of earheads/m2, number of fingers per earhead, finger length, test weight, grain and straw yield were recorded periodically during entire growing season and at the time of harvest. Soil temperature at 10 cm depth was recorded daily, soil moisture at 15 days interval and incident, reflected and transmitted photosynthetically active radiation (PAR) at 7 days interval were also recorded during the experimental period. Results revealed that LAI, plant height and biomass at all the growth stages differed significantly under different microclimatic regimes with highest values recorded in the early sown (D1) crop. Accumulated agroclimatic indices such as GDD (growing degree days), HTU (heliothermal units) and PTU (photothermal units) decreased gradually with successive delay in sowing time with highest value being recorded under D1. Yield attributes and grain yield were found highest in early sown crop (D1) as compared to late sown crops. The vegetative phase of the first sown (D1) crop was exposed to comparatively higher soil temperature regime as compared to late sown crops (D2 and D3). The crop sown on 6th August (D3) had the highest PAR interception rate (72.6%). Among the genotypes, Gossaigaon Maruadhan (V1) was found to be superior with respect to growth parameters and yield (17.94 q/ha).

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Department: Agrometeorology

Major Adviser: Dr. Rajib Lochan Deka

Correlation analysis revealed that yield attributes and yield were significantly positively correlated with Tmax, Tmin, and WS whereas the correlation was negative and significant with RHI during all growth phases. EVP and BSSH had significant positive association with yield and yield attributes in all the phases of the crop growth except during reproductive phase. Yield predictive models were developed by utilizing step-wise multiple regression method using mean and accumulated agroclimatic indices during different pheno phases and entire period of crop growth. The most efficient yield predictive model among mean phasic meteorological parameters was found with Tmin during vegetative phase with highest coefficient of determination (R2=0.932) irrespective of varieties. While, among the accumulated meteorological indices, the best models were found for PTU (R2=0.932) and RF (R2=0.932) during vegetative phase and entire growing period respectively. For genetic diversity analysis, 20 RAPD primers were used out of which 7 were found to be polymorphic. These markers amplified 46 alleles with an average of 4.6 alleles per marker. Genetic relationship among finger millet genotypes were found out on the basis of pairwise Jaccard's similarity coefficient whose value ranged from 0 to 0.6 with an average of 0.295. Cluster analysis by UPGMA method grouped 20 samples into two major clusters, each further sub-divided into two sub-clusters. Cluster A comprised of 15 samples while cluster B had only 5 samples. All the treatment combinations of varieties V2, V3, V4 and V5 were grouped in cluster A, while treatment combinations of V1 were grouped in cluster B which indicates their genetic dissimilarity. These results indicated that different plant characters exhibiting strong positive genotypic and phenotypic correlation with grain yield can be used for development of high yielding genotypes of finger millet crop.

Agro-climatic characterization for planning smart agricultural practices in Assam

Mriganko Kakoti

The present study was undertaken with the objective to characterize the agro-climatic environment for improved planning of agricultural practices in Assam bycalculating assured weekly rainfall at different probability levels along with occurrence of dry and wet spell and estimation of moisture availability index which will help in accessingthe crop growing duration as well as planning suitable agricultural practices in the region. Long- term rainfall data for a span of 31 years (1991-2021) across 33 designated stations located at six agro-climatic zones of Assam were gathered from IMD, Pune. However, the daily temperature data (maximum and minimum) for the same period were not available inthe IMD dataset for all the selected stations. To compensate for this missing information, daily temperature data was obtained from the NASA POWER (Prediction of Worldwide Energy Resources) data portal. The amount of weekly rainfall at different probability levels (90%, 75% and 50%) were calculated using incomplete gamma distribution model andMarkov chain model was used to find out the probabilities of occurrences of 2 and 3consecutive wet weeks or dry weeks by taking threshold limit of 20 mm of rainfall per week. Characterization of rainfall revealed that annual mean rainfall was highest at Karimganj (3397 mm) followed by Lilabari (3182 mm), Kokrajhar (3170 mm), Silchar (3104 mm), Gharmura (3095 mm) and lowest was observed at Lumding (1305 mm) followed by Bokajan(1341 mm). The coefficient of variation (CV %) of annual rainfall varied from 12.4 % to24.9 % in Lower Brahmaputra valley zone (LBVZ), 13.1 % to 18.1 % in North Bank plains zone (NBPZ), 15.1 % to 18.9 % in Central Brahmaputra valley zone (CBVZ),11.4 % to 18.3% in Upper Brahmaputra valley zone (UBVZ), 13.2 % to 26.8 % in Hills zone (HZ) and17.3 % to 27.4 % in Barak valley zone (BVZ) during 1991-2021 indicating rainfall was highly dependable and less erratic in LBVZ, NBPZ, CBVZ and UBVZ as compared to HZand BVZ which showed high CV. Seasonal rainfall analysis revealed that contribution of monsoon season rainfall to the total annual rainfall was highest (66 %) followed by pre- monsoon season rainfall (26%), post-monsoon (7%) and winter (2%). Rainfall during post- monsoon and winter were highly variable as CV (%) was more

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Department: Agrometeorology

Major Adviser: Dr. Rajib Lochan Deka

than 45% and 50%. The weekly rainfall data indicated that rainfall was mainly concentrated between 16th to 38th SMW and more than 20 mm of assured rainfall was received during this period at 75%probability level. However, in some stations under Kamrup (R), Kamrup (M) and Sonitpur district this period was between 16th to 35th SMW while the stations under rain shadow belt like Lumding, Golaghat and stations of eastern Karbi Anglong district the period was between 19th to 36th SMW. From 42nd SMW onwards less than 10 mm of weekly rainfall was received at 75% probability level across all the designated stations. The probable occurrence of two consecutive wet weeks increased from 15th, 16th to 38th SMW across all the stations except this period was less for stations under Kamrup (R), Kamrup (M) andSonitpur district (NBPZ) and for stations located under the rain shadow belt (18th to 38th SMW). Occurrence of dry weeks probability was more than 50% from 43rd SMW across all the stations which corresponds with the growing season of rabi crops in the region. The weekly Moisture Adequacy Index (MAI) values were determined by computing the ratio of AET to PET. PET values were estimated using Thornthwaite's (1948) method, while AETvalues were derived from Thornthwaite and Mather's (1955) water balance model. This calculation allowed us to assess the availability of moisture in the study area on a weeklybasis. Assam comprises of a mixture of different types of soil types. For crop planning andsuggesting suitable practices, major two types viz., sandy loam soil having 100 mm water holding capacity and silt clay loam soil with 200 water holding capacity were consideredand accordingly MAI was calculated. MAI value increased from 0.4 in rabi season andreaches maximum value of 1 during kharif season indicating enough moisture to support water demanding crops. Almost in most of the stations there was greater chance for water surplus during monsoon season thus offer opportunity for water harvesting andsupplemented irrigation to mitigate moisture stress conditions. It can prove beneficial for successive rabi crops also. Soil with high water holding capacity i.e., 200 mm WHC hadhigher MAI value in all the seasons as compared to soils with l00 mm WHC. The weeklyMAI suggests the possibility of sowing kharif crops without affecting the later rabi crops. The length of growing period (LGP) calculated over the period 1991-2021 revealed that the lowest average LGP of 239 days was found in stations of Hills zone and the highest average LGP of 303 days was found in stations of BV zone. When averaged over 31 years, it was observed that the mean LGP accounts for 277 ± 31 days with RF/PET ratio greater than 0.5and MAI value ranging more than 0.75. The weeks in which the RF/PET ratio was greater than 0.25 with MAI value ranging from 0.4 to 0.75 indicated the presence of residual soil profile moisture. Based on these approaches, pre sowing cultivation, seed bed preparation, sowing and transplanting window was suggested for different agroclimatic zones of Assam.

Comparative assessment of insect pest- disease dynamics and the performance of Greengram under different microclimates

Roshani Yadav

Field experiments were conducted in the Instructional-Cum-Research (ICR) Farm of Assam Agricultural University, Jorhat during kharif, 2022 and summer, 2023 withan objective to study the seasonal variation in incidence of insect pests and disease dynamics of green gram, and also to assess the performance of four cultivars of green gramviz., SGC 16, SGC 20, IPM 02-3 and MH 421 under three different microclimates createdby manipulating sowing dates. The crop was sown on 11 September (D1), 28 September (D2) and 13 October (D3) during kharif, 2022, whereas it was sown on 13 February (D1), 28 February (D2) and 14 March (D3) during summer, 2023. The results revealed that aphid(Aphis craccivora) and jassid (Empoascakerri) population on green gram reached its peakin 50th and 42nd SMW, respectively in kharif season and 18th SMW in summer season. Podborer (Helicoverpaarmigera) population recorded highest in 44th SMW during kharif and20th SMW in summer seasons. Likewise, whitefly population (Bemisiatabaci) was recorded maximum in 46th and 16th SMW during kharif and summer seasons, respectively. In addition, Cercospora leaf spot (Cercospora canescens) and Moongbean Yellow Mosaic Virus (MYMV) disease infection reached its peak during 45thSMW in kharif and, 20th and18th SMW, respectively during summer season. The Percent Disease Index (PDI) of Powdery mildew (Erysiphe polygoni) and Anthracnose (Colletotrichum sp.) was recordedhighest in 51st SMW during kharif and 23rd SMW in summer season. In summer greengram, aphid population was significantly and positively correlated with maximum (0.55*) and minimum (0.45*) temperature; while it had a significant negative correlation withminimum temperature (-0.65**) duirng kharif season. Jassid and whitefly had positive andsignificant correlation with maximum and minimum temperatures. None of the weather variable had a significant impact on pod borer population during both of the season. Likewise, Cercospora leaf spot exhibited significant and positive correlation with temperature atripening phase in kharif green gram. The reliability of regression

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Department: Agrometeorology

Major Adviser: Dr. Kuldip Medhi

model (R2) developed based on insect pest and disease weather relationship were found to be variedwithin 0.04 to 0.77 and 0.24 to 0.85, respectively. The results revealed that among the varieties, MH 421 (539.1 kgha-1) performed better during kharif, whereas least yield (410.9kgha-1) was observed when sown as summer crop. Poor performance of MH 421, can be indirectly referred from a depletion of 26.9% of intercepted PAR (iPAR) in summer crop relative to kharif crop due to low canopy growth. In contrary, SGC 16 maintained its performance in both kharif (491.2 kgha-1) and summer (512.5kgha-1) seasons. Mainly, substantial difference in plant height, LAI, above ground biomass and number of pods per plant corresponding to early and late sowings during kharif and summer, respectivelydefines the yield of the crop. In case of early (D1) sowing date, sufficient moisture is available during kharif season, whereas less moisture is available in summer season for supporting initial crop establishment. The mean percentage of iPAR was found 3.4% (SGC16), 8.4% (SGC 20) and 9.6% (IPM 02-3) higher under late (D3) sown summer season croprelative to kharif season. Overall, protein content in seeds of green gram varied from 22.07to 24.50%, irrespective of sowing dates and found maximum in SGC 20 (>24.0%); andminimum in SGC 16 (22.0%) in kharif and MH 421 (21.6%) in summer. Maximum proteincontent was recorded in D2 (23.8%) and D3 (23.9%) corresponding to kharif and summer season, respectively. Moreover, negative association was observed among seed yield andprotein content of seedsof green gram.

Interval Estimation for Decision Making in Crop Yield of Assam

Ankur Jyoti Gayan

Crop yield is an important factor in agricultural sector because it is directly related to food security, essential for economic development, important for employment generation and has significant impact on export revenue. So estimation of crop yield is equally important because it helps in better planning for farmers, optimizing resource allocation and forecasting market supply and demand. In this study crop yield of the state of Assam was taken into consideration. Under this study, all the necessary data has been collected from secondary sources, which include district level data from ICRISAT website, Statistical handbook of Assam and Economic survey of Assam. The objectives of the study are: 1. Estimation of parameters and their applications with inequalities for the normal population 2. Application of the bootstrap method for the non-normal population to test the variances. Simple linear regression was used to estimate prediction interval and it was found that for 23 districts of Assam yield of rice, pigeon pea, sesamum, rapeseed & mustard the prediction interval is true for 85.21%, 83.48%, 86.95% and 85.21% respectively for the period of 2018-2022. P-P plot was used to distinguish between normally distributed data and non-normally distributed data where it was found that for yield of rice, pigeon pea, sesamum, rapeseed & mustard there were 8, 5, 10 and 13 districts of Assam respectively which were normally distributed. For normally distributed data the average rice yield, pigeon pea yield, sesamum yield, rapeseed & mustard yield of Hailakandi, Dibrugarh, Karbi Anglong and Jorhat respectively were the highest. Also, Chebyshev's inequality was used to estimate confidence interval for normally distributed data. At last bootstrapping method was used to test the equality of variances for nonnormal data.

Abstract of M.Sc. thesis

Department: Agricultural Statistics

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Production of Major Fruit Crops in Assam: A Time Series Analysis

Dipankar Bhattacharjya

Pomology, one of the key subfields of horticulture, is the study of fruit cultivation. It has been practiced in India for many centuries. Nutritional importance of fruits for human being is well known. Man cannot survive just on cereal. Fruits and vegetables must be consumed for a balanced diet and optimum health. Nearly 90% of the nation's overall horticultural production is made up of fruits and vegetables. India is presently the world's second-largest producer of fruits and vegetables and the world's top producer of various kinds of horticulture crops, including okra, cashew nuts, bananas, papayas, and mangoes. Horticulture crops cover approximately 15% of the total cultivable area of Assam. Assam's favorable agro-climatic conditions foster the growth of a wide range of fruits and vegetables in the state.For conducting this research secondary data was collected for the period from 1991 to 2020 from the Directorate of Economics and Statistics, Government of Assam. The objectives of my research topic were- To study the growth trends of area, production and productivity of Major fruits grown¬ in Assam. To study the instability in area, production and productivity of Major fruits grown in¬ Assam. To develop a suitable forecast model for describing the production of Major fruits¬ grown in Assam. From CAGR analysis, it was observed that the area, production and productivity of banana, pineapple, orangeshowed positive growth rate. On the other hand, the area and production of coconut also showed positive growth rate. For papaya also production and productivity showed positive growth rate. From CDVI analysis, it was observed that the area, production and productivity of banana, pineapple, papaya and coconut showed low instability while in case of orange the area and productionshowed medium instability but the productivityshowed low instability. For banana production, ARIMA (3,3,1), for pineapple production, ARIMA (6,3,1) and for orange production,ARIMA (2,3,1) were found to be suitable models for forecasting. Similarly, in case of papaya and coconut, ARIMA (2,3,3) and ARIMA (5,3,1) were found to be suitable models for forecasting respectively.

Abstract of M.Sc. thesis

Department: Agricultural Statistics

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A comparative study of arrivals and prices of Onion and Potato in Assam

Ananthula Sindhu Priya

The present study was undertaken to study the arrivals and prices of Onion and Potato in Assam, with the objectives to study the trends, relationship and problems associated with the arrivals and prices. For that purpose, the study was carried out in 6 major district markets of Assam. Information was collected from the secondary sources: AGMARK website and Assam State Marketing Board and from primary sources, with the help of pretested schedule with sample size of 30 (10 farmers, 10 wholesalers, 10 retailers) in Jorhat. The findings of the study revealed that the highest mean and CV of prices of Onion were observed in October and November, lowest in April and May and for arrivals the highest in November and December, lowest in May and June. It was found that, the values for CAGR of prices of Onion were observed to be positive in Nagaon, negative in Bongaigaon and Kamrup, a mixture of both in Golaghat, Sonitpur and Jorhat. For arrivals, all positive growth rates were observed in Nagaon, Jorhat and Bongaigaon and few negative values were seen in Golaghat and Sonitpur and all negative values in Kamrup. Seasonal indices of arrivals of Onion, a large fluctuation is observed. And for prices, highest in October and November and lowest in April and May. It was also found through Pearson's correlation co-efficient that, In Jorhat and Kamrup markets, the correlation values were all negative. Positive values were seen in the markets like, Nagaon and Golaghat. For Potato, highest mean and CV of prices was observed in November and December, and lowest in January and February. And for arrivals, the highest mean and CV for observed in May and June and lowest in September and October. The values for CAGR for prices both positive and negative rates was seen in all the 6 districts, with highest values in Nagaon and lowest in Jorhat. For arrivals, all positive growth rates were seen in Jorhat, Bongaigaon and Sonitpur and all negative growth rates in Kamrup, a mixture of both in Nagaon and Golaghat. In the Seasonal indices of arrivals, a large fluctuation was observed. For prices, highest in November and December and lowest in February and March. When correlation was calculated, both positive and negative relationship between arrivals and prices were seen in all most all the markets. In Sonitpur and Golaghat markets, more negative

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Department: Agricultural Economics & FM

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relationship between the arrivals and prices were seen. Problems like, Insect and pest attack in Onion, Diseases especially late blight and early blight in Potato, Perishable commodity resulted economic losses, Lack of storage facilities, small land holding and transportation are observed to be affecting the arrivals and prices to a great extent.

Structure and Efficiency of Jagiroad Dry Fish Market in Morigaon District of Assam

Chayanika Saikia

Fish is a very perishable food item and requires preservation through drying for future consumption. Dried fish is just as important as fresh fish in terms of protein consumption because the crude protein levels are roughly twice as high. Dried fish being portable, storable and affordable meets the requirement for food as well as nutrition security. Jagiroad Dry Fish Market is believed to be Asia's largest dry fish market. The market is situated near New Jagiroad Railway station and National Highway no. 27 in Jagiroad in Morigaon district of Assam and is spread across an area of 5 ha (approx). The present study was undertaken to analyse the structure, conduct and performance, to find out the marketing efficiency of the channels and to identify the problems faced by the marketers in the study area. A total of 70 respondents were selected randomly for the study. The study brought out that the market was involved in the trade of atleast 300 dry fish species which arrived from various regions of India and Assam and transported to mainly North-Eastern regions and other nearby countries from the market. According to Mallick et al. (2022), in the year 2021-22, the highest arrival recorded was from Gujarat which was about 58% of the total arrival and highest percentage of transport was to Arunachal Pradesh which was about 30% of the total quantity transported. The quantity arrival and prices of 15 major species of dry fish available in the market were obtained for the month of Jan 2022 to Dec 2022 and it was observed that the highest quantity arrival was for the species Corica soborna and the highest price recorded was for the species Harpadon nehereus. The gini coefficient of the market was found to be 0.29 which revealed that there existed a lesser degree of inequality in the sale of dry fish among the respondents. The Lorenz curve showed that there was unequal distribution in the sales among the respondents of different income groups. Certain barriers to entry were found in the market out of which the most notable barrier was requirement of large amount of start-up capital for financing of the business. Market conduct was studied through exchange function, price determination, product differentiation and product promotion which revealed that the exchange took place through cash and carry condition and on credit, price was determined through direct

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negotiation, product was differentiated based on price, quality, taste and packaging and there was no product promotion followed in the market. Profitability analysis of the market showed that the highest B:C ratio was obtained for wholesaler cum commission agents followed by other intermediaries. Finally, the overall structure of the market revealed that it highly exhibited the feature of a monopolistic market except that price determination was through market forces of demand and supply. The study revealed that there were mainly five marketing channels found in the market out of which quantity handled through Channel I (54.3%) was highest in comparison to Channel II (22.5%), Channel III (7.8%), Channel IV (11.9%) and Channel V (3.4%). The efficiency of these channels were found out for the six major dry fishes of the market. For the species Corica soborna, channels found were II, III and IV out of which channel-IV was the most efficient. Similarly for the species Harpadon nehereus, channelIV was the most efficient channel. For the species Puntius sophore, channel-III was the most efficient channel. For the species Labeo rohita, channel-V was highly efficient channel. For the species Sperata seenghala, channel-V was the most efficient channel and lastly, for the species Channa punctatus, channel-III was the most efficient channel. The study brought into light that the main problems encountered by the market intermediaries were lack of storage facilities, high price fluctuation, lack of continuous supply, high transportation cost, physical loss, distant markets, lack of sanitation, high shop rent, lack of financial support, unorganised marketing, poor marketing facilities and lack of govt. initiatives. On the basis of garret scores, these problems were ranked from I to XII respectively. Finally, certain policy implications were given to overcome those problems in the market.

Production and marketing of Tezpur Litchi in Sonitpur district of Assam

Gunjan Bora

Litchi is an important sub-tropical fruit crop and is considered as the queen of fruits in India. Litchi reached India through Burma during the 18th century. Presently, India and China accounts for 90 percent of total litchi production in the world. India ranks second to China both in terms of area and production of litchi. Within India, among all the litchi growing states like West Bengal, Jharkhand, Assam, Chhattisgarh, Punjab, etc Bihar alone contributed 41.79 percent of country's total litchi production for the year 2021-22. While Assam stands at sixth position in terms of area and fourth in terms of litchi production for the year 2021-22. The present study revolves around the GI tagged Tezpur Litchi that is exclusively found in the Sonitpur district of Assam. The study was conducted to examine the status of litchi cultivation in the state of Assam along with understanding the economics of production and marketing of Tezpur Litchi and identifying the production and marketing constraints faced by Tezpur Litchi growers in the Sonitpur district of Assam. For the study, a sample of 80 Tezpur Litchi growers were selected from the study area. The study revealed that during the period from 2002-03 to 2021-22, the area, production and productivity of litchi in the state increased significantly with compound growth rate of 1.92 percent, 5.59 percent and 3.59 percent respectively. In terms of variability, production showed highest variation with 29.60 percent, followed by productivity with 20.44 percent and then area with 11.29 percent. On all farms, the establishment cost for Tezpur Litchi was calculated to be Rs. 143230.17 per hectare and the operational and maintenance cost during the bearing period for years 6 to 8, 9 to 11, 12 to 14 and 15 and above were calculated to be Rs. 56884.09, Rs. 80689.57, Rs. 120850.87 and Rs. 160535.70 per hectare respectively. Throughout the bearing years, watch and ward and harvesting operations were found to be the two major components of operational cost. The net returns of all farms for years 6 to 8, 9 to 11, 12 to 14 and 15 and above was estimated to be Rs. 200603.12, Rs. 283833.60, Rs. 393282.23 and Rs. 469521.15 per hectare respectively. The Tezpur Litchi cultivation was observed to be economically viable in the study area as NPV was positive, BCR was greater than unity and IRR was greater than the discount rate. The

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discounted payback period reflected that initial investment was recovered within 6.08 years of Tezpur Litchi cultivation in all farms. A comparison of different marketing channels revealed that under both Acharya's approach and Shepherd's approach of marketing efficiency Channel V (Litchi growers – Consumer) was identified to be most efficient and Channel III (Litchi growers - Pre- Harvesting contractor - Wholesalers - Retailer -Consumer) was the least efficient. Disease and pest infestation of fruits and fruits damage during harvesting period by birds and animals emerged as the major production problems. Whereas, high perishability of litchi fruit and price fluctuations were the major marketing problems. Thus, there is need for appropriate training, support and awareness programmes, research works aimed at extending the shelf-life of litchi fruit and development of proper market infrastructure.

Assessment of Crop Loss due to flood and its mitigation strategies: A farm level study in Morigaon district of Assam

Kalpana Deka

Assam faces its vulnerability to annual flooding, particularly during the monsoon season. The intricate network of rivers, including the mighty Brahmaputra and its tributaries, coupled with the region's low-lying terrain, makes Assam susceptible to widespread inundation. The annual monsoon rains, which are essential for agriculture and water resources, also bring about a cycle of flooding that can profoundly impact the lives and livelihoods of the people residing in this region.

The present study was conducted in the Morigaon District of Assam. The study aimed at assessing the land area, production, and productivity of important crops in Assam, and Morigaon district throughout a span of ten years. The study reveals that in Morigaon District, rice cultivation faces a decline in area (-0.35), production (-1.39), and yield (-1.05). Pulse crops show strong growth in area (1.07), production (2.77), and average yield (1.68). Fibre crop area shrinks (-0.34), but production (6.45) and productivity (6.86) rise. Oilseed crops exhibit significant growth in area (5.66), production (9.68), and productivity (3.81), with the highest CAGR in oilseed production over a decade (2012-13 to 2021-22). At the farm level, it also assesses the major crop damage due to floods in the districts and different mitigation strategies to overcome any losses. As rice was the main crop that suffered due to monsoon floods, therefore, at the farm level, rice crop was selected for the study. Further, the farmers are divided into Flood affected and non-flood-affected farmers where the findings revealed that the majority (82.08) of the respondents were young to middle-aged and a majority of the respondents (31.34) had formal education up to high school. Flood-affected farmers had higher operational costs of Rs 79401.95/ha compared to unaffected ones who spent only Rs 66589.78/ha - a difference of Rs 12812.17/ha. The primary drivers of this cost differential are higher expenses in seeds, machinery, and labour. The yield per hectare for flood-affected farmers was significantly lower than that of unaffected farmers. The average benefit-cost ratio was 1.07 for flood-affected farmers and 1.93 for non-flooded

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farmers. The strategies were categorised pre, during, and post-flood to reduce crop loss from floods. Pre-flood measures include flood-tolerant crop varieties (the most favoured pre-flood mitigation strategy) flood control structures and many others. Early warning systems and disaster preparedness are also used. Communities and government agencies provide relief and support to those affected and seek sustainable solutions in flood-prone areas.

Production and Marketing of Watermelon in Assam

Lopamudra Sarma

The current research was carried out in Nagaon district of Assam to study the resource utilization pattern, cost, returns, income, marketing pattern and constraints of watermelon cultivation. To conduct the study, a stratified random sampling technique was used, and a total of 120 sample farmers were interviewed using pre-structured schedules. Additionally, three wholesalers and three retailers were chosen to investigate the marketing of watermelons in the study area. The findings of the study revealed that maximum value on resources was found to be utilized by seed and mulching sheets for all 3 groups. Value on hired labour was found to have been most utilized by medium and small group of farmers whereas, the value on family labour was found highest for marginal group of farmers. The price of variable resources for growing watermelons across different farm sizes was calculated. The results of the study revealed that the cost of seeds for marginal farms was the highest (20.65 perent), followed by the cost of mulching sheets (20.57 percent) and the cost of family labour(16.54 percent). Seed accounted for the largest portion of small farms' costs (20.65 percent), followed by mulching sheets (20.98%) and hired manpower (20.98 percent). Similar to small farms, medium farms spent the most money on hired labour(17.17 percent), mulching sheets (20.61 percent), and seed (20.36). For all farm sizes combined, mulching sheets cost the most on average (20.73 percent) while growth regulators cost the least (1.12 percent). The MVP/MFC ratio revealed that the value of fertilizer, micronutrients, plant protection chemicals, family labour, hired labour, and machine labour were all underutilized. Value of seeds and mulching sheets were found to be slightly over utilized. Lastly, the MVP/MFC ratio for FYM showed a negative value which indicates its inverse relationship with gross return. The cost of cultivation of watermelon production in the study area followed an increasing trend, which is they increased with an increase in farm size. For small farms, the gross income per hectare was calculated to be Rs. 2,32,063.59. The study's findings revealed that the gross income per hectare was lowest in marginal farms (Rs. 2,09,464.76 per ha) and highest in medium farms (Rs. 2,33,512.63 per ha). On average, the net income per hectare for the entire sample was

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calculated to be Rs. 85,222.04. However, the B:C ratio was observed to be highest for small farms(1.68), followed by medium farms(1.64) and then marginal farms(1.56). This may be attributed due to better resource and labour management practices adopted by small watermelon farms. A total of four marketing channels were identified in the study area, with Channel I having the highest marketing efficiency followed by Channel III, Channel IV, and Channel II, which had the lowest efficiency. The results also demonstrated that the main challenges to the production of watermelons were pest and diseases, low capital for investment, lack of training programmes, unfavourable weather conditions, labour intensiveness and high cost of labour, theft, animal attack and low yield. With respect to marketing of watermelon, price fluctuation was found to be the major problem followed by post harvest loss, poor market access, lack of market infrastructure, occurance of festivals, high transportation cost, poor information on market price and absence of branding.

Consumption Patern of Different Food Items in Jorhat District of Assam

Manikanta Sagar

The Roman philosopher Seneca once said, "A hungry person listens neither to reason nor to religion; nor is bent by any prayer". He wants food today and not just assurance of food for tomorrow. From this statement we all get to know about the importance of food and food consumption. According to Adam Smith, “Consumption is the sole purpose of all production”. Consumption is a start of every human activity. The present study was undertaken to address more specifically the consumption pattern of different food items, monthly per capita consumption expenditure (MPCE) and factors influencing the purchase decision and consumption expenditure. For that purpose, information was collected with the help of pretested schedule from 100 sample households in the district of Jorhat by interviewing them personally. The findings of the study reveal that both urban and rural consumers consume cereals, pulses, milk and milk products, salt and sugar, edible oils, egg, fish, meat, vegetables, fruits, spices and beverages with certain degree of variation. The most noticeable variations were observed in case of egg, fish & meat, milk & milk products, edible oil, vegetables and fruits which were consumed more by the urban consumers as compared to the rural consumers, the possible reason may be higher income of the urban consumers, their better standard of living and the food availability. Analysis of MPCE indicate that the rural household spends about Rs 10,964 on food items which accounts for 38% share of their monthly income. As against this, the urban households spend Rs 12,057, representing 22% share of their monthly income. Attempt was made to identify the factors influencing the consumption expenditure and for that matter regression analysis was carried out with total MPCE of the household on food items as dependent variable and household size, monthly income, land holding, education status, age, family type dummy and mass media exposure dummy as independent variables, which explained 80 to 81% variation. On the basis of the results, one may suggest that well thought out policy may be formulated/executed which may lead to increase in disposable income of the consumers and increased awareness on family welfare and food nutrition. To study

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the factors influencing purchase decision of aforementioned food products limited variables are considered and asked to rate them from 1 to 5 (1-extremely important, 2-very important, 3- somewhat important, 4-not so important and 5-Not at all important). The factors like Cleanliness of the product, quality of the product and price played significant role while making purchase decision in both rural and urban consumers.

A Study on the Economics of Millet Production in Assam

Pranjal Protim Mudoi

The miracle grains millet is now a globally popular crop because of its numerous benefits. Millet plays a crucial role in the lives of millions of resource-poor farmers in India, serving as a significant source of food and fodder. Its contribution is vital to the country's ecological and economic stability. Millets offer compelling reasons for farmers to cultivate them and for consumers to choose them over other cereals. Millet can thrive in rainfed conditions and adapt well to various ecological environments. Millets demonstrate remarkable resilience to rising temperatures and droughts, requiring only 28 percent of the water needed for paddy cultivation. Their ability to grow in marginal land with minimal inputs makes them agriculturally superior to other commercial crops. Compared to other cereals, millets boast a superior micronutrient profile. Studies indicate that millets contain 20 percent less carbohydrates than rice and wheat, making them an excellent option for health-conscious individuals. Recent research highlights millets as a rich source of protein, fiber, minerals, and vitamins, effectively addressing deficiencies in iron, zinc, and protein. The primary objective of this study was to assess the status of millet cultivation in the state of Assam and analyse its cost, returns, and resource utilization efficiency. Additionally, the research examined the challenges related to millet production and marketing, while also exploring the potential opportunities for the crop's future in the region. The research took place in the Gossigaon sub-division of Kokrajhar district, involving 120 millet farmers. The study revealed a positive and statistically significant growth in millet cultivation in Assam between 2007-08 and 2020-21, as indicated by an increase in the area (0.949), production (1.09), and productivity (2.118 ***). This outcome highlights the considerable potential of millet cultivation in the state. Total cost of cultivation of Millet for Group I, Group II and Group III was found to be Rs 27013.95/ha, Rs 30589.30/ha and Rs 31234.63/ha respectively and Human labour constitute highest to the total cost. For all groups of farms, the Return over Variable Cost was determined to be 1.83, 1.92, and 1.99, respectively. This indicates that the crop is currently profitable at its existing level, with the potential to be significantly enhanced in terms of

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profitability. The functional analysis demonstrated that the coefficient of multiple determination (R2) for Group I, Group II, and Group III farmers were 0.83, 0.85, and 0.95, respectively. These values indicate that the variables considered in the production function accounted for approximately 83%, 85%, and 95% of the variations observed in the production process. Further the MVP to MFC ratio for groups were greater than unity indicating that farmers have opportunities to increase the production by using more resources. However, there are certain problems related with millet production such as lack of technical know-how among the farmers, high labour requirement for post-harvest operation, lack of proper market etc. Awareness drive on the benefits of millet consumption and production and training on adoption of recommended practices would help in popularising millet in the state.

An Economic Analysis on Production and Marketing of Honey in Assam

Priyangshi Hazarika

Honey is a sweet, sticky liquid made by the bees. The bees create honey from the sweet juices of plants (known as floral nectar) or from the secretions of other insects (like honeydew). The present study was designed to investigate the production and marketed surplus of honey, marketing practices and efficiency and to identity the problems and factors affecting the production and marketing of honey with a sample of seventy beekeepers. The study was conducted in Jorhat and Golaghat districts of Assam. The study revealed that all group average production of honey per farm and per colony was worked out to be 229.64kg and 5.85kg respectively. The per colony production in Apis mellifera was 12.56 kg while that in Apis cerena was 5.31 kg. The all group wax production per farm was found to be 39.27kg and 1kg per colony. In Apis mellifera it was 1.03kg per colony and Apis cerena it was 1kg per colony. From the total production, in all group average 97.63 per cent of honey was marketed. The cost analysis revealed that in per farm all group total cost and return was estimated to be Rs 45502.88 and Rs 102776.01. In case of per colony total cost was Rs1159.10 and gross return was Rs 2618.08. Furthermore, per kg total cost of production was Rs209.34 and gross return was Rs 458.38 in all group analysis. The benefit cost ratio in all group was found to be 2.26 which made it a profitable enterprise. The various practises followed in the marketing of honey were packaging, labelling and method of selling of the honey. The channels involved in marketing of honey were– Producer-Consumer, Producer-Retailer- Consumer, Producer- WholesalerConsumer, Producer- Processing unit-Retailer – Consumer and among the channels the sell of honey to direct consumer was found to be most efficient according to Shepherd's and Acharya approach. From the result of the analysis based on Garrett Ranking the main problems faced by beekeepers were lack of flower which leads to absconding of bees and in case of marketing lack of proper marketing information and knowledge was found to be the most important problem. The factors affecting production and marketing were analysed by semi logarithm regression model, where it was observed that number of hives and pest control affecting the production was found to be significant and positive in all groups

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and in case of marketing number of hives and price was found to be significant and positive in all groups. For the growth of the industry problems must be paid attention through policy measures like Government price fixation, formation of cooperatives and impart of market information.

Dynamics in Rice Production Technology – A Study in Jorhat District of Assam

Satabdi Borah

More than half of the world's population relies on rice as the primary means of dietary habits, with Asia, South America, Africa and Sub-Saharan Africa as its major consuming regions. This emphasizes how crucial it is to sustain sufficient food for a large population. Enhancing the rice crop's output potential, stability, and nutritional value is of the utmost importance right now. The purpose of the present study was to investigate the technical advancements in rice farming from 1981 to 2022, the consequences on farm income and the challenges farmers endured in implementing new technology throughout time. In order to sustain the research purpose detailed information were collected from 120 samples of Jorhat district, especially Titabar, with the help of a properly structured schedule by personal interview method and the considered 41 years was divided into three periods viz. Period I-1981, Period-II 2015 and Period-III 2022. Findings revealed that average operational holding of the farmers had declined from 1.17 ha in 1981 and 2.00 ha in 2015 to 1.01 ha in 2022. Morever during 2022, cropping intensity (105.94) showed 20.63 per cent and 15.92 per cent decline from 1981and 2015 respectively. The type and amount of labour, quantity of fertilizer, seed rate and variety were found to be the areas where technological variations had the most obvious effects. Over the time, rapid mechanization led to a decrease in the utilization of human and animal labour in rice farming. In all of the periods, less fertilizer was applied than what Assam Agricultural University had recommended. However, because of the concurrent use of DAP and SSP, phosphorus application was found to be higher during 2015 and 2022. The seed rate used in the current period was within the range of recommendations, unlike the improbable excess use of seeds in 1981 and 2015. Since the fields were previously dominated by local varieties, the application of HYV of Sali rice on farms in later periods had altered the total input utilization. These technological changes over time had increased the yield, attributed to higher earnings of the farmers. Although net income had increased by 279.30 per cent over 1981, it had decreased by 22.95 per cent from 2015 at current price. Over the periods, farmers had faced various challenges in adopting new technology, but the absence of irrigation infrastructure was consistently found to be a constraint to rice farming.

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Performance Evaluation of Soil Health Card Scheme in Relation to Farmers' Income- A Case Study in Cachar District of Assam

Sradhanjali Deb

The Soil Health Card (SHC) Scheme is a government initiative aimed at assessing and improving agricultural soil quality throughout the country by informing farmers about their soil. Farmers who are benefitted in this program receive Soil Health Cards that contain detailed information about the health and nutrient status of their soil. The program assists farmers in making educated crop selection, fertilizer application, and soil management decisions. The Soil Health Card scheme helps to improve crop productivity, optimize resource utilization, and thus ensuring profitability for farmers. The current study was undertaken primarily to assess the impact of the Soil Health Card scheme on farmers' income in the Cachar district of Assam, examine the status of implementation of Soil Health Card scheme across districts of Assam, and investigate the problems associated with the use of Soil Health Cards. The sampling design used for the study was multistage random sampling design. The study was conducted with a sample size of 60 Soil Health Card users and 60 Soil Health Card non-users from the Silchar sub-division of Cachar district of Assam. The distribution of Soil Health Cards in Assam's districts was discovered to be uneven, with some districts like Dibrugarh, Tinsukia, Sivasagar leading the board, while districts in hilly ecological zone such as Dima Hasao, Karbi Anglong etc. lagging behind significantly, constituting not even 1 per cent of the total Soil Health Cards distributed in the state. The soil testing laboratories in the state were not evenly distributed, Jorhat district had 10 numbers of Soil Testing Laboratories, which was highest among all the districts of Assam. The data from the study revealed that there was a discrepancy in utilization of funds that were allocated year-wise from 2017 to 2021. The utilized amount of fund was significantly lesser than the allocated funds with only 29 per cent of the allocated fund being used. The per hectare cost of rice cultivation for Soil Health Card users and Soil Health Card non-users was calculated, and it was discovered that the total variable cost for Soil Health Card users was (Rs. 43395.7/ha), which is slightly higher than that of Soil Health

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Department: Agricultural Economics & FM

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Card non-users (Rs. 41714.56/ha). On an average, total cost of cultivation (Cost C3) of Soil Health Card users came out to be Rs. 64749.18, which was again higher than the average total cost of cultivation (cost C3) of Soil Health Card non-users, which was Rs. 64400.30 The returns structure in rice production, on the other hand, revealed that the gross returns obtained by Soil Health Card users were relatively higher (Rs. 78368.35/ha) than those obtained by Soil Health Card non-users (Rs. 69674.45/ha). Similarly, net returns realized by Soil Health Card users (Rs. 19901.24/ha) were higher than net returns realized by non-users (Rs 12286.07/ha). The returns per rupee of investment for Soil Health Card users and non-users were 1.30 and 1.19, respectively, indicating that Soil Health Card use has benefited farmers. Furthermore, independent t-test and paired t-test were performed and both revealed a statistically significant difference in returns and yield between Soil Health Card users and non-users. Independent t-test revealed a significant difference in yields across the farm size classes which were marginal (2.94**), small (3.25**), medium (2.36**), the test displays a significant difference in returns across the size classes which are marginal (2.20**), small (2.41**) and medium (2.67**) groups of Soil Health Card users and Soil Health Card nonusers. Further, paired t-test revealed similar results showing a positive significant difference in yield (4.20***), gross returns (4.66***), and net returns (4.03***) between Soil Health Card users and Soil Health Card non-users, pointing to an advantageous position of Soil Health Card users in terms of profitability. Overall, the Soil Health Card can be viewed as a tool to help farmers increase their income. Farmers of the study area, on the other hand, face some challenges in adopting Soil Health Cards, such as difficulty in understanding recommended doses of fertilizers given on the Soil Health Card, lack of capital to afford fertilizers according to recommended doses, lack of follow-up training and advice from extension agents, delay in disposal of Soil Health Cards to farmer after sampling of soil, lack of proper knowledge on the scheme, and so on. More training, awareness camps, and government subsidies on fertilizers would help to alleviate farmers' problems, accelerating the state's adoption of Soil Health Cards.

An Economic Analysis of minor millets cultivation in Assam

Tarik Anowar

Assam being the highest producer of minor millets in North-east the present study was conducted to analyse the economic aspects in three districts of Assam viz. Dhubri, Bongaigaon and Barpeta with highest area under cultivation. A total of 120 respondent farmers were selected randomly from three development blocks from each district, comprising two villages from each selected block (total=18 villages). The primary data was collected for the year 2022-2023 through personal interview method with the help of pre-tested structured schedule. Stratified random sampling was employed in the study to select the respondents adequately to fulfil the objectives. In context with the current scenario of "International Year of Millets-2023" and "Assam Millet Mission", and India being the highest producer of minor millets, an attempt has been made in the study to analyze the scenario of minor millet cultivation in the region, including types of millet species grown, to estimate the resource use efficiency of the farmers and lastly, to explore the prospects of value addition and constraints associated in cultivation in the study area. The study on socio economic profile of the respondent farmers revealed that the average size of land holding of the sample households was 1.87, 1.43 and 1.78 hectares for the foxtail millet growers, proso millet growers and farmers growing both the millet species respectively. Average area under millet cultivation was 0.45 ha (foxtail), 0.44 ha (proso) and 0.73 ha (both) and cropping intensity was found to be 124 %, 127% and 128%. Average age of respondent farmers revealed by the study was 43.56 years. Adult male constitute 89 % and female constitute 11%. Study also revealed that the literacy rate of among the respondent farmers were 75.83%.The total cost of cultivation for foxtail millet per ha was found to be Rs. 30922.90, proso millet (Rs.30147.03 per ha) and farmers cultivating both millet types were (Rs. 22418.58 per ha) with gross return per ha was reported as Rs. 46246.55, Rs. 52551.98 and Rs. 46246.55, generating a net return of Rs. 15323.64, Rs. 23912.61 and Rs. 20180.64 respectively, resulting the returns per rupee (Benefit-Cost) of 1.50, 1.62 and 2.07 respectively. The commercial cost of cultivation (C3) was found to be Rs. 34015.19/ha for foxtail millet, Rs. 35608.48/ha for proso millet and Rs. 24660.44 /ha for

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farmers cultivating both millet species. Stochastic Frontier Method (SFA) approach was employed to estimate the resource use efficiency of the farmers and their mean technical efficiency was found to be 0.677 (foxtail millet growers), 0.703 (proso millet growers) and 0.740 (for farmers cultivating both foxtail and proso). Prospects of value addition from minor millets in the study area include preparation of millet rice and flour, ready to eat snacks and beverages, bakery items, weaning foods, etc. The major production constraints (calculated through Garrett Ranking Method) confronted by respondent farmers of the study area were found to be weed infestation, shortage of human labour, high input cost, non-availability of good quality seeds, lack of knowledge of package and practices,etc. Furthermore, constraint associated with value addition and marketing of minor millets were lack of proper market information system and market price, lack of processing facilities, low and fluctuating price of the produce, poor road connectivity to the cultivating area, lack storage facilities, etc. Adequate policy measures by the Government regarding processing and marketing could uplift the minor millet growers in the study area.

A production trend and marketing of bamboo in Assam

Tulika Chutia

Bamboo, the tallest and the fastest growing (up to one metre per day) woody perennial grass on planet earth, belongs to family Poaceae with about 1,200 species reported globally (Lobovikov et al., 2007). Height of bamboo species varies from a few centimetres to about 30 metres and can reach to a diameter of up to 30 centimetres. Because of wide adaptability and utility bamboos are ecologically, socially, commercially and environmentally important group of plants. Bamboos are naturally distributed in the tropical and subtropical belt between 46º north 47º south latitude, and are commonly found in Africa, Asia, and Central and South America. Bamboo species are found in diverse climates ranging from cold mountains to hot tropical regions. The total population of bamboo species in the world is represented by 80-90 genera and about 1000-1500 species. India is the second richest country of the world after China in terms of bamboo genetic resources, as per the FAO report on world forest resources. According to the India State Forest Report 2017, in India there are 125 indigenous and 11 exotic species of bamboo belonging to 23 genera. The total bamboo area in Assam is about 2.23 million hectares as against India's total area of about 11 million hectares under bamboo. Out of the 130 bamboo species available in India, 34 species are available in Assam. The main bamboo growing areas of Assam are the districts of Cachar, KarbiAnglong, North Cachar Hills, Nagaon and Lakhimpur. The present study is an attempt made to investigate and analyse the level of area, production and marketing of bamboo and bamboo related products in Jorhat district of Assam. The entire state of Assam is selected for analysing variability in area and production growth of bamboo cultivation. Multistage random sampling design was used present study for collection of primary data from Jorhat District. Total of eighty households were selected from kaliapani block and Titabor block and categorized into four group, viz. marginal, small, semi-medium and medium based on their operational land holding. The study shows that the recorded forest area of Assam experienced the highest increase of 23.73% between the years 2011 and 2017. From 2011 to 2017, the pure bamboo area experienced a significant decrease (-60.95%). After 2017, area shows significant

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increase. Density of bamboo decreases from 2017 to 2019 significantly (-56.14%) and it further decreased from 2019 to 2021(-2.12%). The average area and production covered by Bholuka bah is more than that of Jati and Kako bah. BC ratio of marginal, small, semi-medium and medium Bholuka bah farmers are 1.57, 1.71, 2.15, 2.35 respectively. For Jati bah growers, 1.80, 2.07, 2.42, 2.14 and Kako bah growers 1.93, 1.99, 2.24, 2.50 respectively. The key bamboo uses in the study area included bamboo house construction, residential fencing, furniture, agricultural purpose, food, fuel and other minor cottage industry handicraft products like basketry, tray, showpiece, lamp and flower vase etc. The study identified four important marketing channels for Bholuka bah and Jati bah and two marketing channels for Kako bah. Out of these four channels, the marketing cost was found to be highest in channel IV and least marketing cost observed in channel II for Bholuka bah and Jati Bah growers. The marketing efficiency was found to be highest in channel III followed by channel II and lowest in channel IV for both Bholuka bah and Jati bah growers. Among all the problems of growers the most important problem was technical problem then timely non availability of labour and high labour cost followed by lack of knowledge about managements, small land holding, lack of technology and lack of planting materials. The present study recognized the bamboo as an important means for increasing return per unit area, which influenced a considerable number of growers to engage in production and marketing. Hence better improvement of their socio economic status is to be expected.

Production and Marketing of Pineapple in Ri-Bhoi district of Meghalaya

Winsaphisha Diengdoh

The study was undertaken to address more specifically the production and marketing of pineapple in Ri-Bhoi district of Meghalaya, its economic feasibility and the various factors influencing the outcome of pineapple cultivation in the district. The data pertains to the year 2022-23 and the information was collected with the help of a pretested schedule from a sample of 120 farmers through face-to-face interview. A multistage random sampling procedure was followed for selection of the sample households, which were the primary source of data for the study. Descriptive statistical tools, simple tabular and percentage analysis were used to obtain economics of pineapple production along with the constraints faced by the stakeholders of pineapple cultivation. Multiple regression analysis was used to see the effect of various factors on pineapple production and the Cobb – Douglas type of production function was used. The study revealed that the average size of holding under pineapple cultivation was found to be 1.95 hectares, the average number of suckers per hectare was found to be 7963 in numbers and the total average labour requirement for pineapple cultivation per hectare was found to be 25.67 man-days. Economic analysis through Cost concept revealed that pineapple production in the district was financially profitable with high Benefit-Cost ratio in each farm size. The B: C ratio was found to be the highest in the marginal farm (1.71) and the lowest in small farm (1.59). The major problems faced by various stakeholders of pineapple cultivation are labour intensive, lack of storage facility, perishable nature of pineapple, wide fluctuation in price and high transportation cost but despite the various constraints faced by the pineapple growers. The results of the study showed that pineapple cultivation in the district despite the various constraints faced by the growers and due to its labour-intensive nature still had the potentiality to generate employment and generate income all throughout the year.

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Major Adviser: Dr. Prodyut Bijoy Gogoi

Management of Self-help groups (SHG) and Marketing of their products in South Tripura

Babita Mog Choudhury

A Self-help group is an organized together for a common goal. Generally, a Self-Help Group consists of 10 to 20 women. The women save some amount that they can afford. It is small amount ranging from Rs. 10 to 200 per month. A monthly meeting is organized, where apart from disbursal & repayment of loan, formal and informal discussions are held. on many social issues also. Women share their experiences in these groups. Their main objective is to work towards achieving common economic outputs. These groups are voluntary in nature and they function for getting mutual benefits. The self-help group members work collectively for the purposes of financial independence, generating regular income, and for tackling the problems of unemployment. The origin of self-help group can be traced from Grameen bank of Bangladesh, which was founded by Muhammad Yunus. SHGs were started and formed in 1975. In India NABARD initiated in 1986-1987. The present study was on Management of Self-Help Groups and marketing of their product in South Tripura District. Total number of SHGs formed in India so far accounts to 4,84,74,416 and in Tripura total number of SHGs formed accounts to 4,6017. The study examined information obtained from the survey conducted in the South Tripura district using random sampling on 4 Self-Help Groups. Among various districts of Tripura, the South district has the maximum number of SHGs. The findings of the study revealed that performance of SHGs is proved to be good in terms of production. The major problem faced by the members of Self-Help groups was male domination in the market, absence of promotion & marketing of their products, lack of trained manpower & permanent market area and lack of capital. Based on the results, one may suggest that the Govt. of Tripura should promote the products of SHGs. Educational institutions and voluntary organizations should come forward in educating women SHG members to improve their managerial ability and to remove their ignorance and creating awareness.

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Major Adviser: Dr. Udeshna Talukdar

Evaluation of damage caused by root knot nematode and its survival in tuberose during storage of bulb

Babyshree Arandhara

In the present investigation on evaluation of damage caused by root knot nematode and its survival in tuberose during storage of bulbs, it was observed that all growth parameters of tuberose were affected with corresponding increase in inoculum levels. Plant showed gradual increase in number of galls, egg masses and final nematode population in the soil with increase in population levels of root knot nematode from 20 to 10,000 nematode per pot. Reproductive rate was found to be maximum at lowest inoculum and minimum at highest inoculum of 10,000 M. incognita per kg soil. In the investigation on survival of root knot nematode during storage of bulb, the study of stored planting material (bulbs of tuberose) reveled that all the stages of root knot nematode were present within the bulbs. J2 were found within the bulb and also in between the layers of bulbs. J3, J4 and adult females were found in the bulb tissue. Some adults were also found to be aggregate in between the layers of bulb tissue. There was a reduction in nematode population (56.91%) during the storage period of 6 months. Egg masses within the bulb were brownish in colours, protected by gelatinous matrix and the bulb tissue. The egg masses attached to the basal portion of the bulbs were deep orange colour. The change in colour of egg masses attached to the basal portion of the bulbs during the storage period might be due to drying and tanning of the gelatinous matrix may be due to low moisture for an extended period of time. Germination percentage of the stored bulb was recorded to be 70%. There was 30% reduction in germination of stored bulb due to heavy nematode infestation and drying of bulbs in storage. When infected stored bulbs were replanted in pots with sterilized soil, survival and transmission of nematode to the new crop was confirmed by the developed symptoms (gall and egg mass formation) on roots.

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Department: MBA (Agri. Business)

Major Adviser: Dr. B. B. Gogoi

Processes Food Products in Mangaldoi town of Darrang district: A case study on Repose bakers

Chandan Ballav Baruah

Food processing is the conversion of agricultural products into food or of one food type into another. Food processing encompasses a wide range of food processing technologies, from grinding grain to make raw flour to home cooking to complex industrial methods used to produce convenience foods. India is the world's second largest food producer, after China, and has the potential to be the largest. The domestic food market in India is predicted to expand by about 40% by 2015, reaching $258 billion and $344 billion by 2025. Bakery industry is one of the large growing food industries in the world. Food processing sector of Assam is in an infant stage and percentage of Agriculture based micro, small and medium enterprise is 20 per cent. Assam's bakery industry incorporates local flavours and ingredients into their products. The present study of my research is on SRD Bakers, one of the leading industry in Assam among thirteen industries of SRD group, which involves in production of Bakery items and different value added products. The research was conducted in Repose bakery factory,spread across an area of 5 bigha 3 katha, situated in Chapai Chowk area of Mangaldoi town of Darrang District. The organisational structure of the Bakery was shown. B:C ratio of five financial years are calculated from 2018-19 to 2022-23. Also, a comparison is made with the COVID 19 yeras and noemal years to show how any emergency create an impact in any industry or company. Additionally there are two marketing channel in which percentage of flow of revenues in the five financial years are shown. Finally the various financial, production and marketing problems are pointed out along with various prospects are given to make the factory run efficiently and increases its revenues generated. E-tailing is one of the best way to generate revenue and also increase the market of the company.

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Major Adviser: Dr. Udeshna Talukdar

Agri-business Potential of Indian Jujube (BER) in Darrang district, Assam

Jillul Hoque

India ranks second among Jujube-growing countries in the world after China. The annual production of jujube in India is estimated at 10 lakh tonnes. The productivity of jujube in India is 10 metric tonnes/hectare. India with an area of approximately 1 lakh ha, ranks second among jujube-growing countries in the world after China. India has produced 586 thousand metric tonnes of Indian jujube in the 53-thousand-hectare area in 2021-22. The Indian Jujube, also known as Ber or Boroi in Assam, is a fruit-bearing tree that is commonly found in the region. The Indian Jujube belongs to the species Ziziphus mauritiana. It is a small to medium-sized tree. The tree is known for its spiny branches and glossy green leaves. The fruit of the Indian jujube is a drupe. It has a sweet and tangy taste, often described as similar to dates. It is well adapted to a wide range of soil types and climatic conditions, making it suitable for cultivation in Assam. Indian Jujube fruits are rich sources of Vit C and contain significant amounts of other essential nutrients like calcium, iron and phosphorous. It is also known for its high fiber content. In Assam, the Indian Jujube holds cultural significance, and the fruit is often offered during religious ceremonies and festivals. The tree's wood is used in making small tools and handicrafts. The cultivation of Indian Jujube provides a source of income for farmers in Assam, and the fruits are also sold in local markets. Additionally, the tree helps in soil conservation and provides shade for other crops. The present study is on Indian jujube farming over a 13.65-hectare sample area. Three separate ways of distribution for Indian jujube products were found. Channel I was a route that included manufacturers, wholesalers, retailers, and consumers. Channel II took a more direct route, connecting producers to traders directly, resulting in consumer purchases. Channel III represented the most straightforward way, with producers selling directly to customers. The study found a promising return over the cost ratio of 2.50, showing that Indian jujube farming is profitable. This means that farmers who cultivate jujube can earn a good living, proving the financial sustainability of this agricultural endeavour.

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Major Adviser: Dr. Rinumoni Buragohain

Socio-Economic Profile of Women Entrepreneurs Exploring the Weaving Industry – A Case Study in Barpeta District of Assam

Kashmiree Pathak

The weaving industry being women intensive in nature provides a suitable setting to examine how the women owned enterprises contribute to the development of regional economy. Also, in a society where there is patriarchal hegemony, they face various gender biasness and stereotypes and despite of these challenges the women entrepreneurs have shown tremendous resilience and determination by breaking the stereotypes and empowering themselves by making independent decision and having financial independence thus challenging the traditional gender dynamics. This research study investigates the socio-economic profile of women entrepreneurs engaged in the weaving industry in Barpeta district of Assam with the objective to examine the profile of women entrepreneurs in weaving industry in Barpeta District, analyse the contributing factors to income generation of women entrepreneurs from weaving industry, and identify the production, marketing and financial constraints faced by women entrepreneurs in weaving idustry. Primary data pertaining to the year 2022-2023 were collected from 50 women entrepreneurs selected from Bhabanipur block and Chakachaka block of Barpeta district of Assam. The women entrepreneurs were further classified into two groups based on their loom size to give them fair representation. The present study thus the reveals several key findings. Firstly, the study sheds light on the diverse socio-economic backgrounds of these women, with variations in age, education, marital status, source of income, training status, family history in weaving and family size impacting their income as well as. Different types of weaved products were produced by the women entrepreneurs namely Chadar, Mekhela, Set, Bihuwan Gamosa, Uka Gamosa and Anakota Gamosa. The unit prices of the yarns were also different and prices per kg varied based on the types and grades of yarn used. The average total variable cost and total fixed cost incurred by per entrepreneur of the overall sample size in a year was Rs 1,35,717 and Rs. 1,49,624. The average total gross return per entrepreneur was estimated to be Rs. 5,03,108. The benefit cost ratio was found to be

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1.80. The marketing profile reveals that three marketing channels were used where 76% of the entrepreneurs used channel III. Among all the channels channel I was found to be the most efficient and channel III being the most effective as volume of transaction was the highest through that channel. The income generation of the women entrepreneurs was found to be contributed by socio-economic characteristics such as education, marital status, age, family size, training, hours of work, number of employees, past history. Age and marital status were found to be negative and significant in contributing to income generation, whereas training and past history were not significant but contributed positively. Education (0.20**), hours of work (0.09***), number. of employees (0.11**) and family size (0.09***) contributed positively and significantly. Various responses of women entrepreneurs were also taken of the factors that motivated them to generate income, it was found that supporting family financially was the most important motivating factor among the respondents Moreover, the research examines the production, marketing and financial constraints faced by women entrepreneurs in the weaving sector, which revealed that shortage of labour, tough competitions from established retailers and regular and frequent need of working capital were some of the major constraints faced by the women entrepreneurs in the study area. The study provides valuable insights into the socio-economic profile of women entrepreneurs and that the women entrepreneurs of the weaving industry in Barpeta district have made significant accomplishments and progress despite the difficulties in the weaving industry. The study thus suggests approaches to improve the production and marketing of their products to increase their returns and for the overall development of the weaving industry.

Consumers Perception Towards Organic Food Products in Nellore District of Andhra Pradesh

Nallaka Rushitha

In the recent times, there has been a growing demand in the consumption of Organic food products due to various nutritional and health benefits. Organic food products add to the benefits of environmental protection in addition to providing safety of humans and animals and these organic food products have been gaining importance among the public especially after covid 19 pandemic. The present study was undertaken mainly to understand the status of organic food products available in Nellore, to understand the consumer awareness, knowledge and perception towards Organic food products. In addition to this, the current study also analyses the major factors that plays a vital role in consumption of Organic food products. The study helps the marketers to create new marketing tactics for manufacturing and distribution of organic food products. The present study was conducted in the Nellore district of Andhra Pradesh from 60 consumers of organic food products. The findings of the study revealed that major organic food products available in the retail outlets are rice and cereals, millets, pulses, processed food products and dry fruits from the brands of Prakruthivanam, Nischalam, Goshala, Timbaku, Prabhakar brand, AH, Bheeshma, Nature Land and Khadi Organics. The correlation analysis reveals that out of the seven profile variables selected, Age, Education, Monthly income and Monthly expenditure on organic products has shown significant relation with the awareness, knowledge and perception on organic food products. The study also reveals that consumer purchase behavior has significant relation with consumer satisfaction, knowledge and perception. For factor influencing purchase decision, out of 33 variables ten variable have loadings on factor one with 50% of cumulative variance, six variables on factor two with 60% of cumulative variance, seven variables on factor three with 64.5% of cumulative variance, five variables on factor four with 68.6% of cumulative variance and three variables on factor five with 72.2% of cumulative variance. However, there are certain problems in consumption of organic products like high price, Inadequate availability, less access to quality products etc., Moreover consumption of organic food products motivates farmer to go for organic farming practices which is considered safe and healthy as well as eco-friendly.

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Department: MBA (Agri. Business)

Major Adviser: Dr. Manashi Gogoi

A study on fisheries management systems in Manipur

Premlata Soibam

Manipur, a state in northeastern India offers the perfect climate and soil for agricultural growth. LOKTAK LAKE, the largest freshwater lake in North-East India with a surface size of 24,672 hectares, is the state's most important inland water resource. Fishing and other fisheries activities in and around the lake account for somewhat more than half of the fish produced in the state. Manipur shares a section of the Indo-Burma biodiversity hotspot and is abundantly endowed with a range of biological resources. In Manipur, aquaculture is significant not just for nutrition but also for the state's rural economy. This suggests an excellent opportunity to develop fish culture enterprises and boost the rural economy. The present study is an attempt to study the fisheries management systems in Manipur. The study was conducted in the four highest fish-producing districts of Manipur. The data were collected using a special schedule through personal interviews with respondent farmers. The government record showed that the state comprised 56,461.05 ha of diversified water bodies suitable for fish farming with different species of fish being cultured by Manipuri people producing 33,112 tonnes of fish in the year 2021-22. The compound growth rate analysis of table fish and fish seed reflected a positive growth rate during the period of 2012 to 2021. The study revealed that the majority of fish farming in the state was based on polyculture, with a variety of species stocked in the same pond. It had also been observed that the majority of the state's aquaculture practices were traditional, they also followed semi-intensive and intense farming systems. The analysis of the study reflected that the resources use patterns among the different groups of fish farmers seem to be different from one another which also revealed the inefficient use of resources for fish farming in the study area. Manipur has a huge potential to advance its fish farming industry by implementing improved production techniques. The study's demand and supply gap analysis reflected that the demand was more while the supply was less, for that tonnes of fish, had been brought in from other states of India to fulfil the demand. After the analysis, it was clear that for Manipur's fish industry, effective administration practices and leveraging current technology to tap into untapped and prospective resources will develop growth in the production of fish.

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Major Adviser: Dr. Sangita Borah

Value Chain Analysis of Kiwi in Arunachal Pradesh

Priya Thihing

The kiwifruit (Actinidia deliciosa Chev.) is a fruiting vine, also referred to as "China's miracle fruit" and "Horticulture Wonder of New Zealand". It is believed to be native to china, but New Zealand introduced it to the world market. In India, kiwi fruit was first introduced in 1963 in Shimla and later spread to the mid and low-hills of the country, and has been identified as one of the significant and profitable fruit crops for the future. The present study was on Value Chain Analysis of Kiwi in Arunachal Pradesh, largest producer of kiwi fruit in India. It contributes 44% of the total 16.13 thousand tonnes of kiwi produced in the country. As part of the Mission Organic Value Chain Development Programme for the North East Region (MOVCDP-NER), the Lower Subansiri district of Arunachal Pradesh is the first in the country to receive an organic certification for kiwi. The major objectives of the study includes production and disposal pattern of Kiwi, mapping the value chain and finally to examine the problems throughout the value chain. Primary data were collected from the sample farmers of the Lower Subansiri district using random sampling techniques from 40 farmers and 20 stakeholders. Simple tabular and percentage analysis, compound growth rates, producer's surplus analysis and garret ranking techniques were used as per the needs of the objectives. The findings of the study revealed that kiwi fruit production and commercialization are emerging farming operations in the study area. Kiwi farming is becoming an appealing agricultural business, as it generates a considerate income for farmers. The CGR was found to be 16.60, 11.51 and -3.96 respectively for area, production and productivity of Kiwi in the study area. The marketable surplus was 1299.50 quintals but the marketed surplus was found to be more than marketable surplus (1314.20qts). it implies distress sale on the part of the sample farmers. Out of the 6 marketing channels identified, channel –VI, viz., producer – cooperatives – distant trader / wholesaler – distant retailer – consumer was found to be the most effective channel, dealing with 36.70% of the total production. It was also found that 78.50 % and 21.50 % of Kiwi reaches the consumer as fresh and processed Kiwi respectively. The major problems encountered during production and marketing were found to be high

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cost of establishment, lack of grading facilities Providing production subsidy, nurseries for quality planting material, developing knowledge and skills of the grower, and developing post harvest practices may lead to develop the Kiwi sector to a great extent. India imports fresh kiwis to satisfy domestic demand; hence there is enormous potential to boost kiwi production in Arunachal Pradesh. However, the lack of reliable production data, research and extension services, post-harvest infrastructure, and the poor credit support make it difficult to develop an efficient value chain. Marketing is also a major challenge due to a lack of cold storage and processing facilities, as well as other infrastructure for promoting kiwifruit in the region. On the basis of the results, one may suggest that a dedicated research centre, training and extension services, financial support and infrastructure facilities may be provided to increase the productivity and improve the value chain of kiwi in the study area.

Production Pattern, Marketing and Brand Positioning of Dairy Products: A case study in Ajmer Dairy of Rajasthan

Saurabh Sharma

India is the highest milk producing countries of the world. India contributed 24 per cent of the milk production to the world. As to sustain the nation the government of India started dairy development in 1965 following Anand pattern in the country. Currently the nation had 228 District Milk Producer Unions in the countries which employed more than 170 million of people. Rajasthan is the leading milk producing state in the country with contribution of 15.05 percent. The state government initiated dairy development in the early seventies. RCDF (Rajasthan Cooperative Dairy Federation) became the nodal agency for implementation of Operation Flood and other dairy development programmes in Rajasthan. The federation had 24 District Milk Unions collecting milk from 18,213 village dairy cooperative societies. The federation had daily milk procurement of about 3148 thousand kilogram and liquid milk marketing of about 2247 thousand litres of milk per day with registered membership of 8,80,793 milk producers. Ajmer Dairy was established in 1972 as a subsidiary unit of Rajasthan Cooperative Dairy Federation (RCDF). Initially the union procured 500 litres of milk per day. Over the years Ajmer dairy had made significant growth in all the fields, i.e., procurement, processing and production of various milk and milk products and marketing thereof under the brand name of "SARAS". Currently Ajmer dairy ranked third highest in the milk procurement and second highest in liquid milk marketing. The union processes a number of milk and milk products which are very popular at different parts of Rajasthan. Saras milk was the main product of the plant with 857.75 lakh litre of production with a product share of 61 percent. Saras lassi had the lowest share (1 per cent) due to seasonal demand and nature of production. Ghee, paneer, ice-cream, sweets, curd, etc. are the other products manufactured at the plant. The union had a turnover of 727 crore rupees in the year 2022 and made payment of 503.5 crore rupees to the milk producers. The union marketed its milk products through 36 different routes. The union had installed 509 booths, 1915 shops and 79 parlours in Ajmer and its adjoining tehsils. The union marketed its milk and milk products through two channels. The results of the

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study of marketing channel indicated Producer Union Consumer was the most common channel used by the dairy plant in the study area. For this study, a total of 60 members of consumers were drawn randomly from Ajmer city to assess the brand value of Ajmer dairy in the market.

Consumer preference and perception towards value-added products of soybean in Jorhat market

Shreya Rawat

Soybean (Glycine max) has a long history of 5000 years and has been hailed as the "golden miracle bean" of the 21st century. The most important and foremost reason is its nutritional profile, it is rich in protein and high nutritive value. Soybean is one of the most important oilseed crops in India. We are living in a world of a growing population and climate crisis; it becomes extremely difficult to fulfil a nutritional need of a growing population. Soybean stands out as one of the best options due to its nutritional qualities and its versatility. The present study was undertaken to explore consumer preference and perception towards value-added products of soybean in Jorhat district. A total sample size of 80 consumers were taken from the Jorhat market, various soybean value added products were selected for the study such as soy chunks, soy oil, soy sauce, soy snacks, infant food, health drinks, breakfast cereals, tofu, soymilk and soy granules. The findings of the study revealed that consumers perception regarding soy food products were found to be different for all the products. Consumers were found to be purchasing soy food products only once in a month. For majority of products consumers took a planned purchase decision. Consumers preferences were influenced by a wide variety of factors such as sales promotional activities, quality of product, price, product advertisement, type of packaging and design, taste and flavour, and nearness to the source of purchase. various problems related to the consumption of soybean products were identified. Lack of knowledge about the nutritional benefits of soy products, misconceptions regarding soybean intake, reluctance by family members to change food habit and beany flavour of soybean were some of major constraints. Increasing consumer awareness through government-led awareness activities, enforcing regulations and quality standards for soybean products, conducting more research and development for innovative soy products, are some of the recommended steps to address these challenges.

Abstract of M.Sc. thesis

Department: MBA (Agri. Business)

Major Adviser: Dr. Nivedita Deka

Management Performance of Dairy Farm Business in Jorhat District of Assam

Sumit Kumar Upadhyay

The research project shed light on the status of dairy farming and management practices in Jorhat District. Despite the status needs to be more satisfactory, there is a positive and encouraging trend of gradual improvement within the sector. The selected dairy farms demonstrated commendable efficiency and proficiency in their management practices, with Navneet Dairy leading the way in terms of financial performance. Notably, private farms displayed a distinct advantage over dairy cooperative societies (DCSs) by successfully expanding their product offerings beyond fresh milk. this diversification strategy contributes to higher revenue generation. On the consumer front, Navneet Dairy products garnered significant preference, especially the MD brand, due to high satisfaction levels among consumers. However, it is worth noting that other brands faced challenges in consumer preference, potentially due to packaging issues, particularly those using loose packaging. Enhancing packaging strategies could prove beneficial in attracting more consumers and increasing market competitiveness for these brands. While Navneet Dairy and its MD brand received high satisfaction ratings, there is an opportunity for other brands to improve their product quality, branding, and marketing strategies to meet consumer expectations. By focusing on delivering superior products and ensuring consistent quality, dairy farms can cultivate stronger consumer loyalty and capture a larger market share. Overall, the study underscores the importance of further development and improvements in the dairy farming sector in Jorhat district. By leveraging efficient management practices, diversifying product offerings, and addressing packaging concerns, the sector can strive towards enhanced growth and meet the evolving demands and preferences of consumers.

Abstract of M.Sc. thesis

Department: MBA (Agri. Business)

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Entrepreneurial Growth and Financial Status of Incubates under NEATEHUB, AAU

Taniya Yengkokpam

India's entrepreneurial landscape has witnessed a significant transformation over the years, with the agriculture sector benefitting from the rise of agri-startups. The liberalization policies since 1991 have further facilitated the growth of entrepreneurship, creating a favourable environment for startups to flourish. The North East region, though having a lower number of registered businesses, is experiencing a surge in startups, particularly in agriculture, thanks to institutions like the North East Agriculture Technology Entrepreneurs Hub (NEATEHUB). As an Atal Incubation Centre, the NEATEHUB plays a crucial role in nurturing successful startups in agriculture and allied sectors, contributing to sustainable economic growth and food security in the region. Moreover, startups benefit from technical support, access to the latest technologies, necessary certifications, and pre-incubation training and legal services, ensuring a strong foundation for their businesses. The facilitation of the primary level supply chain of agrocommodities and trade facilitation further adds to NEATEHUB's significance as a driving force for sustainable development and economic prosperity in the region. The present study entitled "Entrepreneurial Growth and Financial Status of Incubates under NEATEHUB, AAU" highlights the status of the entrepreneur in business development, the financial position & stability of the business and the problems faced by the incubates in the growth and development of the business. The analysis reveals that incubation significantly contributes to the growth and success of startups. Many startups showed increased employment and income generation after incubation, with the "Waste to Wealth" group exhibiting notable progress. For the study of the financial position of the startup, ratio analysis was calculated. The current ratio of all the startups have above 1 showing stronger short-term liquidity and most of the startups maintain a relatively low debt- equity ratio and maintains a decent net profit margin ratio. The ratio analysis of the startups revealed that all the startups are financially healthy and proven to be all feasible and profitable. However, despite these successes, startups still face significant challenges, including lack of equipment and machinery, limited access to marketing information and technology, and difficulties in

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Department: MBA (Agri. Business)

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raising finances and attracting investments. In conclusion, India's rich entrepreneurial landscape, bolstered by supportive policies and institutions like NEATEHUB, contributes to drive economic prosperity and job creation.

Effect of nano urea and irrigation management practices on rabi maize (*Zea mays* L.)

Akash Paul

A field experiment was conducted at Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during the rabi season of 2022- 2023 to study the effect of irrigation and nitrogen management in rabi maize (Zea mays. L). The experiment consisted of four irrigation schedules viz., rainfed (I1), irrigation at 0.6 IW/CPE ratio (I2), irrigation at 0.8 IW/CPE ratio (I3), irrigation at grand growth period + tasseling + grain filling stages (I4) and three different nitrogen management practices viz., RDF + water spray at knee high and tasseling stages (N1), 50% RDN through urea as basal + 4 ml/litre nano urea at knee high and tasseling stage (N2), 50% RDN through urea as basal + 6 ml/litre nano urea at knee high and tasseling stage (N3). The experiment was laid out in split-plot design with three replications. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.23), medium in organic carbon (0.67 %), low in available N (247.43 kg/ha), available P2O5 (18.53 kg/ha) and medium in available K2O (185.76 kg/ha). The initial bulk density, porosity and water holding capacity of the soil at 0-20 , 20-40 and 40-60 cm depth were 1.38, 1.39 and 1.41 g/cm3 ; 47.22, 47.43 and 47.51 %; and 46.34, 46.57 and 46.71 %, respectively. The maize variety “DKC 9081” was sown on 23rd October, 2022 and harvested on 25h February, 2023. The results revealed that irrigation schedules influenced growth characters of maize in terms of plant height, number of leaves/plant, leaf area index, dry matter accumulation, crop growth rate, relative growth rate and relative leaf water content. Irrigation at grand growth period + tasseling + grain filling stages (I4) recorded the highest values for all the growth parameters which were statistically at par with irrigation at 0.8 IW/CPE ratio (I3). The maximum values for yield attributing characters, cob yield (89.80 q/ha), kernel yield (68.69 q/ha) and stover yield (115.53 q/ha) as well as N, P and K uptake were recorded under irrigation at grand growth period + tasseling + grain filling stages (I4) which was also statistically at par with irrigation scheduled at 0.8 IW/CPE ratio (I3) (86.97 q/ha cob, 66.61 q/ha kernel and 113.47 q/ha stover yield). Similarly, the maximum evapotranspiration rate and total water use was observed under irrigation at grand growth period + tasseling + grain

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filling stages (I4) treatment which was closely followed by irrigation at 0.8 IW/CPE ratio (I3). However, maximum crop and field water use efficiency, soil temperature over the intervals were observed under rainfed condition (I1).

Effect of integrated nutrient management on growth and yield of finger millet (*Eleusine coracana* L.)

Anasuya Borua

A field experiment entitled "Effect of integrated nutrient management on growth and yield of finger millet" at Instructional-cum-Research Farm, Assam Agricultural University, Jorhat to evaluate the performance of AAU-GSG-Marua Dhan-1 variety of finger millet under integrated nutrient management practices was conducted during 2022-23. The experiment was conducted in a randomized block design (RBD) with three replications comprising an individual plot size of 4 m × 3 m. The nursery sowing was done on September 2, 2022, transplanted in the main field on October 2, 2022 and harvested on January 18-27, 2023. The nutrient management practices consisted of control (T1), recommended NPK (40- 20-20 kg ha-1) + FYM 1 t ha-1 (T2), recommended NPK (40-20-20 kg ha-1) + vermicompost @ 0.5 t ha-1 (T3), recommended NPK (40-20-20 kg ha-1) + poultry litter vermicompost @ 0.5 t ha-1 (T4), FYM @ 1t ha-1 (incubated with microbial consortia @ 0.2% w/w for 15 days) mixed with quick lime @10 kg ha-1 (1000:10) at basal and 30 DAS (T5), vermicompost @ 0.5 t ha-1 enriched with microbial consortia @ 0.2% w/w for 15 days (T6), poultry litter vermicompost @ 0.5 t ha-1 enriched with microbial consortia @0.2% w/w for 15 days (T7), vermicompost @ 0.5 t ha-1 (incubated with microbial consortia @ 0.2% w/w for 15 days) mixed with 50% of the recommended dose of NPK applied as basal (T8), poultry litter vermicompost @ 0.5 t ha-1 (incubated with microbial consortia @ 0.2% w/w for 15 days) mixed with 50% of the recommended dose of NPK applied as basal (T9). The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 4.98), medium in organic carbon (0.58 %), low in available N (263.42 kg ha-1) and available P2O5 (20.52 kg ha-1) and medium in K2O (250.39 kg ha-1). The results revealed that the growth, yield attributing characters and N, P, K content were significantly higher in the T3 (Recommended dose of NPK (40-20-20 kg ha-1) + vermicompost @ 0.5 t ha-1). As compared to control, Ca content (305.0 mg 100 g -1) and Fe content in grain (5.18 mg 100 g-1) was found to be higher in T3 (Recommended

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dose of NPK (40-20-20 kg ha-1) + vermicompost @ 0.5 t ha-1 . The grain yield (18.19 q ha-1) and stover yield (34.89 q ha-1) were significantly higher in plants grown in T3 (Recommended dose of NPK (40-20-20 kg ha-1) + vermicompost @ 0.5 t ha-1). Significantly higher N, P, K, and total uptake by grain and stover was recorded in all the INM practices over control. Incubation with microbial consortia in different sources of manures have shown differential results in agronomic efficiency. Agronomic efficiency (AE) for nitrogen was recorded highest for T6 i.e., vermicompost @ 0.5 t ha-1 enriched with microbial consortia @ 0.2% w/w for 15 days (20.31 kg kg-1). AE for phosphorus was recorded highest for T4 i.e., recommended dose of NPK (40-20-20 kg ha-1) + FYM @ 1 t ha-1 (31.67 kg kg-1). AE for potassium was found to be the highest in T7 i.e., poultry litter vermicompost @ 0.5 t ha-1 enriched with microbial consortia @ 0.2% w/w for 15 days (71.26 kg kg-1). After harvest of the crop, the highest soil available N, P2O5 and K2O (255.1, 28.53 and 243.1 kg ha-1 respectively) was recorded under the application of recommended NPK (40-20-20 kg ha-1) + vermicompost @ 0.5 t ha-1 (T3). It was observed that the highest net returns of ₹ 36978.31 ha-1 with a B:C of 1.24 was recorded with the application of recommended dose of NPK (40-20-20 kg ha-1) + vermicompost @ 0.5 t ha-1 (T3) followed by the application of recommended dose of NPK (40-20-20 kg ha-1) + FYM 1 t ha-1 (T2) with a net returns and B:C of ₹ 30892.18 ha-1 and 1.20, respectively.

Effect of plant density on growth, yicld and economics of local small potato varieties under rainfed condition of Assann

Arunima Goswami

A field experiment entitled "Effect of plant density on growth, yield and economics of local small potato varieties under rainfed condition of Assam" was conducted during rabi, 2022-23 at the experimental field of the Department of Agronomy, BNCA with the objectives to find out the optimum spacing for local small tuber potato and to study growth, yield and economics of local small tuber potato. The experiment was laid out in a Split Plot design with three replications placing varieties in the main plots and spacings in the sub-plots. The treatments consisted of 2 varieties of local small tuber potato viz. white eyed small tuber potato (V1) and red eyed small tuber potato (V2) and 6 spacings viz. 50cm × 20cm (S1), 50cm × 15cm (S2), 50cm ×10cm (S3), 60cm × 20cm (S4), 60cm × 15cm (S5) and 60cm × 10cm (S6). From the experiment, it was found that between the varieties, the local red eyed small tuber potato reflected better performance in terms of tuber yield (13.00 t ha-1) over local white eyed small tuber potato (10.41 t ha-1). Yield attributing characters viz. tubers per plant, tuber weight per plant, harvest index and production efficiency were also higher in red eyed small tuber potato over white eyed variety. The higher Gross return (Rs. 3,90,139 per ha), Net return (Rs 2,63,068 per ha), B:C ratio (2.84), Net return per rupee invested (Rs. 1.84 per ha) and Economic efficiency (Rs 2297.58 ha-1 day-1) was recorded by red eyed small tuber potato. There was no significant effect of varieties on morphological parameters, phenological parameters (viz. days to seedling emergence, days to stolon formation and days to tuber initiation) and physiological parameters (viz. LAI, CGR, RGR and NAR). Among the spacings, S3 (50cm × 10cm) recorded the highest tuber yield (13.88 t ha-1) with the highest Gross return (Rs 4, 16,434 per ha), Net return (Rs 2,73,762 per ha) with a B:C ratio of 2.92. The effect of spacings was found to be significant in respect of growth, yield and physiological parameters except for RGR and NAR. The interaction effect of varieties and spacings was significant registering highest tuber yield of 14.45 t ha-1 by red eyed variety at a spacing of 50cm × 15cm. The higher

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values of soil available N, P2O5 and K2O at harvest was recorded by white eyed variety. Similarly, spacings reflected significant effect on soil N, P2O5 and K2O kg ha-1 recording the highest value at S4 (60cm × 20cm) over other spacings. Red eyed variety showed better uptake of NPK (kg ha-1) and difference in spacings also exerted significant influence on total uptake of NPK (kg ha1) recording highest at 50cm × 10cm.

Effect of varieties and establishment methods on grain and fodder yield of finger millet (*Eleusine coracana* L.)

Banothu Chakravarthi

A field experiment was conducted during the Sali season of 2022-23 at the Instructional cum Research (ICR) Farm, AAU, Jorhat. The main focus was to examine the impact of different finger millet (Eleusine coracana) varieties and establishment methods on both grain and fodder yield. The study aimed to achieve two objectives: firstly, to assess the performance of finger millet varieties under different establishment methods in terms of growth, yield, and quality; secondly, to evaluate the potential fodder yield and nutritive value across various establishment methods. The experiment included four establishment methods: broadcasting (M1), line sowing (M2), transplanting (M3), and SFMI (System of finger millet intensification) (M4). Three varieties were tested: GPU-67 (V1), CFMV-2 (V2), and AAU-GSGMaruvadhan (V3). The experiment followed a Factorial Randomized Block Design (RBD) with three replications. The soil at the experimental site was sandy loam, slightly acidic (pH 5.10), had moderate organic carbon content (0.51%), medium available nitrogen (279.41 kg/ha), medium available phosphorus (23.86 kg/ha), and low available potassium (128.40 kg/ha). Results indicated that establishment methods significantly influenced growth and yield-related characteristics throughout all growth stages. Transplanting (M3) consistently outperformed broadcasting (M1), line sowing (M2), and SFMI (M4) in terms of plant height, population density, leaf area indices, dry matter accumulation, and crop growth rate at all growth stages. Additionally, transplanting (M3) led to higher values for yield-related traits such as finger length, number of fingers per ear head, ear head weight, and test weight, followed by SFMI (M4), line sowing (M2), and broadcasting (M1). Broadcasting (M2) resulted in the highest number of ear heads per square meter. Transplanting (M3) exhibited the highest grain yield (23.46 q/ha), fresh straw yield (59.32 q/ha), and dry straw yield (32.95 q/ha). This method also recorded higher nitrogen, phosphorus, and potassium uptake in both grain and straw. In terms of varieties, CFMV-2 (V2) showed superior growth and yield characteristics, followed by

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GPU-67 (V1) and AAU-GSG-Maruvadhan (V3). CFMV-2 (V2) had the highest grain yield (21.42 q/ha), fresh straw yield (52.54 q/ha), dry straw yield (30.16 q/ha), and nutrient uptake. When considering treatment combinations, the combination of transplanting (M3) with CFMV-2 (V2) demonstrated the best growth and yield attributes, followed by transplanting (M3) with GPU-67 (V1) and transplanting (M3) with AAU-GSG-Maruvadhan (V3). Economically, the transplanting (M3) and CFMV-2 (V2) combination yielded the highest gross return (Rs. 93754.97/ha) and net return (Rs. 58520/ha) with a benefit-to-cost ratio (B:C) of 2.66.

Response of kharif rice to deep placed fertilizer briquettes

Dhritismita Das

An experiment was performed in Instructional-cum-Research Farm, Assam Agricultural University, Jorhat on transplanted kharif rice (variety- Ranjit Sub-1) in 2022 entitled "Response of kharif rice to deep placed fertilizer briquettes''. The field experiment comprised of 13 fertilizer management treatments with three replications was laid out in Randomized Block Design (RBD). The treatments consisted of T0: Control; T1: Recommended Dose of Fertilizer (RDF); T2: RDF + ZnSO4 @ 10 kg/ha; T3: RDF + ZnSO4 @ 10 kg/ha + bio-fertilizer; T4: Fertilizer deep placement (FDP); 80% Recommended Dose of Nitrogen (RDN) +100% P and K; T5: FDP; 80% RDN + 100% P and K + ZnSO4 @ 10 kg/ha; T6: FDP; 80% RDN + 100% P and K + ZnSO4 @ 10 kg/ha + biofertilizer; T7: FDP; 100% RDN + 100% P and K; T8: FDP; 100% RDN + 100% P and K + ZnSO4 @ 10 kg/ha; T9: FDP; 100% RDN +100% P and K + ZnSO4 @ 10 kg/ha + biofertilizer; T10: FDP; 120% RDN + 100% P and K; T11: FDP; 120% RDN + 100% P and K + ZnSO4 @ 10 kg/ha and T12: FDP; 120% RDN + 100% P and K + ZnSO4 @ 10 kg/ha + biofertilizer. The soil texture of the experimental site was sandy loam, acidic in reaction (pH 5.27) with bulk density 1.42 Mg/m3 , medium in organic carbon (0.57%) and available N (290.56 kg/ha) and low in available P2O5 and K2O (20.56 kg/ha and 126.74 kg/ha, respectively) and medium in DTPA Zn (0.86 mg/kg). Initial soil microbial biomass carbon was 200.32 µg/g of soil. The findings from the experiment revealed that fertilizer management practices under the study influenced crop growth and yield attributes, yield, nutrient content and uptake by crop, availability of N, P2O5 and K2O in soil at different stages of the crop and DTPA Zn, soil organic carbon and soil microbial biomass carbon (SMBC) at harvest, nutrient use efficiencies and economics of transplanted kharif rice. Among fertilizer management treatments of the present investigation, FDP; 120% RDN + 100% P and K + ZnSO4 @ 10 kg/ha + biofertilizer (T12) showed significantly higher values in case of all the crop growth parameters such as plant height, root length, number of tillers/m2 and dry matter accumulation etc. at 30, 60, 90 and 120 DAT as compared to rest of the treatments other than FDP; 120% RDN + 100% P and K + ZnSO4 @ 10 kg/ha (T11) and FDP; 120%

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RDN + 100% P and K (T10). All the physiological parameters viz., leaf area index, specific leaf weight, leaf area duration, NDVI value and SPAD chlorophyll meter content significantly increased in T12 followed by T11 and T10 throughout its growth stages over control. In case of weed density and weed dry matter significantly lower values were noted under all the deep placed fertilizer briquettes treatments compared to surface broadcasted plot and control at 30, 60, 90 and 120 DAT. The treatment FDP; 120% RDN + 100% P and K + ZnSO4 @ 10 kg/ha + biofertilizer (T12) significantly increased yield attributing parameters such as number of panicles/m2 , panicle length (cm), number of grains/panicle, number of filled grains/panicle and 1000 grain weight by 86.2, 72.1, 54.7, 66.3 and 21.9 %, respectively resulting the highest grain, straw and biological yields and the increment was by 85.4, 54.0 and 66.4 %, respectively over control. This treatment was at par with T11 and T10 in this regard. No significant variation was registered with subject to harvest index among all the treatments. The correspondence per cent increase in N, P, K and Zn content in grain and straw under T12 were 71.4 and 40.2; 30.9 and 57.5; 33.0 and 65.1, and 140.8 and 171.2. The respective per cent increase in N, P, K and Zn uptake by grain and straw under T12 were 217.9 and 115.5; 143.0 and 140.5; 147.2 and 154.0, and 345.5 and 319.1. Significantly higher periodic availability of nutrients (available N, P2O5 and K2O at 30, 60, 90, 120 DAT and at harvest) was recorded under the deep placed fertilizer briquettes containing 100 and 120% N treatments over control, in addition to this DTPA Zn at harvest was also found significantly higher in all Zn applied treatments over non Zn applied treatments and control. Agronomic and apparent recovery efficiencies based on inorganic N applied were higher under FDP; 120% RDN + 100% P and K + ZnSO4 @ 10 kg/ha + biofertilizer (T12) followed by FDP; 120% RDN + 100% P and K + ZnSO4 @ 10 kg/ha (T11) and FDP; 120% RDN + 100% P and K (T10). On the other hand, in case of partial factor productivity, FDP; 80% RDN + 100% P and K + ZnSO4 @ 10 kg/ha + biofertilizer (T6) indicated higher values followed by FDP; 80% RDN + 100% P and K + ZnSO4 @ 10 kg/ha (T5) and FDP; 80% RDN +100% P and K (T4). All the treatments where inorganic fertilizer was combined with biofertilizer (T3, T6, T9 and T12) recorded significantly enhanced soil microbial biomass carbon at 60 DAT and at harvest out of all the treatments. T12 showed significantly higher organic carbon over control and the increase was 28.9 % over control. Higher gross and net returns were noted by T12 (143968.89 and 95363.69 ₹/ha, respectively) which was closely followed by T11 and T10. Further, the highest B:C was also established by T12 (1.96) closely followed by T11 (1.93) and T10 (1.86).

Response of rapeseed (*Brassica campestris* var. toria) to jasmonic acid under different micro-climatic regimes

Dimpi Dutta

A field experiment entitled "Response of rapeseed (Brassica campestris var. toria) to jasmonic acid under different micro-climatic regimes." was conducted at Instructionalcum- Research (ICR) farm, Assam Agricultural University, Jorhat during rabi season of 2022- 23. The objectives of the experiment were to study the effect of jasmonic acid on growth and physiological parameters as well as to find out the effect of jasmonic acid on yield attributing characters, yield and oil content of rapeseed under different micro-climatic regimes. The rapeseed variety TS 67 was selected for the experimentation. The treatments were laid out in a split-plot design with three replications. The treatments comprised of three different sowing dates viz., D1: 15th Nov, D2: 30th Nov, D3: 15th Dec in main plots and sub-plots consisted of different jasmonic acid (JA) concentrations i.e., C1: Control, C2: 50 µmol JA, C3: 100 µmol JA and C4: 150 µmol JA. The soil of the experimental site was sandy loam in texture, acidic in nature (pH 5.22), medium in organic carbon content (0.54 %), low in available N (239.54 kg per ha), P2O5 (22.40 kg per ha), K2O (112.42 kg per ha) and sulphur (6.61 mg per kg). Results revealed that among the different sowing dates, the crop sown on 15th November (D1) recorded significantly increased plant height, number of primary, secondary branches and dry matter production per plant, whereas, the crop sown on 15th December (D3) recorded significantly higher root-shoot ratio and proline content. In case of physiological parameters also, 15th November sown crop (D1) recorded significantly higher chlorophyll content, relative water content, leaf area and other growth indices viz., leaf area index, leaf area duration crop growth rate and relative growth rate. The crop sown on 15th November (D1) required significantly higher number of days to flower initiation (28.50 days), 50% flowering (34.50 days), siliqua formation (34.58 days) and physiological maturity (87.08 days) along with significantly higher accumulated growing degree days (1199.77 0C day), helio-thermal units (7567.22 0C day hours) and photo-thermal units (12766.70 0C day hours). The

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yield attributing characters such as siliquae length (5.48 cm), number of siliquae per plant (58.65) and number of seeds per siliqua (12.03) were found to be maximum under the sowing of crop on 15th Nov (D1). Significantly higher seed yield of 6.66 q ha-1 , stover yield of 14.11 q ha-1 and oil yield of 243.62 kg ha-1 were also obtained from the sowing of the crop on 15th November (D1). On the other hand, crop sown on 15th December (D3) recorded lowest seed as well as stover yield of 4.99 q ha-1 and 12.21q ha-1 respectively. In case of different concentrations of jasmonic acid (JA), the application of 100 µmol JA (C3) significantly increased plant height and dry matter production at different growth stages. The physiological parameters including relative water content, proline content, leaf area, leaf area index (LAI), leaf area duration (LAD) and crop growth rate were also found to be maximum with the application of 100 µmol JA (C3). In case of yield and yield attributes, significantly higher siliquae length (4.73 cm), number of siliquae per plant (55.75), number of seeds per siliqua (12.09) and seed, stover yield of 6.32 qha-1 and 14.21 qha-1 respectively were recorded with the application of 100 µmol JA (C3). The interaction between microclimatic regimes and jasmonic acid concentrations significantly influenced the plant growth, physiological and yield parameters. The crop sown on 15th November with the application of 50 µmol of jasmonic acid (D1C2), recorded significantly increased plant height, dry matter production, leaf area and leaf relative water content. The yield attributing characters as well as seed yield (6.78 qha-1), stover yield (14.89 qha-1) and oil yield (252.95 kg ha-1) were also found to be maximum in case of D1C2 treatment combination. In terms of economics the highest gross returns (₹ 40680 per ha), net returns (₹ 21046 per ha), and B-C ratio (2.07) were recorded for the crop sown on 15th November with 50 µmol JA application (D1C2), which was followed by sowing the crop on 15th Nov with the application of 100 µmol JA (D1C3) with gross return of ₹ 39060 per ha, net return of ₹ 19269 per ha, and 1.97 B-C ratio.

Effect of weed management practices on weed dynamics, growth and yield of rainfed rabi groundnut (*Arachis hypogaea* L.)

Dipannita Patgiri

A field experiment entitled "Effect of weed management practices on weed dynamics, growth and yield of rainfed rabi groundnut (*Arachis hypogaea* L.)" was conducted during rabi, 2022-23 at PG Experimental field, Department of Agronomy, B.N College of Agriculture, AAU, Biswanath Chariali with the objectives of: (i) Asses the effect of weed management practices on weed dynamics of rainfed rabi groundnut (ii) Evaluate the effect of weed management practise on growth and yield of rainfed rabi groundnut and (iii) Find out the economic weed management practice for rainfed rabi groundnut. The experiment was laid out in a randomized block design with three replication and eleven treatments viz.,(T1): Hand weeding twice at 15 and 35 DAS,(T2):Application of Pendimethalin @ 1kg a.i ha-1 as preemergence (PE),(T3): Application of Imazethapyr 10% SL @ 0.1 kg a.i ha-1 as post-emergence (PoE),(T4): Application of bio mulch @ 5t/ha,(T5): Hand weeding at 35 DAS + Application of bio mulch @ 5t/ha,(T6): Application of Pendimethalin @ 1kg a.i ha-1 (PE) + Hand weeding at 35 DAS,(T7): Hand weeding at 15 DAS + Application of Imazethapyr 10% SL @ 0.1 kg a.i ha-1 (PoE),(T8): Application of Pendimethalin @ 1kg a.i ha-1 (PE) + Application of bio mulch @ 5t/ha,(T9): Application of Imazethapyr 10% SL @ 0.1 kg a.i ha-1 (PoE) + Application of bio mulch @ 5t/ha,(T10): Application of Pendimethalin @ 1kg a.i ha-1 (PE) + Application of Imazethapyr 10% SL @ 0.1 kg a.i ha-1 (PE) and (T11): Unweeded (Control). The results from the present investigation revealed that weed management practices had significant influence on suppression of grassy, broad-leaved and sedge weeds including total weed population at 15, 35, 60 DAS and at harvest. Among weed management practices, significantly lower weed dry weight was found in 'Hand weeding twice (15 and 35 DAS)' at 35, 60 DAS and at harvest stage and this treatment also recorded highest weed control efficiency and lowest weed index. Morphological parameters viz., plant height, branches plant1 and leaf area showed significant differences among the weed management practices. Lowest plant height was

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observed in 'Hand weeding twice (15 and 35 DAS)' at 35 and 60 DAS and was comparable with 'Hand weeding at 15 DAS + Application of imazethapyr' at 35 and 60 DAS and later one recorded lowest plant height at harvest. Maximum branches plant-1 at 60 DAS and at harvest; leaf area at 60 DAS; green leaves at harvest and crop dry matter (15, 35, 60 DAS and at harvest) were obtained under 'Hand weeding twice (15 and 35 DAS)' and was comparable with 'Application of Imazethapyr 10%SL + Application of bio mulch'. Yield attributes. viz., pod yield plant-1 (70.4g), seed index (56.49 g), pods plant-1 (32.73), seeds pod1 (2.33), pod yield (3248 kg ha-1), seed yield (2344 kg ha-1), haulm yield (5539 kg ha-1) and harvest index (36.96 %) attained superiority in 'Hand weeding twice (15 and 35 DAS)' over other weed management practices. Weed management practices have exerted significant effect on available nitrogen, phosphorus and potassium but failed to influence on organic carbon and pH. Uptake of nutrients (N, P, K) by pod and haulm was significantly higher under 'Hand weeding twice (15 and 35 DAS)' over other weed management practices and this also recorded lowest uptake of nutrients by weeds. The highest gross return (Rs 324833 ha-1) and net return (Rs 222321 ha-1) recorded under 'Hand weeding twice (15 and 35 DAS)', however, significantly higher B:C ratio (2.39) was attained under 'Application of Imazethapyr + Application of bio mulch' followed by 'Hand weeding twice (15 and 35 DAS)' (2.17). Based on the above findings, it may be summarized that with the availability of human work force 'Hand weeding twice (15 and 35 DAS)' to be adopted for effective weed suppression, higher crop growth and yield of groundnut. While, the profitability (B:C ratio) is concerned, 'Application of imazethapyr + Application of bio mulch' proved to be better for rainfed rabi groundnut.

Performance of direct-seeded winter rice (wet DSR) as affected by different weed management practices

Hridesh Harsha Sarma

A field experiment was conducted at the research farm of AAU-ARRI, Titabar during the sali season (2022) with a view to study the growth and yield behavior of wet direct-seeded sali rice under different crop establishment techniques as well as to find out the best weed management practices for directseeded sali rice. The treatments consisted of three establishment techniques viz., broadcasting (M1), drum seeding (M2), line sowing (M3) and six different weed management practices viz., hand weeding at 20, 40 and 60 DAS (W1), pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS fb bispyribac-Na @ 25 g/ha at 25 DAS (W2), pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS fb mechanical weeding at 40 and 60 DAS (W3), pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS fb bispyribacNa @ 25 g/ha at 25 and 45 DAS (W4), weed free check (W5), weedy check (W6). The experiment was laid out in split-plot design which was replicated thrice. The soil of the experimental site was clay loam in texture, acidic in reaction (pH 4.97), medium in organic carbon content (0.56 %), low in available N (242.41 kg/ha), medium in available P2O5 (24.16 kg/ha) and available K2O (154.23 kg/ha). The results revealed that establishment techniques brought significant influences on growth and yield attributing characters, yield, weed density and weed dry weight in all the growth stages. Drum seeding (M2) proved statistically superior in regards to growth attributes viz., plant height, number of tillers/m2 , leaf area index and dry matter accumulation at all growth stages compared to line sowing (M3) and broadcasting (M1). Similarly, drum seeding recorded significantly the highest yield attributing characters such as number of panicles/m2 , panicle length, panicle weight, number of filled grains/panicle followed by line sowing (M3) and broadcasting (M1). Drum seeding technique (M2) also recorded significantly highest grain yield (43.07 q/ha) and straw yield (68.79 q/ha). Moreover, higher uptake of nitrogen, phosphorus and potassium by grain, straw and total uptake were also recorded in the same treatment. Among the different weed management practices, weed free (W5) check recorded the lowest weed density, weed dry matter and

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weed index as well as highest weed control efficiency and weed control index at all the growth stages followed by pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS fb bispyribac-Na @ 25 g/ha at 25 and 45 DAS (W4). Weed management practices also significantly recorded higher growth attributes viz., plant height, number of tillers/m2 , leaf area index and dry matter accumulation, yield attributing characters viz., number of panicles/m2 , panicle length, panicle weight, number of filled grains/panicle, grain and straw yield as well as uptake of nitrogen, phosphorus and potassium in grain, straw and total uptake. The highest grain (47.50 q/ha) and straw yield (75.11 q/ha) was recorded under weed free check (W5) which was followed by the treatment of pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS fb bispyribac-Na @ 25 g/ha at 25 and 45 DAS (W4) (44.37 q/ha grain and 71.80 straw q/ha). In terms of treatment combinations, drum seeding along with weed free check (M2W5) recorded the highest interaction effect in respect to number of tillers/m2 at 90 DAS (393.67), number of filled grains/ panicle (130.00), grain yield (51.22 q/ha), straw yield (78.35 q/ha), nitrogen uptake by grain (55.57 kg/ha) and phosphorus uptake by straw (16.26 kg/ha) which was followed by drum seeding along with pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS fb bispyribac-Na @ 25 g/ha at 25 and 45 DAS (M2W4) (49.23 q/ha grain and 75.84 q/ha straw yield) being statistically at par with line sowing along with weed free check (47.43 q/ha grain and 75.30 q/ha straw yield). In terms of economics, the treatment combination of drum seeding along with pyrazosulfuron-ethyl @ 30g/ha 2 DAS fb bispyribac-Na 10 % SC @ 25 g/ha at 25 and 45 DAS (M2W4) recorded the highest net return (Rs. 74,705/ha) and B:C (2.27).

Effect of weed management on growth and yield of summer baby corn (*Zea mays* L.)

Kamal N

A field experiment entitled "Effect of weed management on growth and yield of summer baby corn (*Zea mays* L.)" was carried out at Instructional-CumResearch farm Assam Agricultural University, Jorhat during summer 2023 to study the effects of different weed management practices on weeds and growth, yield and economics of baby corn. The treatments consisted of Earthing-up and weeding at 25 DAS (T1); Paddy straw mulching at 1 DAS 4 t/ ha (T2) ; Paddy straw mulching at 1 DAS 4 t/ ha followed by earthing-up and weeding at 25 DAS (T3); Atrazine 1.0 kg/ha as preemergence (T4) ; Metribuzin 2.0 kg /ha as pre-emergence (T5); Metribuzin 1.0 kg/ha as pre-emergence followed by hand weeding 25 DAS (T6); Metribuzin 1.0 kg/ha as pre-emergence followed by hand weeding at 40 DAS (T7); Metribuzin 1.0 kg/ha as pre-emergence followed by POE application of tembotrione 120 g/ha at 25 DAS (T8);The weedy check (T9) and Weed free (T10). The experiment was laid out in randomized block design with three replications. The soil texture of the experimental site was sandy loam which was low in available N (262.93kg/ha), medium in available P2O5 (27.48kg/ha), medium in available K2O (147.94 kg/ha) and medium in organic carbon(0.52 %). The baby corn hybrid G-5414 was sown on 21.02.2023and first picking was done on 21.04.2023.The total rainfall received during the crop growing period was 263.80 mm In the experimental site, total 10 major weed species were recorded including grasses, sedges and broad leaved. Different weed management practices significantly influenced the density and dry matter of weeds at all the observations. At 40 DAS application of paddy straw mulching at 1 DAS (4t/ ha) followed by earthingup and weeding at 25 DAS(T3) recorded the lowest weed density whereas the lowest dry matter was recorded with application of Metribuzin 1.0 kg /ha as pre-emergence followed by hand weeding 25 DAS(T6).Similarly, all the weed management treatments significantly influenced the growth, yield attributes and yield of baby corn. The highest plant height (146.50cm), number of leaves/plant(11.38), LAI(5.64) at 60 DAS and dry matter accumulation(60.26 g/ plant) at harvest was recorded with the T3treatment which was found at par with the T6 and T8 treatments. The highest number of baby corn/plant (2.78), corn weight with

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husk(53.64 g) ,corn weight without husk(13.74 g) and cob yield (9.45 t/ha) and green fodder yield (29.32 t/ha) was recorded with the T3 treatment which was found at par with the T6(cob yield: 9.28 t/ha) and T8(cob yield : 9.23 t/ha) treatments. The content and uptake of N, P and K by plant as well as available N, P2O5 and K2O post harvest soil was also recorded highest with the T3treatment which was at par with T6 treatment. The highest gross return ₹ 220317.00 /ha was recorded with the T3 treatment. However, the highest B-C ratio of 3.32 and the highest net return of ₹ 164815.00/ha was recorded with treatment T6. The study revealed that the application of paddy straw mulching at 1 DAS @ 4t/ha followed by earthing-up and weeding at 25 DAS (T3) resulted in effective management of weeds as well as the highest cob yield (9.45t.ha) and green fodder yield (29.32t/ha) with a net return of ₹ 1,56,409.00/ha and B-C ratio 2.45. However, application of Metribuzin 1.0 kg/ha at as pre-emergence followed by hand weeding at 25 DAS (T6) recorded the next best cob yield (9.28t/ha) and green fodder yield (28.72 t/ha) with the highest net return of ₹ 1,64,815.00/ha and B-C ratio of 3.32 due to low cost of cultivation in T6 treatment compared to the T3 treatment.

Performance of aromatic rice (*Oryza sativa* L.) under natural farming practices

Kishor Jyoti Bhuyan

A field experiment entitled "Performance of aromatic rice (*Oryza sativa* L.) under natural farming practices" was conducted at the organic block of the Instructional-cumResearch Farm, Assam Agricultural University, Jorhat, during kharif, 2022–23, with a view to studying the growth, yield, quality and economics of joha rice (variety: Tulasi joha) as well as its impact on overall soil health under natural farming practices. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The experiment consisted of eight different treatments of natural farming practices, viz., T1: control (no nutrient input), T2: vermicompost (*RD of N), T3: panchagavya as foliar application @ 1.5% each at 30, 60 and 90 DAT, T4: enriched panchagavya as foliar application @ 1.5% each at 30, 60, and 90 DAT, T5: jeevamrutha as foliar application @ 1.5% each at 30, 60, and 90 DAT, T6: beejamrutha as root dip treatment @ 3%, T7: vermiwash as foliar application @5% each at 30, 60, and 90 DAT, T8: green leaf manuring (5t/ha). The soil of the experimental site was sandy loam in texture, acidic (pH 5.25), medium in organic carbon (0.76%), low in available N (270.89 kg/ha) and K2O (134.76 kg/ha), and medium in P2O5 (23.90 kg/ha). The total rainfall received during the crop period was 935.9 mm. The treatments had a significant influence on the various growth, yield and quality parameters, while, a few parameters like leaf chlorophyll content, relative growth rate and L-B ratio were found to be non-significant. Among the different treatments, enriched panchagavya as foliar application @ 1.5% each at 30, 60, and 90 DAT (T4) showed significantly higher crop growth and physiological parameters such as plant height, number of tillers/m2 , number of leaves/ plant, root length, root volume, root dry weight, leaf area index, leaf area duration, plant dry weight and Crop Growth Rate (CGR) at different crop growth stages, followed by vermicompost (T2) and panchagavya as foliar application @ 1.5% each at 30, 60 and 90 DAT (T3). The yield attributing characters such as number of panicles/m2 , length of panicle, weight of panicle, number of filled grains/panicle and quality parameters such as length, breadth and amylose content of grains were found to be highest under the treatment enriched panchagavya as foliar application @ 1.5% each at 30, 60, and 90

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DAT (T4) followed by vermicompost (*RD of N) (T2) and panchagavya as foliar application @ 1.5% each at 30, 60 and 90 DAT (T3). In the case of grain yield, enriched panchagavya as foliar application @ 1.5% each at 30, 60, and 90 DAT (T4) showed significantly higher (24.80 q/ha) results, which was at par with T2, T3, T5 and T6. However, the treatments did not have any significant variations on the straw yield or harvest index. Except for soil organic carbon, higher soil chemical properties such as available N, P2O5 and K2O at harvest were recorded in the treatment T8 consisting of green leaf manuring (5 t/ha), followed by vermiwash as foliar application @5% each at 30, 60, and 90 DAT (T7) and beejamrutha as root dip treatment @ 3% (T6), while, higher soil biological properties such as total microbial count, dehydrogenase activity and microbial biomass carbon were found in enriched panchagavya as foliar application @ 1.5% each at 30, 60, and 90 DAT, which were at par with panchagavya as foliar application @1.5% each at 30, 60, and 90 DAT (T3). An economic analysis showed that the highest net return (₹91133/ha), gross return (₹138072/ha) and highest B:C (1.94) were recorded in the treatment enriched panchagavya as foliar application @ 1.5% each at 30, 60, and 90 DAT (T4) followed by panchagavya as foliar application @1.5% each at 30, 60, and 90 DAT (T3).

Conservation agriculture practices in rice-linseed cropping sequence

Manish Kumar Maurya

A field experiment entitled "Conservation agriculture practices in rice-linseed cropping sequence" was conducted at Instructional cum Research (ICR) farm, AAU, Jorhat during kharif, 2022 and rabi season, 2022-2023. The experiment consisted of three objective viz. (i) to study the effect of rice establishment methods on growth and productivity of rice and on succeeding linseed crop, (ii) to examine the effect of kharif rice stubble managements on performance of linseed crop and (iii) to assess the economics of the rice based double cropping system as influenced by rice establishment methods and stubble management practices. The experiment consisted of three rice establishment methods viz. transplanting (M1), wet-DSR (M2) and dry-DSR (M3) in main-plot and four stubble management practices viz. no residue (S1), 15 cm tall stubble chopped (S2), 15 cm tall stubble unchopped (S3) and 30 cm tall stubble chopped (S4) in sub-plot. The experiment was laid out in split-plot design with three replications. The soil at experimental site was sandy loam in texture with a pH of 5.1 and 5.26, medium in availability of nutrients including N (282.4 and 279.09 kg ha-1), P2O5 (23.86 and 24.79 kg ha-1), K2O (128.4 and 126.5 kg ha-1) and organic carbon content (0.51 and 0.53%) in Kharif and rabi season, respectively. The total rainfall received during kharif and rabi season was 1267.9 and 278.5 mm, respectively. The mean maximum and minimum temperature during kharif season ranged from 28.2 to 34.90C and 10.9 to 25.60C, respectively while during rabi season, they ranged from 21.4 to 31.90C and 7.9 to 20.50C, respectively.

Different growth and yield attributing characters, as well as the yield of rice, were significantly influenced by rice establishment methods. All the growth and yield attributing characters were significantly higher in transplanting (M1) over wet-DSR and dry-DSR. The highest grain yield (5.17 t ha-1) and straw yield (7.04 t ha-1) were also recorded with transplanting (M1). Similarly, different growth and yield attributing characters, as well as the seed yield of linseed were significantly influenced by rice establishment methods and stubble management practices. All the growth and yield attributing characters were significantly higher where linseed was grown following the

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dry-direct-seeded rice (M3). The highest seed yield (5.28 q ha-1) and stover yield (11.29 q ha-1) were also recorded where linseed was grown following the dry-direct-seeded rice (M3). Similarly, among the stubble management practices, growth and yield attributes were significantly higher where linseed was grown following 30 cm tall rice stubble chopped (S4). The highest seed yield (5.72 q ha-1) and stover yield (11.53 q ha-1) were also recorded where linseed was grown following 30 cm tall rice stubble chopped (S4). The highest cost of cultivation (₹ ha-176169.46) in the rice-linseed cropping system was incurred where linseed was grown after transplanted rice with 30 cm tall stubble chopped (M1S4). The highest gross return (₹ ha-1 137376.7) and net return (₹ ha-1 61207.21) were obtained by the treatment combination of linseed grown after transplanted rice with 30 cm tall stubble chopped (M1S4). However, the maximum benefit-cost ratio was recorded where linseed succeeded wet-direct-seeded rice with 30 cm tall rice stubble unchopped (2.02:1) followed by linseed grown after wet-direct-seeded rice with 30 cm tall stubble chopped (1.95:1). From the point of view of the rice-linseed cropping system, the best combination in terms of rice equivalent yield (6668.77 kg ha-1) was obtained by linseed following transplanted rice with 30 cm rice stubble chopped (M1S4).

Efficacy of herbicide combinations for weed management in direct seeded kharif rice

Mirdan Beypi

A field experiment entitled "Efficacy of herbicide combinations for weed management in direct seeded kharif rice" was carried out in Instructional-cum-Research farm, Assam Agricultural University, Jorhat during kharif, 2022.The Randomized Block Design was used to arrange 12 weed management treatments in 3 replications. The treatments were weed free (T1), weedy check (T2), bispyribac-sodium 25g/ha + pyrazosulfuron 20g/ha 20 days after sowing (DAS) as check (T3), pretilachlor 750g/ha preemergence followed by fenoxaprop-p-ethyl 50 g/ha + ethoxysulfuron 15g/ha 20 DAS (T4), pretilachlor 750g/ha pre-emergence followed by triafamone + ethoxysulfuron 60g/ha 20 DAS (T5), pretilachlor 750g/ha pre-emergence followed by penoxsulam 30 g/ha + bentazone 1080 g/ha 20 DAS (T6), glyphosate 1000 g/ha followed by one mechanical weeding 30 DAS (T7), glyphosate 1000 g/ha followed by fenoxaprop-p-ethly 50g/ha + ethoxysulfuron 15g/ha 20 DAS (T8), glyphosate 1000 g/ha followed by triafamone + ethoxysulfuron 60g/ha at 20 DAS (T9), glyphosate 1000g/ha followed by penoxsulam 30g/ha + bentazone 1080g/ha 20 DAS (T10), hand weeding at 20 DAS and weeding with grubber at 40 DAS (T11) and two mechanical weeding at 20 and 40 DAS (T12). The texture of the soil was sandy loam with pH of 5.5, bulk density of 1.40 Mg/m3 , organic carbon of 0.67% and available N, P2O5 and K2O of 289.93, 19.69 and 114.11 kg/ha, respectively. All treatments significantly lowered the weed density as well as dry matter in terms of broad-leaved, sedge and grassy weeds at 60, 90 and 120 DAS and at harvest as compared to weedy check. Significant reduction (75.59, 56.97, 44.77 and 30.44 %, respectively) in density of total weeds was observed in treatment (T5) pretilachlor 750g/ha pre-emergence followed by triafamone + ethoxysulfuron 60g/ha 20 DAS at 60, 90 and 120 DAS as well as at harvest over weedy check. The same treatment recorded significantly lower dry matter of total weeds at 60, 90 and 120 DAS and at harvest to the tune of 73.39, 52.71, 37.76 and 27.46 %, respectively over weedy check. Pretilachlor 750g/ha pre-emergence followed by triafamone + ethoxysulfuron 60g/ha 20 DAS (T5) showed higher result with regards to crop growth parameters viz., plant height, number of tillers/m2 , leaf area index, dry matter accumulation/m2 and crop

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growth rate at all the stages as compared to rest of weed management treatments except for plant height which was found to be not significant at 30, 120 DAS and at harvest. The above-mentioned treatment also showed higher result in terms of yield attributing characters viz., number of panicles/m2 and number of grains/panicle with 77.60 and 40.97 % increase over weedy check. In case of panicle length and test weight, the result was found to be not significant among all the treatments. Grain yield was found to be significantly higher in pretilachlor 750g/ha pre-emergence followed by triafamone + ethoxysulfuron 60g/ha 20 DAS (T5) with 175.16 % higher over weedy check and was at par with pretilachlor 750g/ha pre-emergence followed by fenoxaprop-p-ethyl 50 g/ha + ethoxysulfuron 15g/ha 20 DAS (T4). Similar result was observed in terms of straw and biological yield with 137.38 and 152.37 %, respectively increase over control. In case of straw yield (50.68 kg/ha) T5 was at par with T4 (46.65 kg/ha) and T6 (44.85 kg/ha). Weed management treatment did not significantly affect harvest index of direct seeded kharif rice. The lower weed index was recorded in pretilachlor 750g/ha pre-emergence followed by triafamone + ethoxysulfuron 60g/ha 20 DAS (T5) (5.84 %) followed by pretilachlor 750g/ha pre-emergence followed by fenoxaprop-p-ethyl 50 g/ha + ethoxysulfuron 15g/ha 20 DAS (T4) (13.30 %) and pretilachlor 750g/ha pre-emergence followed by penoxsulam 30 g/ha + bentazone 1080 g/ha 20 DAS (T6) (17.49%). No significant change in N, P and K content was recorded in grain and stover whereas N, P and K uptake by the crop was significantly higher in pretilachlor 750g/ha pre-emergence followed by triafamone + ethoxysulfuron 60g/ha 20 DAS (T5). The mentioned treatment decreased N, P and K content in weeds and their uptake as compared to weedy check by 5.18, 22.08 and 6.78, and 50.18, 59.02 and 50.76 %, respectively over weedy check. The same treatment recorded higher available N, P2O5 and K2O by 7.55, 19.57 and 3.96 %, respectively over weedy check. Weed management treatment did not significantly affect soil organic carbon of direct seeded kharif rice. The highest gross and net returns (103541 and 62751 ₹ /ha, respectively) were noted by pretilachlor 750g/ha pre-emergence followed by triafamone + ethoxysulfuron 60g/ha 20 DAS (T5) along with the highest B-C ratio (1.54) closely followed by pretilachlor 750g/ha pre-emergence followed by fenoxaprop-p-ethyl 50 g/ha + ethoxysulfuron 15g/ha 20 DAS (T4) (1.36).

Performance of rabi maize (*Zea mays* L.) based intercropping systems under different tillage practices

Nilabh Talukdar

A field experiment entitled "Performane of rabi maize (*Zea mays* L.) based intercropping systems under different tillage practices" was conducted at the Instructional Cum Research (ICR) Farm of Assam Agricultural University, Jorhat during the rabi season of 2022-2023.

The objectives of the experiment were to evaluate the performance of rabi maize and its intercrops under different tillage practices and to access the post harvest soil status under maize based cropping system. The variety of maize, rajmah and lathyrus taken were DKC 9081, Arun, Prateek respectively. The treatments were laid out in a split plot design (SPD) with three replications. Under main plot it consists of tillage practices and sub plot consists of cropping systems. Tillage practices were: T1 - Conventional tillage & T2 – minimum tillage and cropping systems were: C1 – Maize + Lathyrus (30/90 cm, 2:2 paired row ratio), C2 – Maize + Lathyrus (1:1), C3 – Maize + Rajmah (30/90 cm, 2:2 paired row ratio), C4 – Maize + Rajmah (1:1), C5 – Sole maize, C6 – Sole lathyrus, C7 – Sole rajmah. All the crops were sown on 28th of October, 2022. Lathyrus was harvest on 17th of February, 2023 (110 days after sowing); rajmah was harvested on 1st of March, 2023 (121 days after sowing); maize was harvested on 5th of March, 2023 (124 days after sowing). The soil of the experimental site was sandy loam in textureand acidic in reaction (pH 5.23), medium in organic carbon (0.67%), medium in bulk density (1.41 Mg/m3), optimum field capacity (24.60%), optimum water holding capacity (44.19 %), medium hydraulic conductivity (2.10 cm/hr), electrical conductivity (0.49 %, non saline), low in available nitrogen(245.11 kg/ha), low in available phosphorus (18.22 P2O5 kg/ha) and medium in available potassium (184.33 K2O kg/ha).

Results from the experiment revealed that conventional tillage significantly enhanced the growth and yield characters of all the crops. Light interception was higher with minimum tillage as compared to conventional tillage, but because of more vigorous growth of all the crops in conventional tillage, light depletion was higher with

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conventional tillage. The nutrient content and nutrient uptake of all the crops were significantly higher in conventional tillage over minimum tillage. The soil available N, P2O5 and K2O were also higher in minimum tillage as compared to conventional tillage. Moreover, final bulk density, final soil organic carbon and soil microbial biomass carbon were higher in minimum tillage.

The growth and yield of maize, rajmah, lathyrus respectively were significant due to different cropping systems. In case of maize, sole maize recorded highest values for growth and yield attributes among all the cropping system. Similarly nutrient content and uptake was also more with sole crop. Soil available nitrogen, organic carbon and soil microbial biomass carbon was less with the sole crop. In case of rajmah, sole rajmah was at par with maize + rajmah (2:2 paired row ratio) for growth parameters and yield parameters viz, number of pods/plant, number of seeds per pod & 100 seed weight was only at par. Nutrient uptake was highest with sole crop. This trend was also followed in case of lathyrus where sole lathyrus was at par with amize + lathyrus (1:1).

In terms of calculation of intercropping indices, maize + rajmah (2:2, paired row ratio)recorded the highest maize equivalent yield and highest land equivalent ratio was recorded under maize + rajmah (1:1).

Considering the overall economics of the system, maize + rajmah 2:2 ratio combined with c o n v e n t i o n a l t i l l a g e resulted in highest mean gross return (Rs 217022.60.00/ha), net return (Rs 179322.60/ha) and benefit-cost ratio (4.76). This was followed by and maize + rajmah 1:1 ratio in combination with conventional tillage.

Smart nutrient management with nano urea on rabi Maize (*Zea mays* L.) under rainfed situation

Rajib Singh

A field experiment was carried out during rabi, 2022-23 at the experimental plot of the Department of Agronomy, B. N. College of Agriculture, Assam Agricultural University, Biswanath Chariali to assess "Smart nutrient management using nano urea on rabi maize (Zea mays L.) under rainfed situation" with two objectives viz. studying the effect of foliar application of nano-urea on growth and yield of rabi maize and to find out the optimum combination of nano-urea and with conventional urea. The experiment consisted of 11 treatments in randomized block design viz. T1: Recommended Dose of Fertilizer (RDF) T2: 100% P & K + Spray of Nano urea @ 6 ml l-1 at knee high and tasseling stage, T3: 100% P & K + Spray of Nano urea @ 8 ml l-1 at knee high and tasseling stage, T4: 100% P & K + Spray of Nano urea @ 10 ml l-1 at knee high and tasseling stage, T5: 25% N + 100% P & K + Spray of Nano urea @ 6ml l-1 at knee high and tasseling stage, T6: :25% N + 100% P & K + Spray of Nano urea @ 8ml l-1 at knee high and tasseling stage, T7: 25% N + 100% P & K + Spray of Nano urea @ 10ml l-1 at knee high and tasseling stage, T8: 50 % N + 100% P & K + Spray of Nano urea @ 6 ml l1 at knee high and tasseling stage, T9: 50 % N + 100% P & K + Spray of Nano urea @ 8 ml l-1 at knee high and tasseling stage, T10: 50 % N + 100% P & K + Spray of Nano urea @ 10 ml l-1 at knee high and tasseling stage, T11: 100% P & K. The results of the investigation revealed that the treatment T1 (RDF) resulted in relatively taller plant height (103.20 cm) at knee high stage which is statistically at par with T8, T9 and T10. However, the highest plant height during tasseling (245.20 cm) and physiological maturity (243.80 cm) was observed in T8 (50% of recommended dose of N from conventional urea + spraying Nano urea @ 6 ml l-1 at knee high and tasseling stage). T1 also registered the significantly higher number of green leaves (8.73) plant-1 , dry matter accumulation (138.83 g) and leaf area index (1.84) at knee high stage. Conversely, in later stage of growth, effect of nano urea was found to be significant with notably higher value of number of green leaves plant-1 (11.67 and 9.60); leaf area index (4.63 and 3.10 plant-1) and dry matter accumulation (214.76 and 645.26 g plant-1) recorded at tasseling and physiological maturity, respectively under T8. The crops under

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this treatment also showed the significantly thicker stem (7.53 cm). Crops receiving 50 % N from conventional urea and 6 ml l-1 of nano urea recorded greater crop growth rate (CGR) between knee high and tasseling (209.79 g m- ² day-1) and between tasseling and physiological maturity (638.10 g m- ² day-1). In case of, relative growth rate (RGR), higher value (0.32 g g-1 d -1) was recorded under T6 that receiving 25% recommended N from conventional source and 6ml l-1 of nano urea in between knee high to tasseling; whereas between tasseling to physiological maturity stage the highest value (0.47 g g-1 d -1) was found in T8. The effect of nano urea was also observed with respect to leaf chlorophyll content and relative water content (RWC) of leaf as the highest being 1.37 mg g-1 fw. and 91.23 %, respectively recorded under T8 . Effect on yield parameters revealed significantly influence of nano urea with respect to increased length (35.88 cm), weight (368 g) and girth (20.29 cm) of cob together with more number of seeds per cob (615.93) and test weight (247.54 g) which were recorded under T8. The improvement of these yield parameters was reflected in grain yield (72.25 q ha-1), stover yield (110.67 q ha-1) and harvest index (39.50 %) and production efficiency (120.42 %) as well. The soil available nitrogen was highest (268.75 kg ha-1) in T10 (50 % N + 100% P & K + spray of Nano urea @ 10 ml l-1), however T1 (RDF), T8 (50 % N + 100% P & K + Spray of Nano urea @ 6 ml l-1) and T9 (50 % N + 100% P & K + Spray of Nano urea @ 10 ml l-1) showed comparable value and the lowest value (241.19 Kg ha-1) was recorded in T11 i.e. 100% P & K. Among all the treatments, T1 (RDF) recorded the highest cost of cultivation (80,650 ha-1) followed by T8 and, the lowest (75000 ha-1) was incurred in T11 i.e.100% P & K. The highest gross return (Rs. 1,50,569 ha-1), net return (Rs. 72,069 ha-1) and benefit-cost ratio (1.91) was obtained in T8 whereas, T11 i.e. 100% P & K recorded the lowest gross return (. 86,305 ha-1), net return (11,305 ha-1) and benefit-cost ratio (1.15). Results showed that spraying of nano urea @ 6ml/L at knee high and tasseling stage with basal application of 50% of recommended N from conventional urea with 100 % P & K was superior in terms of noticeably enhanced and economically efficient corn yield which was resulted from significantly improved growth and yield parameters. Therefore, it could be inferred that spraying of nano-urea @ 6ml l -1 at knee high and tasseling stage coupled with basal application of 50% of recommended N from conventional urea with 100 % P & K could be a promising and smart option as nutrient management strategy to harvest higher and economically efficient rabi corn yield under rainfed upland situation in Assam.

Evaluation of organic and natural farming practices on crop productivity and soil in kharif rice

Saurav Kumar Dutta

A field experiment entitled "Evaluation of organic and natural farming practices on crop productivity and soil in kharif rice" was conducted in research farm of AAU-ARRI, Titabar during the sali season of 2022-23 with a view to study the growth, yield behaviour, soil conditions of scented rice (variety: Bokul joha) under different organic and natural farming treatments. The experiment was laid out in randomized block design with three replications. The treatments consisted of eight in total viz. absolute control(T1), complete natural farming (beejamrit + ghanajeevamrit + jeevamrit mixture at 300 litres/ha at 30, 60 and 90 DAT) (T2), enriched compost 5 t/ha + biofertilizer (Azospirillum, PSB 4 kg/ha as seedling root dip (T3), enriched compost 5 t/ha (T4), vermicompost 5 t/ha (T5), enriched compost 2.5 t/ha + vermicompost 2.5 t/ha (T6) , fresh azolla at 400 kg/ha as dual crop + biofertilizers (Azospirillum, PSB and KSB mix at 4 kg/ha as seedling root dip) (T7), vermicompost at 1 t/ha mixed inocula of Azospirillum amazonense A-10 and Bacillus megaterium P-5 4 kg/ha and rock phosphate 10 kg/ha P2O5 (T8). The treatments brought significant influences on the various growth and yield attributing characters. Among the different treatments, the highest plant height, dry matter, leaf area index and number of tillers at different intervals were found in the vermicompost @ 1t/ha mixed inocula of Azospirillum amazonense A-10 and Bacillus megaterium P-5 4 kg/ha and rock phosphate 10 kg P2O5. The highest grain (34.62 q/ha) and straw yield (15.50 q/ha) were also obtained from application of vermicompost 1t/ha (on dry weight basis) mixed inocula of Azospirillum amazonense A-10 and Bacillus megaterium P-54 kg/ha rock phosphate @ 10 kg/ha P2O5 (T8) followed by the treatment including fresh azolla @ 400 kg/ha as dual crop + biofertilizers (Azospirillum, PSB and KSB mix @ 4 kg/ha as seedling root dip) (T7). In case of the soil, residual N (272.09 kg/ha) was found to be significantly high in fresh azolla at 400 kg/ha as dual crop + biofertilizers (Azospirillum, PSB and KSB mix at 4 kg/ha as seedling root dip) (T7) whereas P2O5 (22.8 kg/ha) and K2O

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(123.17 kg/ha) were found to be highest in vermicompost 1t/ha (on dry weight basis) mixed inocula of Azospirillum amazonense A-10 and Bacillus megaterium P-54 kg/ha rock phosphate @ 10 kg/ha P2O5 (T8).

Integrated weed management in summer maize (*Zea mays* L.)

Tulika Narah

A field experiment on "Integrated weed management in summer maize (Zea mays L.)" was carried out during summer, 2022 at the Instructional-cum-Research (ICR) farm, AAU, Jorhat, with the objectives of identifying the weed flora during the crop growth period; the best weed management practice in the crop and to understand the effect of the weed management practices on the soil physical, chemical and microbial population. A total of ten treatments were taken for the research which included - T1:Farmers practice i.e. manual weeding, T2: Recommended practice (Atrazine 1kg ha-1 PE), T3:Weedy fallow, T4: PE application of atrazine 0.5 kg ha-1 followed by PoE application of tembotrione 120 g ha-1 , T5: Live mulching with cowpea, T6:Live mulching with greengram, T7: Mulching with lemongrass, T8:Mulching with biodegradable polythene, T9:Weedy Check and T10:Weed free check.The experiment was laid down in Randomized Block Design (RBD) with three replications. The soil of the experimental plot was of sandy loam texture with a pH of 5.1, available N in the medium range (286.54 kg ha-1), available P2O5 and K2O in low range with 24.37 kg ha-1 and 158.82 kg ha-1 , respectively. The results of the experiment revealed that the PE application of atrazine 0.5 kg ha-1 followed by PoE application of tembotrione 120 g ha-1 (T4) has been able to control the weeds more effectively than the other treatments at the early stage of crop growth. However, during the later stage of crop growth more effective management of weeds was seen under mulching with lemongrass (T7). Mulching with lemongrass (T7) showed higher result with regards to crop growth parameters viz., Plant height, dry matter accumulation,crop growth rate, number of leaves plant-1 and leaf area index at all the stages as compared to rest of weed management treatments. Mulching with lemongrass(T7) also showed higher result in terms of yield attributing characters viz., number of cobs plant-1 , cob length, cob girth, 1000 grain weight. Grain yield (69.15 q ha-1) was found to be significantly higher in mulching with lemongrass(T7). Significantly higher cob yield with husk(93.34 q ha-1) and cob yield without husk (90.68 q ha-1) was recorded in mulching with lemongrass(T7). Similarly straw yield (95.97 q ha-1) was found to be highest in mulching with lemongrass(T7).

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Department: Agronomy, BNCA

Major Adviser: Dr. K. Kurmi

Relative performance of niger varieties to different microclimatic regimes under rainfed situation

Vaishali Gogoi

A field experiment entitled "Relative performance of niger varieties to different microclimatic regimes under rainfed situation" was conducted at Instructional-cumResearch (ICR) farm, AAU, Jorhat during rabi season of 2022-23. The experiment was laid out in split plot design with three replications. The treatments consisted of five sowing dates viz., 20th October, 5th November, 20th November, 5th December and 20th December in main plots and three varieties viz., NG-1, GA-10 and JNS-9 in sub- plots. The experimental site was sandy loam in texture with pH 5.43, medium in available N (283.14 kg/ha), available K2O (156.55 kg/ha), organic carbon (0.56%) and low in available P2O5 (18.67 kg/ha). Different growth and yield attributing characters of niger were influenced significantly due to different dates of sowing. The growth characters viz., plant height, number of leaves per plant, number of branches per plant, leaf area index, plant dry weight, crop growth rate, relative growth rate, yield attributing characters viz., number of capitula per plant (16), number of seeds per capitulum (34.66) were significantly higher in the crop sown on 20th October (D1). The nutrient content and uptake (N, P and K) was also the highest in case of D1. Significantly higher seed yield (468.33 kg/ha) and stover yield (1935.22 kg/ha) were recorded when the crop was sown on 20th October. Among the varieties, growth parameters such as plant height, number of leaves per plant, number of branches per plant, leaf area index, plant dry weight, crop growth rate, relative growth rate, yield attributing characters such as number of capitula per plant (14.46), number of seeds per capitulum (32.06) and test weight (3.35g), seed yield (457.46 kg/ha), stover yield (1967.40 kg/ha) and oil yield (164.75 kg/ha) were significantly higher in the variety NG-1 (V1) over the other two varieties viz., GA-10 (V2) and JNS-9 (V3). However, significantly higher oil content was obtained in the variety GA-10 (37.61 %). Treatment combination of sowing of variety NG-1 on 20th October (D1V1) recorded the highest interaction effect in case of number of capitula per plant (17.66), seed yield (511.33 kg/ha), oil yield (164.75 kg/ha) and N- uptake by seeds (14.50 kg/ha). In terms of economics, the highest gross return (₹ 31138/ha), net return (₹ 18999/ha) and B-C ratio (1.57) were recorded when the

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variety NG-1 was sown on 20th October (D1V1). This was followed by sowing of variety JNS-9 on 20th October (D1V3) with gross return (Rs. 29030/ha), net return (₹ 16891/ha) and B-C ratio (1.39).

Effects of Brassinosteroid on Morphophysiology and Yield of French Bean (*Phaseolus vulgaris* L.)

Bibha Changmai

An experiment entitled "Effects of Brassinosteroid on Morpho-physiology and Yield of French Bean (*Phaseolus vulgaris* L.)" was conducted during November, 2022 to February, 2023 in the Department of Crop Physiology and in the Experimental Farm, Department of Horticulture, Assam Agricultural University, to evaluate the effects of homobrassinolide on growth and yield of French bean. The experiment was carried out in two phases i.e. A) Laboratory experiment and B) Field experiment. The laboratory experiment was laid out in completely randomized design (CRD) with 4 replications using one variety (Falguni) of the crop. Seeds of French bean were treated with different concentrations of homobrassinolide viz. 0.25 ppm, 0.50 ppm, 0.75 ppm, 1.00 ppm and control (0 ppm) to examine the germination and seedling growth of the tested crop. Among all the applied concentrations of homobrassinolide, 0.50 ppm was found to show superior results in increasing the germination percentage, germination index, shoot and root lengths, shoot and root fresh weights, shoot and root dry weights and vigour index of the tested crop. The field experiment was conducted to investigate the effect of foliar application of homobrassinolide on morpho-physiology and yield development of French bean (variety Falguni). Foliar spray was done at 20 days after sowing (20 DAS) and 40 days after sowing (40 DAS). The experiment was laid out in Randomized block design (RBD) with four (04) replications and nine (09) treatments viz. T1 (0.25 ppm; single application : 20 DAS), T2 (0.50 ppm; single application: 20 DAS), T3 (0.75 ppm; single application: 20 DAS), T4 (1.00 ppm; single application: 20 DAS), T5 (0.25 ppm; double application: 20 DAS + 40 DAS), T6 (0.50 ppm; double application: 20 DAS + 40 DAS), T7 (0.75 ppm; double application: 20 DAS + 40 DAS), T8 (1.00 ppm, double application: 20 DAS + 40 DAS) and T9 (0 ppm; control). Among all the treatments, T2 (0.50 ppm; single application: 20 DAS) exhibited higher increase in plant height, leaf number, shoot and root fresh weights, shoot and root dry weights, chlorophyll content, leaf NPK content, root nodule number, nitrate reductase activity, yield and all yield attributing parameters. Single application of 0.50 ppm homobrassinolide resulted in the highest cost benefit ratio (1: 1.65), where 27.27% increase in yield over control was recorded.

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Department: Crop Physiology

Major Adviser: Dr. Kaushik Das

Identification of morphophysiological markers for cold tolerance in boro rice (*Oryza sativa* L) varieties

Hidangmayum Priyanka Devi

Low temperature is a significant abiotic factor that can severely impact rice cultivation, especially during the Boro season, where suboptimal temperatures can lead to reduced growth and yield. The present study was undertaken to identify morpho-physiological and biochemical markers associated with cold tolerance in Boro rice varieties. In the present study, 10 Boro rice varieties viz., Kanaklata, Sona Mahsuri, Disang, Lal Mahsuri, Jyoti Prasad, Dinanath, DRR 44K, Swarnabh, Cauvery, No.29 (BRRI dhan29) were used to identify the suitable varieties for growing under low temperature. The first experiment was conducted in the laboratory of the Department of Crop Physiology and Agriculture Biotechnology to identify Boro rice germplasm based on their germination studies. The germination tests were conducted under four different temperature regimes viz., 5-6°C (av.5.5°C), 7-9°C (av. 8°C), 10-12°C (av. 11°C) and ambient condition (28°C) using growth chambers and the experiment was laid in the factorial CRD with 3 replications. The study revealed that the varieties Kanaklata and Sona Mahsuri revealed superior performance in germination-related parameters than the other varieties. A field study was also conducted in the ICR farm, AAU, Jorhat during 2022-23 with an aim to identify the various morpho-physiological markers for cold tolerance in the abovementioned ten boro rice varieties. The experimental design was laid out in the RBD with three replications. Morphological parameters, viz. plant height, no. of leaves per plant, number of tillers per plant, shoot biomass, root dry weight and length of the longest roots were found to be highest in Kanaklata, followed by Sona Mahsuri, Disang, Swarnabh and Dinanath while the lowest was recorded in Lal Mahsuri. Physiological and biochemical parameter viz. proline content, total chlorophyll content and relative leaf water content were recorded highest in Kanaklata, followed by Sona Mahsuri, Disang, Swarnabh and Dinanath. Yield parameters viz. panicle length, panicle weight, no. of grains per panicle, grain yield per plant and harvest index were recorded the highest in Kanaklata followed by Sona Mahsuri, Disang, Dinanath and

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Major Adviser: Dr. Sangita Das

Swarnabh. Moreover, in correlation studies, the morphological trait such as the number of tillers per plant, shoot biomass and root biomass showed a positive correlation with yield and physiological, biochemical traits viz. relative leaf water content, proline content and total chlorophyll and yield related traits viz.; no. of effective tillers per plant Panicle weight and no. of grains per panicle also showed a positive correlation with grain yield. Therefore, these traits can be useful in breeding and crop management programmes for cold tolerance in Boro rice.

Effect of acid mine drained water on physiology of rice (*Oryza sativa* L.) genotypes

Mriganka Borgohain

Two experiments laid out using Completely Randomized Design (CRD) were conducted in the Stress Laboratory, Dept of Crop physiology, Assam Agricultural University. The main objective behind the experiments was to study the effects of acid mine drained (AMD) water on physiology of some varieties of Ahu rice (Mashuri, Jaya, Chilaria, Lachit, Mulagabharu, Jyoti Prasad, Bishnuprasad, Kanaklata) and Sali rice (Ranjit sub-1, Moniram, Piyolee, Bahadur Sub-1, Kushal, Muglagabharu, Bina-2, Satyaranjan). The varieties were treated with the simulated AMD containing sulphur at pH<2 (HSO3-), pH 4-6 (S03-), pH>6.0 (SO42-) and pH 5 (Control) basally in soil at vegetative stage. Nitrogen as Urea @ 60Kg/ha (50% as basal and 50% at maximum tillering stages), and whole doses of Phosphorus (@40Kg/ha) and Potassium (@20Kg/ha) as SSP and MoP respectively were applied as basal before transplanting. In case of the Ahu Rice, the varieties treated with pH<2 (HSO3-) was highly affected in terms of overall reduction in specific leaf area (SLA) at maximum tillering stage(1.20 to 54.75%) at panicle initiation stage(1.02 to 56.73%), plant height (6.9 to 55.6%) at harvest, root biomass (2.9% to 49.8%) at harvest, total chlorophyll content (2.26% to 55.4%), nitrate reductase (NR) activity (0.08% to 45.3%), cell membrane stability (CMS) (1.10% to 60.78%) at maximum tillering and panicle initiation stages, and economic yield (1.30% to 80.3%). Similarly, in Sali rice, decrease in SLA at maximum tillering stage (0.0 to 23.91%) and at panicle initiation stage (0.0% to 26.92%), plant height at harvest (0.10% to 56.61%), total chlorophyll content (0.05% to 52%), CMS (0.0% to 31.67%), NR activity (0.24% to 31.67%), panicle length (1.31% to 41.89%), panicle weight (3.60% to 51.64%) at maximum tillering and panicle initiation stages, test weight (4.30% to 62.02%), high density grains (0.07% to 43.19%), and economic yield (1.72% to 60.99%) except sterility percentage (0.0% to 114.85%) at harvest stage. Among the varieties, Mashuri (Ahu) and Ranjit Sub-1 (Sali) possessed higher CMS and lower lipid peroxidase activity accompanied by higher NR activity, chlorophyll contents and economic yield which are the key factors for tolerance mechanism.

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Department: Crop Physiology

Major Adviser: Dr. Bhagawan Bharali

Physiological performance of chickpea (*Cicer arietinum* L.) under organic and integrated nutrient management practices in Assam condition

Nang Vishaka Manphai

Chickpea (*Cicer arietinum* L.), is one of the most important rabi seasonpulse crops of India that ranks second in area and third in production. In Assam the production and productivity of chickpea are 1,582 tones and 699 kg/ha respectively(Anon., 2017), corresponding an area of 2,429 ha (Anon., 2019). Every year Assam use tohave a rice fallow land of 10.34 lakh ha (Deka et al., 2020) which can be utilized profitablyto grow rabi pulses like chickpea, pea, lathyrus etc. using some adapted varieties for this region and nutrient management approaches . Chickpea being a leguminous crop can fixatmospheric nitrogen and thereby contribute to plant and soil health. The nodulation as well as nitrogen fixation capacity can be influenced by the form of nutrients applied(Shahzad et al., 2014). Substituting inorganic form of nitrogen partially as well as completely with organic sources has been reported to improve photosynthetic activity anddry matter production. Compared to the use of chemical fertilizers alone the integratednutrient management (INM) practices are reported to result in significantly higher grainyield by improving nutrient uptake from the soil. A pot experiment entitled "Physiological performance of chickpea (Cicer aerietinum L.) under organic and integrated nutrient management practices in Assam conditions" was conducted in Rainout shelter phenotypingfacility, Department of Crop Physiology, Assam Agricultural University, Jorhat-13 duringthe rabi season of 2022-23. The experiment was carried out in pots filled with dry soil byfollowing two factor completely randomized design (CRD) with seven treatments and four genotypes of chickpea, which was replicated four times. The seven treatments studiedwere T1 (100% of recommended dose of N through Farm yard manure), T2 (100% of Nthrough Vermicompost), T3 (100%of recommended dose of N through Enriched compost), T4 (50% of recommended dose of N through Farm yard manure + 50% of recommendeddose of N through Urea), T5 (50% of recommended dose of N through Vermicompost +50% of

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recommended dose of N through Urea), T6 (50% of recommended dose of Nthrough Enriched compost + 50% N through Urea), T7 (100% of recommended dose of Nthrough Urea). The dried soil was initially mixed thoroughly with well decomposed FYMin ratio of 3:1. Four chickpea genotypes namely IPC 07-28, IPC 11-112, IPC 06-77 andIPCK 02-29 were used for the study. Sowing was done on 16th November 2022 andsubsequently the inter-cultural operations were carried out as and when required. Results revealed that all the morpho-physiological, biochemical, yieldattributing traits and yield were significantly influenced by the genotypes and treatments. In terms of seed yield with urea as the sole source of nitrogen the genotype IPC 07-28performed better (2.49 g plant-1) compared to other genotypes while IPCK 02-29 recordedthe lowest performance (1.93 g plant-1). The genotype IPC 07-28 also recorded the highest seed yield (5.24 g plant-1) when vermicompost was used as the sole source of nitrogen as well as when N was supplied through the combination of vermicompost and urea eachcontributing 50% of the recommended dose of nitrogen . The highest value of accumulatednitrogen (0.57) was recorded in genotype IPC 07-28 when receiving 50% nitrogen fromvermicompost and 50% from urea although their physiological nitrogen utilizationefficiency was moderate. The genotype IPC 07-28 exhibited the highest per cent increase in the traits namely plant height (41.62%), whole plant biomass (79.06%), root volume (29.41%) root surface area (38.48%), RLWC (34.20%), number of nodules per plant (42.53%), nodule weight (27.90%), total chlorophyll content (91.67%), in-vivo leaf nitrate reductase activity(26%), membrane stability index (66.15%), plant nitrogen content (58.33%), photosynthetic rate (21.5%), physiological nitrogen utilization efficiency (48.55%), no. of pods plant-1 (59.77%), no. of seed pod-1 (13.17%), seed yield (44.52%), harvest index(47.88%) with treatment T5 (50% of recommended dose of N through Vermicompost +50% of recommended dose of N through Urea) as compared to (T7) when nitrogen was supplied through urea only . The best performance of the genotype IPC 07-28 followed by IPC 06-77after receiving 50% of recommended dose of N from vermicompost combined with 50% of recommended dose of N from urea may be causally related to the sustained availability of nitrogen, other nutrients as and growth promoters for the plants throughout the crop life cycle as well as decrease in the N loss as compared to the situation when nitrogen was completely supplied through urea.

Study of root characteristics and yielding ability of some millet under low pH level

Rakesh Kumar Chaudhary

A pot experiment was carried out at the Stress Physiology Laboratory, AAU Jorhat, to evaluate the root characteristics and yield capabilities of millets under low pH conditions. Seven genotypes were chosen for research and cultivated in control conditions using a factorial completely randomised design with three replications. The genotypes were grown in two pH level 4.5 and 5.5. The investigation revealed that there was significant diversity within genotypes under low pH treatments in terms of morphophysiological features, tolerance efficiency, and yield attributing factors. Plant height, leaf area index, leaf area duration, root length, number of primary and secondary roots, and root volume were all significantly higher in the Gossaingaon genotype and significantly lower in the Bharathi genotype. Tolerant efficiency indices viz. CSI, MSI, and PHSI indices demonstrate that genotype Gossaingaon and China mujih also have higher values compared to non-tolerant one. Similarly yield and yield attributing characteristics such as panicle length, harvest index, tiller number, grain per panicle, and 1000 grain weight were recorded significantly greater in Gossaingaon and China mujih even at low pH levels. It can be recognized that some genotypes have a higher ability to grow in low soil pH conditions. Among the genotypes, Gossaigaon, China mujih, and CFMV 2 were found to be the least affected by low soil pH. The ability of tolerant genotypes to grow in low pH conditions may be related to a decrease in H202 and maintenance of chlorophyll content in the leaf as well as intact xylem and phloem size of the root. As a result, genotypes Gossaingaon and China mujih may be considered the most promising genotypes among the seven genotypes under lower pH values in the current study.

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Department: Crop Physiology

Major Adviser: Dr. Ranjan Das

Population structure, damage and management strategies for rodents in storage condition

Archita Bhagawati

Laboratory and field experiments were carried out at Rodent Laboratory, Department of Entomology and at different rural co-operative, grocery and rice mill stores of Jorhat district during 2022-23. During the course of the study, species composition along with population fluctuation of different rodent species were recorded from the mentioned three structures. The morphometric measurements were recorded at monthly interval in both summer and winter season for different rodent species from different storage structures. The experimental findings revealed the presence of three rodent species viz., Bandicota bengalensis, Rattus rattus and Mus musculus in all the three rural storage structures considered for the study. Out of the three species, B. bengalensis was the most predominant species recorded with the highest relative abundance (60.42%) in village rice mill store. R. rattus was observed second highest in all the storage structures, but when compared among different structures, the abundance was highest in grocery store (33.60%) and M. musculus was recorded the lowest in all the structures but when compared among itself its incidence was higher in co-operative store (22.17%). Monthly trap index recorded in different structures revealed the presence of rodent population that cause economic losses. No significant differences was recorded in seasonal and monthly changes in body parameters of different rodent species. For the management of rodents, four treatments and one control were applied and cleanliness was considered as an integral component for all the treatments in both village co-operative and grocery stores. Experimental analysis showed the treatment combination of (cleanliness + sherman trap + ecodon) as the best treatment for both village grocery and co-operative stores. The control success through census baiting method in village co-operative stores was found to be superior (73.75%) for (cleanliness + sherman trap + ecodon) followed by (cleanliness + wonder trap + ecodon) where 71.10% control success was recorded. However, both the treatments were found to be statistically at par. For tracking index method, treatment (cleanliness + sherman trap + ecodon) was recorded 53.47% control success which was statistically at par with (cleanliness + wonder trap + ecodon). However, for village grocery stores, the control

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Department: Entomology

Major Adviser: Dr. Ratul Kumar Borah

success through census baiting method was 67.02% in (cleanliness + sherman trap + ecodon) which was statistically at par with (cleanliness + wonder trap + ecodon), but for tracking index method, (cleanliness + sherman trap + ecodon) control success was 76.38% followed by (cleanliness + wonder trap + ecodon). The outcome of the present investigation revealed (cleanliness + sherman trap + ecodon) as the most effective treatment for management of rodents in both the structures.

Evaluation of some IPM modules against insect pests of Chilli

Arundhati Borgohain

Chilli (*Capsicum annuum* L.) is a crucial vegetable crop and spice in India which is valued for its colour (capsanthin) and pungency (capsaicin). In India, chilli cultivation faces several challenges, including biotic and abiotic factors which affect its yield. Insect pests such as aphid, thrips, fruit borer, leafhopper and whitefly cause substantial damages leading to yield losses of 50 to 90 percent. Indiscriminate use of pesticides in India has led to increased cultivation costs, destruction of natural enemies, while increase in pesticide residues raises concerns for exports. To address these issues sustainably, non-chemical pest management techniques are necessary. Integrated pest management (IPM), employing bio-controls and newer generation insecticides, is recommended as an alternative to conventional pesticides. This approach can effectively control pests, minimize negative impacts, and ensure the production of healthy and nutritious chilli crops. In this investigation, evaluation was done on 8 different integrated pest management modules against insect pests of chilli in Randomised Block Design with 3 replications. The experiment was conducted in the experimental farm for PG research, Biswanath College of Agriculture, Sonitpur during rabi season of 2022-2023. Four sucking pests viz., aphid, Aphis gossypii; thrips, Scirtothrips dorsalis Hood; whitefly ,Bemisia tabaci; leafhopper, Amrasca biguttula biguttula and a fruit borer, Helicoverpa armigera were found infesting the chilli crop. The treatments were applied at different intervals according to its recommendation. It was observed that M4 treatment containing mulching (polyethene) + marigold trap crop + neem cake @ 250kg/ha was found the most effective in controlling thrips, whitefly and fruit borer. M6 seed treatment with Imidacloprid 70% WS at 3 g/kg of seed + foliar application of neem oil @3ml/l was the most effective against aphids, Aphis gossypi. The highest number of coccinelids i.e., natural enemies were found in M8 untreated control and lowest was found in M4. Lowest leafhopper population was recorded in M3 consisting of neem oil 3ml/l + reflecting mulch. All of the treatment modules showed reduction in pest population during the weeks of observation over control. The highest yield was recorded in M4 (yield- 64.80q/ha, B : C ratio- 2.36) and was found to be the most effective

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module. Standard meteorological correlation with insect pests showed significant negative correlation with minimum temperature, bright sunshine hours and relative humidity in some insects. As we seek into the future aspects we can say that pest management modules prioritize the long-term health of agricultural ecosystems and can help achieve consistent, long-term pest suppression and increased yield.

Biosynthesis and utilization of plant based silver nanoparticles (AgNPs) against red spider mite, Oligonychus coffeae

Asma Begum

The present investigation on biosynthesis of silver-nanoparticles synthesized from Phlogocanthus thyrsiflorus leaf extract was carried out at Department of Plant Pathology, Assam Agricultural University (AAU), Jorhat and their bioefficacy against Oligonychus coffeae was carried out at Department of Entomology, AAU, Jorhat during 2021-2023. Characterization of the biosynthesized AgNPs through UV-Vis spectrophotometer in wavelength range of 250-600 nm revealed a peak at 417 nm, which confirmed the formation of silver nanoparticles. Dynamic Light Scattering (DLS) analysis (Z-average of 45.31 nm and polydispersity Index, PDI of 0.286) and Zeta potential (Charge: -22.5 mV) analysis were conducted to characterize the dispersion pattern of the nanoparticles. The size of the AgNPs was calculated to be around 5 nm through TEM analysis with relatively uniform circular and spherical morphology. The Electron Diffraction pattern (ED) showed polycrystalline nature of the AgNPs. SEM analysis also confirmed circular and spherical morphology of the AgNPs with a slight agglomeration, while SEM-EDX revealed the composition of the matrix to be 51.73% oxygen (O), 5.66% Carbon (C), 16.75% sodium-(Na) and 25.86% silver (Ag). FT-IR spectrograph showed strong peaks at ranges of 400-4000 per cm that confirms presence of different functional groups viz., O-H, C-H and C=C. The bioefficacy of AgNPs against O. coffeae at different concentration viz., 100 ppm, 150 ppm, 200 ppm, 250 ppm and 300 ppm and dosage viz., 0.1, 0.5, 1.0, 2.5, 5.0, and 10.0 ml/lit of water as compared with the standard checks viz., azadirachtin 10000 ppm @ 3.0 ml/lit of water and 3.0% P. thyrsiflorus crude extract solution @ 3.0 ml/lit of water in terms of adult mortality, ovicidal and antiovipositional toxicity at different time interval viz., 6, 12, 24, 48, 72 and 96 hours after treatment (HAT) revealed the highest of 100.0% adult mortality of O. coffeae at 200 ppm and 250 ppm at the dosage of 10.0 ml/lit and at 300 ppm at a dosage of 5.0 ml/lit. The lowest LC50 value of 0.10% for adults of O. coffeae was recorded at 200 ppm after 96 hours of treatment. The highest ovicidal activity

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against O. coffeae was recorded at 300 ppm concentration @ 10.0 ml/lit causing the lowest egg hatching (40.13%). The lowest LC50 value (1.63%) in terms of ovicidal effect against O. coffeae was recorded at 300 ppm of the AgNPs. The highest hatching reduction of 54.13% was recorded at 300 ppm concentration of AgNPs @ 10.0 ml/lit against O. coffeae. At 300 ppm concentration, AgNPs recorded the lowest fecundity of O. coffeae recording only 2.57 Nos. of eggs laid per female per day. The present experimentation confirmed the effectiveness of biosynthesized AgNPs as an acaricidal, ovicidal and antiovipositional agent for the management of O. coffeae, showing promise for utilization as a component of integrated tea pest management strategy.

Compatibility of botanicals with entomopathogenic fungus (*Beauveria bassiana*) against cabbage butterfly (*Pieris brassicae*)

Bhaswati Saikia

A laboratory experiment was carried out to study the compatibility of entomopathogenic fungus, Beauveria bassiana with four most promising plant oils (neem, karan-ja, jatropha and citronella oil) at Pest Management Laboratory, Department of Entomology in collaboration with Biocontrol Laboratory, Department of Plant Pathology, Assam Agricultural University, Jorhat, India during 2021-2022. Three different concentrations of each oil viz,. neem oil @ 2.00, 1.00, 0.50; karanja oil @ 2.50, 1.00, 0.25; jatropha oil @ 4.00, 2.00, 0.50 and citronella oil @ 1.00, 0.50 and 0.30 per cent were considered. The biological parameters viz., radial growth, conidial density, sporulation (conidial viability) and per cent inhibition were studied to test the compatibility of different concentrations of plant oils with Beauveria bassiana. The experimental findings revealed that among all the four plant oils, the maximum radial growth (59.20 mm), conidial load (7.44 x107 conidia/ml), conidial viability (80.60 per cent) and least (4.20) per cent inhibition was recorded in the combination of citronella oil (0.30%) + B. bassiana (1x107) and considered the most compatible with highest T value (76.49) which was found to be at par to the control, B. bassiana KR855715 with 61.80 mm radial growth, 7.51x 107 conidial load and 80.80 per cent conidial viability. It was followed by combination of neem oil (0.50%) + B. bassiana (1x107) with T value (75.20) radial growth (58.40 mm), conidial load (7.37 x 107 conidia/ml), conidial viability (79.40 per cent), per cent inhibition (5.50 per cent) and citronella oil (0.50%) + B. bassiana (1x107) with T value (74.8) radial growth (58.40 mm), conidial load (7.39 x107 conidia/ml), conidial viability (77.81 per cent) and per cent inhibition (5.50 per cent). However, the combination of jatropha oil (4.00%) + B. bassiana (1x107) recorded the lowest T-value (45.70) indicating less compatibility and showing least radial growth (18.80 mm), conidial load (5.24 x107 conidia/ml), conidial viability (55.86 per cent) and highest inhibition (59.22 per cent) due to its moderate toxicity. Another laboratory experiment was conducted to test the efficacy of the best compatible combination of each oils with B. bassiana against larvae of cabbage butterfly, Pieris brassicae. All

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together eight treatments viz., the best compatible combinations of each of neem oil (0.50%) + B. bassiana (1x107) (T1), karanja oil (0.25%) + B. bassiana (1x107) (T2), jatropha oil (0.5%) + B. bassiana (1x107) (T3) and citronella oil (0.30%) + B. bassiana (1x107) (T4) along with single application of B. bassiana (1x 107) (T5) and citronella oil (T6) and chlorantraniliprole @18.5SC as check (T7) and water spray as control (T8). It was vivid from the results that the combination, citronella oil (0.30%) + B. bassiana (1x 107) recorded the highest larval mortality of P. brassicae i.e. 5.00, 22.50, 65.00, 92.50 and 100 per cent at 12, 24, 48, 72, 96 and 120 hours respectively following chlorantraniliprole 18.5 SC (check) with 100 per cent at 96 HAT. It was followed by single application of B. bassiana (1x107) with 5.00, 27.00, 55.00, 87.5 and 100 per cent at 12, 24, 48, 72, 96 and 120 hours respectively. However, single application of citronella oil recorded the lowest larval mortality of 75 per cent at 120 HAT. Therefore, the best combination [citronella oil (0.30%) + B. bassiana (1x 107)] of this experiment was taken into consideration to carry out their efficacy under field condition. A field experiment was conducted further to evaluate the efficacy of the best combination, citronella oil (0.30%) + B. bassiana (1x 107) at Horticultural Orchard, Assam Agricultural University, Jorhat, India during 2022-23. Parameters, per cent reduction of pest population, yield, head diameter of cabbage and B:C ratio were recorded after two rounds of spraying. The results of the experiment revealed that the combination, citronella oil (0.30%) + B. bassiana (1x107) recorded 4.51, 11.61 and 28.38 per cent reduction in 3rd, 5th and 7th days after spraying (DAS) respectively. This combined treatment at respective 3rd, 5th and 7th DAS also recorded 27.90, 49.15, 29.98 and 43.72, 50.18 and 60.77 per cent reduction when compared to chlorantraniliprole @18.5SC (check) and control. This combination also recorded the highest (511 q/ha) yield and head diameter (17.06cm) with 53.53 per cent increased yield over control following the check with 576 q/ha yield and 17.45 cm head diameter with 72.89 per cent increased yield over control. However, insect population recorded increasing in control with least (333 q/ha) yield and (9.08 cm) head diameter. Thus, the best combination, citronella oil (0.30%) + B.bassiana (1 x 107) could be used as an effective biocontrol approach to control population of P. brassicae with high B:C ratio (3.08) at low cost.

Exploration of Salicylic Acid induced resistance against tomato fruit borer (*Helicoverpa armigera* Hübner)

Deepika Sorahia

The present investigation on evaluation of effects of exogenous application of salicylic acid (SA) as resistance inducer on tomato against fruit borer, Helicoverpa armigera was carried out in the Insectary under BARC project of Department of Entomology, AAU, Jorhat during 2022-23. During the course of study, two experimental sets were established (set A and set B) with five treatments viz., T1 (SA @ 25 ppm), T2 (SA @ 50 ppm), T3 (SA @ 75 ppm), T4 (SA @ 100 ppm) and T5 (control). Experiments were initiated when single spraying was done at 40 DAT in set A and two sprayings were done at 40 and 80 DAT in set B. Mass rearing of H. armigera larvae was carried out on both artificial and natural diets to maintain the required population of fourth instar larvae as well as to attain synchronised maturity of larvae. Results revealed that the total larval period varied between artificial diet (20.80±1.30 days) and natural diet (22.00±1.58 days). A slight variation was also observed in pupal period between artificial diet (12.80±1.10 days) and natural diet (13.20±1.12 days). The morphometrics of developmental stages of H. armigera were also recorded. The fourth instar larvae were released on the treated plants and feeding preference was studied on foliage and fruits. Results revealed that there was a significant reduction in per cent fruit infestation in set B as compared to set A. However, foliage feeding was totally absent. The highest reduction in per cent fruit infestation was recorded in T4 (6.54±1.33%) followed by T3 (7.42±1.27%) whereas lowest was observed in T5 (14.39±2.73%). Pertinent to the results of larval releases, 100% larval survivability was observed in T5 (control), whereas 75% in T1 under set A followed by pupation in both the treatments. However, adult emergence was successful in T5 only. Results pertinent to plant growth parameters revealed that highest plant height (84.50±2.06 cm) and increased number of branches (19.50±2.08 cm) were recorded in T4 under set A. Similar trend was also observed in set B where highest plant height (114.25±4.2 cm) and increased number of branches (23.75±2.50 cm) were recorded in T4 when compared to T5. In comparison to T4 (2.52±0.74 mg g-1 fresh weight) under set A, set B recorded the highest total

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chlorophyll concentration at T4 (3.09± 0.64 mg g-1 fresh weight). There were appreciable increase in the yield characteristics, such as the mean weight of each fruit (10.35±0.13 g) and the overall yield (212.17±13.85 g) in set B, when compared to set A where the mean weight of each fruit was (10.27±1.06 g) and overall yield was (148.18±10.92 g). Furthermore, significant variations in fruit length and diameter were also observed. Set B yielded fruits with increased diameter (2.74±0.02 cm) and length (2.84±0.02 cm) in T4 whereas set A showed comparatively lesser fruit diameter (2.68±0.09 cm) and length (2.72±0.56 cm). The outcome of present investigation vividly indicated that the best treatment T4 can further be explored for commercial cultivation of tomato for increased yield and production with protection against insect pest attack by inducing resistance.

Evaluation of some newer insecticides against banana leaf and fruit scarring beetle *Basilepta subcostatum* Jacoby (Coleoptera: Chrysomelidae)

Dipanwita Shyam

The present investigation was carried out at the Horticulture Experimental Farm, Department of Horticulture, AAU, Jorhat during 2022-2023. During the course of the study some newer insecticides have been evaluated against banana leaf and fruit scarring beetle, Basilepta subcostatum Jacoby. The four treatments along with control were applied at the three critical stages of banana i.e flower bud initiation stage, shooting stage and bunch formation stage by counting the number of beetles on the central whorl leaf and those present outside of the crown leaf. A pre-count was taken from each plot before one day of application of treatments. The post treatment counts were taken at three days, five days, ten days and fifteen days after spraying. The experimental findings revealed that among the four treatments viz., lambda cyhalothrin 5% EC, chlorantraniliprole 18.5% SC, thiamethoxam 25 WG and imidacloprid 17.8 SL , the highest per cent reduction of beetle population was recorded in imidacloprid 17.8 SL @ 20 g a.i/ha treated plots at all the three stages of the crop (-64.40%, -72.11%, -60.69%, -57.90% flower bud initiation), (-68.13%, -71.72%, -67.52%, -63.72% shooting), (62.21%, -63.15%, -58.84%, -55.05% bunch formation). The second best treatment was exhibited by thiamethoxam 25 WG (-59.94%, -64.98%, -54.90%, -51.22% flower bud initiation), (-62.40%, -65.13, -60.83%, -56.85% shooting), (-57.46%, - 58.95%, -53.74, -49.91% bunch formation) which is statistically at par with imidacloprid 17.8 SL. Similarly in case of leaf scars produced due to the beetle infestation, the treatment T4 (imidacloprid 17.8 SL) exhibited as the best treatments in reducing the number of leaf scars per 5cm2 leaf surface area (10.99, 12.79, 10.86 numbers) whereas chlorantraniliprole 18.5% SC was the least effective with 18.88, 22.46, 20.86 numbers of leaf scars per 5 cm2 surface area. Reduced per cent fruit infestation was also recorded in imidacloprid 17.8 SL treated plants with 7.82% which exhibited best treatment followed by thiamethoxam 25 WG (9.71%), lambda cyhalothrin 5% EC (16.85%) and chlorantraniliprole 18.5% SC (23.20%). Therefore, the present experiment brought out a conclusion that both imidacloprid 17.8 SL and

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thiamethoxam 25 WG can be considered for application against banana leaf and fruit scarring beetle. Hence the present findings can also be strongly supported from the safety point of view for the consumer as well as to the environment in terms free from toxic residue in the treated product with these two new insecticides.

Effect of dates of planting and application of oil cakes on soil insect-pests of potato in rainfed upland situation

Jamini Kumar Dutta

An experiment on "Effects of dates of planting and oil cakes on soil insect pests of potato in rainfed upland situation" was conducted at experimental farm for PG research, Biswanath College of Agriculture, Sonitpur during rabi season, 2022-23. The experiment was laid out in Factorial Randomized Block Design with three replications and 12 treatment combinations with three dates of planting viz., early (D1), normal (D2) and late (D3) planted on 1st week of October, November and December, 2022 and four oil cakes viz., mustard oil cake (C1), neem oil cake (C2) , & castor oil cakes (C3) including control (Co). From the present investigation, four insect pests from three orders and four families were recorded as soil insect pests of potato in the field viz., cut worm, Agrotis ipsilon (Hufnagel); white grub, Holotrichia spp.; red ants, Dorylus orientalis (Westwood) and wire worm, Agreotes spp. The lowest number of cut worm and white grub were observed in D1 with 1.08 and 0.50 numbers of insects per sqm , respectively. The per cent haulm cut by cut worm was recorded as 10.14 per cent during the present investigation. Among all the dates of planting, D1 recorded the lowest tuber damage by weight and number basis with 8.47, 2.49, 3.17 and 2.29 per cent and 7.67, 2.19, 3.21 and 1.97 per cent for cut worm, white grub, red ant and wire worm, respectively. The highest per cent tuber damage by cut worm was recorded in D2 with 14.71 and 12.89 per cent by weight and number basis, respectively. Similarly, white grub, red ant and wire worm recorded the highest tuber damage in D3 by weight and number basis with 6.11, 10.46 and 5.38 per cent and 5.59, 11.37 and 4.92 per cent, respectively. The minimum number of cut worm and white grub larvae were recorded from neem cake treated plot with 0.67 and 0.44 numbers of larvae per sqm at the time of harvest. Moreover, neem cake also recorded the lowest damage (7.55, 2.06, 3.42 and 1.79 per cent) caused by cut worm, white grub, red ant and wire worm, respectively on weight basis. Similarly, on number basis the lowest damage was recorded as 5.92, 1.87, 3.21 and 1.47 per cent due to cut worm, white grub, red ant and wire worm,

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respectively. However, no significant interaction effect was observed between dates of planting and different oil cakes. The highest yield 112.41 q/ha was recorded in D2C2 with a C: B ratio of 1:2.72 .Therefore, from the present investigation, it can be concluded that normal planting with neem oil cake application was most effective against soil pests of potato which also significantly influenced the yield.

Efficacy of plant oils against major insect pests of Brinjal

Krishna Sarmah

The present experiment was carried out to evaluate the efficacy of plant oils against major insect pests of brinjal at the Biological Control Laboratory, Department of Entomology and the experimental farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2022-2023. For the laboratory experiment, the treatments considered were eucalyptus oil, karanj oil, garlic oil, artemisia oil, black pepper oil, neem oil and chlorantraniliprole 18.5 SC. Chlorantraniliprole 18.5 SC was found to be the most toxic with LC50 values of 0.42%, 0.05% and 0.01% at 24, 48 and 72 hours, respectively. Among the plant oils, garlic recorded the lowest LC50 values of 8.45%, 3.70% and 1.20% at 24, 48 and 72 hours, respectively. Karanj oil was the least effective with the highest LC50 values of 15.70%, 13.36% and 8.39% at 24, 48 and 72 hours. Relative toxicity studies showed that 72 hours after treatment, chlorantraniliprole, garlic oil and eucalyptus oil were 382.00, 3.18 and 1.21 times more toxic than neem oil whereas, black pepper oil, artemisia oil and karanj oil were 0.60, 0.50 and 0.45 times less toxic than neem oil, which was used as a standard check. Under field conditions, 10 different insect pests were observed throughout the growing period of the brinjal crop namely, brinjal fruit and shoot borer (Leucinodes orbonalis), aphids (Aphis gossypii and Myzus persicae), whitefly (Bemisia tabacci), white spottedflea beetle (Monolepta signata), crucifer flea beetle (Phyllotreta cruciferae), semi-looper (Trichoplusia ni), Eressa confinis, epilachna beetle (Epilachna vigintioctopunctata) and jassids (Amrasca biguttula biguttula). Additionally, 5 different species of coccinellid predators viz., Cheilomenes sexmaculatus, Brumoides suturalis, Coccinella transversalis, Micraspis discolor and Cheilomenes propinqua were also recorded.10 days after the first spray, an initial decrease in shoot infestation was observed, where chlorantraniliprole 18.5 SC recorded the lowest number of infested shoots (0.33) followed by garlic oil @ 5 ml/l (1.08) and eucalyptus oil @ 5 ml/l (1.58). The highest infestation was observed in control (4.25). 15 days after the first spray, there was a gradual increase in infestation, hence, a second spray was carried out after an interval of 5 days. 20 days after the second spray, it was observed that the highest infestation was in control (4.83).

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Additionally, a decrease in the overall population was observed and the lowest number of fruit infestation was observed in chlorantraniliprole 18.5 SC (0.16) with 92.62 per cent reduction, followed by garlic oil @ 5 ml/l with a reduction of 73.81 per cent. After second spray, the lowest number of aphid population (2.25) was observed in garlic oil @ 5 ml/l with a reduction percentage of 81.69 at 20 days after spraying. Chlorantraniliprole 18.5 SC, garlic oil @ 5 ml/l and eucalyptus oil @ 5 ml/l had no significant effect on the population of coccinellids. After the application of the different concentrations of plant oil in the brinjal crop, phytotoxicity studies were carried out at an interval of 1, 3, 7, 10 and 14 days. There has been no observation of phytotoxic symptoms in the brinjal plant. Further studies on yield parameters revealed that the highest yield was obtained from chlorantraniliprole 18.5 SC (200 q/ha) treated plots, which was statistically at par with garlic oil @ 5 ml/l (190.02 q/ha) treated plots. The highest benefit cost ratio was also recorded in garlic oil @ 5 ml/l (1.1:84) after chlorantraniliprole 18.5 SC treated plots while the lowest yield (117.66 q/ha) was obtained in untreated control. Sensory evaluation tests after cooking indicated that no significant difference was observed between control, garlic oil @ 5 ml/l and eucalyptus oil @ 5 ml/l treated brinjal with resp.

Exploration of Jasmonic Acid induced resistance in Chilli (*Capsicum annuum* Linnaeus) against Aphid (*Aphis gossypii* Glover)

Madevu Sai Kumar

The present investigation on evaluation of Jasmonic acid induced resistance in chilli (*Capsicum annuum* Linnaeus) against aphid (*Aphis gossypii* Glover) was carried out in the Insectary under BARC project of Department of Entomology, AAU, Jorhat during 2022-23. During the course of study, two experimental sets were established (Set A and Set B) with five treatments viz., T1 (JA @ 0.1 mM), T2 (JA @ 0.5 mM), T3 (JA @ 1 mM), T4 (JA @ 1.5 mM) and T5 (control). Experiments were initiated when single spraying was done at 20 DAT in Set A and two sprayings were done at 20 and 60 DAT in Set B. The plants were treated with JA to activate induced resistance. Results revealed that the aphid count (per 10 cm terminal shoot) was reduced in Set B as compared to Set A contributing to the fact that in both the experimental sets the plants recovered from aphid stress induced by foliar sprays of JA. A gradual decrease in the number of aphids per 10 cm terminal shoot was recorded from day to day observation after sprays in T1, T2, T3 and T4 whereas gradual increase followed by decrease in number of aphids was observed in T5. The lowest number of aphids per 10 cm terminal shoot was found in T3 (1.75±2.06 numbers) on 15th day after release of aphids followed by T4 (3.50±2.89 numbers) whereas the highest was recorded in T5 (27.50±1.29 numbers). Similar trend in aphid count was also observed in Set B where the lowest number was observed in T3 (3.75±1.26 numbers) on 10th day after release of aphids and highest was recorded in T5 (35.50±2.06 numbers) after second spray. Significant variation was also observed among the treatments. Comparative analysis on plant growth parameters was carried out in both the sets of experiments. The highest total chlorophyll content was measured in T3 (2.39±0.06 mg/g) under Set B as compared to T3 (1.55±0.07 mg/g) under Set A. The lowest was recorded in T5 (0.61±0.04 mg/g and 1.60±0.04 mg/g) in both the sets A & B respectively. The highest per cent relative leaf water content was measured in T3 (72.60±3.79 %) under Set B as compared to T3 (66.52±3.41%) in Set A. Significant negative correlation was observed between number of aphids, total chlorophyll and relative leaf water content in both the sets at $p \leq 0.05$.

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Analysis on plant growth parameters were carried out in both the sets of experiments. Results revealed that T4 showed the highest plant height (54.13±2.90 cm) whereas T5 showed the lowest plant height (33.63±1.42 cm) in Set A. Similar results were also recorded in Set B where the highest plant height (55.88±2.17 cm) was observed in T4 and the lowest plant height (35.63±0.95 cm) was found in control T5. A substantial increase in plant height was recorded in Set B after second spray where the highest plant height (175.88±4.33 cm) was observed in T4 (JA @1.5 mM) and lowest plant height (152.38±2.81 cm) was found in T5. Reproductive growth represented by the number of flowers also increased significantly with increase in concentration. Highest number of flowers was observed in T4 (80.75±2.63) whereas lowest was observed in T5 (61.25±2.87) under Set A. Comparatively, a significant increase in the number of flowers was observed in T4 (123.75±2.75) in Set B. Results revealed T4 to be the best treatment with yield/plant being 478.25 g and mean weight of fruits being 119.56±4.18 g in Set A. However, increase in yield/plant (691.00 g) and mean weight of fruits/treatment (172.75±2.74 g) was observed in T4 under Set B. The outcome of present investigation vividly indicated that T4 can further be explored for commercial cultivation of chilli for increased yield and production and T3 for protection against insect pest attack by inducing resistance as Jasmonic acid (JA), a plant signaling substance, has a noteworthy reputation in inducing resistance (IR) against insect herbivory.

Study on major insect pests of tomato and their eco-friendly management

Mayurakshi Bora

An experiment entitled "Study on major insect pests of tomato and their eco-friendly management" was conducted at the experimental farm for PG research, Biswanath College of Agriculture, Sonitpur during rabi season of 2022-23. During the present investigation, 11 insect pests from four orders and eight families were recorded as pests of tomato in the field, viz., whitefly, Bemisia tabaci (Gennadius); aphid, Aphis craccivora Koch; leafminer, Lyriomyza trifolii (Burgess); fruitborer, Helicoverpa armigera (Hubner); jassid, Amrasca biguttula biguttula (Ishida); semilooper, Trichoplusia ni (Hubner); epilachna beetle, Henosepilachna vigintioctopunctata (Febricius); flea beetle, Monolepta signata (Olivier); tobacco cutworm, Spodoptera litura (Febricius); cutworm, Agrotis ipsilon (Hufnagel) and green stink bug, Nezara viridula (Linneous). Two coccinellid predators from order coleoptera viz., Micraspis discolor (Fabricius) and Cheilomenes sexmaculata (Febricius) and two spider species Lycosa tista Tikader, Anyphaena accentuata (Walckenaer) were also recorded as natural enemies. Among them B. tabaci, A. craccivora, L. trifolii, H. armigera, A. biguttula biguttula, T. ni, coccinellid predators and spider were found to be most dominant species during the present study. From the correlation study it was observed that aphid population showed a significant negative correlation with both maximum(r = - 0.709**) and minimum temperature(r = -0.511*). Whitefly population registered a negative significant correlation with both maximum(r = -0.745**) and minimum temperature(r = -0.757**) and positive significant correlation with morning relative humidity(r = 0.671**). Jassid exhibited a negative but significant correlation with both maximum(r = -0.782**) and minimum temperature(r = -0.520*). A significant negative correlation was observed between leafminer population and bright sunshine hour(r = - 0.613*). The population of fruit borer registered significant negative relationship with bright sunshine hour(r = -0.674**). Furthermore, cabbage semilooper showed significant negative correlation with maximum temperature(r = -0.611*) and bright sunshine hour (r = -0.542*). As regards coccinellid predators, it showed significant negative correlation with maximum temperature (r = -0.525*), minimum temperature (r = -0.684**) and

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rainfall (r = - 0.528*) and significant positive correlation with morning relative humidity (r = 0.516*). A significant positive correlation of aphid population was also observed with coccinellid predator population(r = 0.743**). Among the seven treatments tested viz., neem oil @ 5ml/lit, garlic extract @ 5ml/lit, biogreen-L @ 5ml/lit, neem oil @ 5ml/lit + garlic extract @ 5ml/lit, neem oil @ 5ml/lit + biogreen-L @ 5ml/lit, garlic extract @ 5ml/lit + biogreen-L @ 5ml/lit, neem oil @ 5ml/lit + garlic extract @ 5ml/lit + biogreen-L @ 5ml/lit, neem oil @ 5ml/lit + biogreen-L @ 5ml/lit was found to be the best treatment in reducing pests population which was closely followed by neem oil @ 5ml/lit + garlic extracts @ 5ml/lit. Neem oil @ 5ml/lit + biogreen-L @ 5ml/lit treated plot showed the best result in reducing the per cent infestation of leafminer and fruit borer. The highest yield (299.56 q/ha) was obtained from the plot treated with neem oil @ 5ml/lit + biogreen-L @ 5ml/lit with a benefit cost ratio of 3.91. The natural enemy (coccinellid) population was found to be more in neem oil @ 5ml/lit treated plots.

Diversity of soil arthropods in potato grown under different soil conservation practices

Prerana Das

A field experiment was carried out at the organic plot of Instructional cum Research farm of Assam Agricultural University, Jorhat during December to March, 2022-23, to study the effect of different soil conservation practices on the diversity of soil arthropods in potato. The experiment was conducted with eight treatments which included one conventional Package of Practices for organic cultivation (T1) followed by six different soil conservation practices viz., Minimum tillage + mulching with rice straw @8t/ha (T2), Minimum tillage + mulching with rice straw @10t/ha (T3), Minimum tillage + mulching with rice straw @12t/ha (T4), Zero tillage + mulching with rice straw @ 8t/ha (T5), Zero tillage + mulching with rice straw @ 10t/ha (T6), Zero tillage + mulching with rice straw @ 12t/ha (T7) along with an untreated control (T8). The diversity of soil macroarthropods were studied through pitfall traps, visual observation, bait traps as well as scouting for hand collection whereas microarthropods were extracted through Tullgren Funnel. Data respective to both macro and microarthropods were recorded at pre-treatment and 15, 30, 45, 60 and 75 days after treatment (DAT). Extent of damage of tubers by major soil insect pests under different soil conservation practices was also assessed in both number and weight basis as well as yield and B:C ratio. Experimental results revealed Hymenoptera as the most dominant order (52.22%) among the different soil macroarthropods observed prior to the treatments followed by Araneae (17.23%) and Orthoptera (14.15%). Among the soil microarthropods, the abundance of Collembola and Oribatida were recorded to be 67.61 and 32.39 per cent, respectively in the pre-treated plots. The number of soil macroarthropods was ranged between 53.00 to 58.00/plot prior to the treatments which showed statistical parity with each other. However, a gradual increase in the number of soil macroarthropods was observed at each 15 days interval after treatment as compared to the pretreated plots. Among the treatments, significantly highest number of soil macroarthropods/plot was recorded in T7 plots (66.67, 68.00, 72.67, 342.00, 400.67 numbers at 15, 30, 45, 60 and 75 DAT) as compared to T1 (60.33, 61.67, 62.67, 267.33, 341.00 numbers at 15, 30, 45, 60 and 75 DAT) and T8 (60.67, 62.00, 62.33, 292.67, 362.00 numbers at 15, 30, 45, 60 and 75 DAT), respectively. Soil microarthropods

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obtained in different plots prior to the treatments was ranged between 625.00 to 722.22 numbers/sq. m. Gradual increase in the number of soil microarthropods was also observed after each interval as compared to the pretreated plots, however, all the treatments did not exhibit any significant (p=0.05) impact on soil microarthropod population during the experimental period. Among different soil conservation practices, the highest infestation of tubers by major soil insect pests was recorded in T7 (7.40% and 17.89%) followed by T4 (7.28% and 16.84%) and T6 (7.20% and 15.13%) whereas the least infestation was recorded in T1 (5.12% and 11.48%) in both weight and number basis, respectively. The total tuber yield was recorded highest in T1 (100.44q/ha) while among the conservation treatments, T7 (99.63 q/ha) recorded maximum yield as well as highest B:C ratio (1.49). In the present study, soil conservation practices showed promising results both in terms of diversity of soil dwelling arthropods and yield of potato. However, proper knowledge on pest status of the cultivating area and their appropriate management strategies may be emphasized for wide spread popularization of the conservation practices among the end-users.

Bioefficacy of certain insecticides and plant oils against major insect pests of cauliflower

Ravishankar G

Field and laboratory experiments were conducted in the experimental farm, Department of Horticulture, and Biological Control Laboratory, Department of Entomology, Assam Agricultural University, Jorhat during the year 2021-22 and 2022-23. The experiment was conducted to evaluate the efficacy of chlorantraniliprole18.5 SC, thiamethoxam 25 WG, emamectin benzoate 5 SG, neem oil 1500ppm (Check), garlic oil and artemisia oil along with control against major insect pests of cauliflower. The LC50 value was the lowest in chlorantraniliprole followed by thiamethoxam and the highest in artemisia oil. Based on LC50 the order of toxicity to Pieris brassicae after 24 hrs was as chlorantraniliprole (0.063) > thiamethoxam (0.199) > emamectin benzoate (0.435) > garlic oil (4.136) > neem oil (5.122) > artemisia oil (7.702), after 48 hrs it was as chlorantraniliprole (0.044) > thiamethoxam (0.072) > emamectin benzoate (0.116) > garlic oil (3.132) > neem oil (4.308) > artemisia oil (5.858) and after 72 hrs it was chlorantraniliprole (0.028) > thiamethoxam (0.039) > emamectin benzoate (0.056) > garlic oil (1.516) > neem oil (3.368) > artemisia oil (4.057). Similar trend was also observed against Trichoplusia ni with the order of toxicity after 24 hrs was chlorantraniliprole (0.086) > thiamethoxam (0.175) > emamectin benzoate (0.457) > garlic oil (5.694) > neem oil (6.111) > artemisia oil (8.178), after 48 hrs it was as chlorantraniliprole (0.059) > thiamethoxam (0.094) > emamectin benzoate (0.167) > garlic oil (4.072) > neem oil (5.138) > artemisia oil (6.387) and after 72 hrs it was chlorantraniliprole (0.032) > thiamethoxam (0.045) > emamectin benzoate (0.064) > garlic oil (2.337) > neem oil (4.141) > artemisia oil (4.498). The field experiment was done in two seasons, during 2022-23. The first one as midseason (Oct, 2022 - Jan, 2023) and second one as late season (Feb - April, 2023). The treatment garlic oil @5ml/lit of first spray along with chlorantraniliprole 18.5 SC @0.3ml/lit of second spray showed maximum percent reduction of P. brassicae population in both the season (96.72 and 97.00), followed by two sprays of chlorantraniliprole 18.5 SC @0.3ml/lit (94.59 and 93.16), two spray of garlic oil @5ml/lit (90.09 and 87.29) and the lowest population reduction was found in control (17.89 and 19.07) against *P. brassicae* during first and

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second season respectively.The maximum population reduction of Trichoplusia ni was observed in garlic oil @5ml/lit of first spray along with chlorantraniliprole 18.5 SC @0.3ml/lit of second spray (96.00 and 95.62) followed by two spray of chlorantraniliprole 18.5 SC @0.3ml/lit (92.10 and 91.35), two spray of garlic oil @5ml/lit (89.00 and 85.24) and lowest reduction was obtained from control (19.16 and 20.55) in both mid and late season cauliflower. In case of aphids, the highest percent population reduction was registered in treatment two spray of garlic oil @5ml/lit (95.60 and 94.40) followed by garlic oil @5ml/lit of first spray along with second spray of chlorantraniliprole 18.5 SC @0.3ml/lit (92.67 and 91.55), neem oil @1ml/lit (85.77 and 83.06) and the lowest reduction was observed in control (8.78 and 18.68) during first and second season respectively. In midseason cauliflower population of Trichoplusia ni was comparatively higher than P. brassicae. In late season cauliflower P. brassicae population was higher than Trichoplusia ni. The garlic oil @5ml/lit, neem oil and chlorantraniliprole showed no significant effects against coccinellid beetles in field conditions. The treatment garlic oil @5ml/lit of first spray along with chlorantraniliprole 18.5 SC @0.3ml/lit of second spray registered the highest mean yield i.e., 171.06q/ha and 168.46q/ha respectively in mid-season and late season crop which was significantly the higher yield than control (93.53q/ha and 91.20q/ha). The highest benefit cost ratio was obtained from the treatment garlic oil @5ml/lit of first spray along with second spray of chlorantraniliprole 18.5 SC @0.3ml/lit (2.43 and 2.89) followed by garlic oil @3ml/lit of first spray along with second spray of chlorantraniliprole 18.5 SC @0.3ml/lit (2.37 and 2.80) and two spray of chlorantraniliprole 18.5 SC @0.3ml/lit (2.33 and 2.75) and the lowest benefit cost ratio was observed in control (1.06 and 1.31) respectively in mid-season and late season cauliflower. The effects of best plant oil i.e., garlic oil @5ml/lit on growth of P. brassicae was also evaluated and observed that garlic oil effect the RGR, RCR and ECI of P. brassicae. The RGR (0.11) and RCR (17.30) was comparatively lower in garlic oil @5ml/lit than control (0.12,18.28, respectively) and they were statistically at par. While the ECI was significantly lower in garlic oil @5ml/lit (5.80) than control (9.24). Garlic oil treated curds were evaluated for their sensory characteristics and found that there was no significant difference between garlic oil @5ml/lit treated curds and control in respect of texture, colour, taste, flavour, odour, appearance, and overall acceptability.

Bioefficacy and dissipation pattern of chlorantraniliprole and jatropha oil against major pests of cabbage

Shahnaz Akhtar

The present experiment on 'Bioefficacy and dissipation pattern of chlorantraniliprole and jatropha oil against major pests of cabbage' was carried out during 2022-2023. The field experiment was carried out at Experimental Farm, Department of Horticulture and the laboratory experiments were carried at Residue Laboratory, Department of Entomology, Assam Agricultural University, Jorhat and Guwahati Biotech Park, Amingaon. The insecticide and botanical used in the experiment were chlorantraniliprole 18.5 SC and jatropha oil respectively. The insect pests found in field during the period Nov-Jan (2022-2023) were cabbage butterfly (Pieris brassicae), cabbage aphid (Brevicoryne brassicae), cutworm(Agrotis ipsilon), cabbage semilooper (Trichoplusia ni), white spotted flea beetle(Monolepta signata), head borer (Hellula undalis) and mustard aphid (Lipaphis erysimi) and 4 species of coccinellid predators viz., red and yellow colour morphs of Coccinella transversalis, Cheilomenes sexmaculata, Harmonia dimidata and Propylea dissecta. After 1, 3, 5, 7 and 10 days of spraying, chlorantraniliprole 18.5SC @ 0.3ml/l showed maximum percent reduction of lepidopteran pests (90.70 to 92.90) followed by jatropha oil @ 7 ml/l (57.00 to 73.90) and highest infestation was observed in control. In case of Brevicoryne brassicae, the maximum percent reduction was observed in chlorantraniliprole 18.5 SC@ 0.3ml/l (74.40) which was statistically at par with jatropha oil@ 7ml/l (64.00). Chlorantraniliprole and jatroha oil had no significant effect on the population of coccinellid beetles. The highest yield was obtained from chlorantraniliprole 18.5SC @ 0.3ml/l treated plots (302.05 q ha-1), which was statistically at par with jatropha oil @ 7ml/l treated plots (299.15 q ha-1). Benefit cost ratio was also highest in jatropha oil@ 7ml/l treated plots (2.4:1). The lowest yield was obtained in control plot (111.95 q/ha). The initial deposits of chlorantraniliprole 18.5SC at 0 day was 0.44 mg kg-1 followed by 0.30, 0.15 and 0.06 mg kg-1 at 1 day, 3 days and 5 days respectively. The highest dissipation (86.36%) of chlorantraniliprole 18.5SC was

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recorded 5 days after spraying. The initial deposit of jatropha oil at 3 and 5 ml/l were found below detectable range while the residues of jatropha oil at 7 ml/l could be detectable only at 0 day (1hr) after spraying (0.08mg kg-1). The half-life values calculated were 1.8 days for chlorantraniliprole 18.5 SC @ 0.3 ml/l. The initial deposit of chlorantraniliprole @ 0.3ml/l was found to be below MRL. Therefore, a waiting period of 5-6 days and 1 day for chlorantraniliprole and jatropha oil, respectively has been suggested to avoid any health hazards to the consumers.

Exploration of termite mound soil as potting media

Shiney Kathbaruah

Laboratory and field experiments were carried out at the Department of Entomology, Soil Laboratory of Advanced Centre for Integrated Farming System Research, Department of Soil Science and at the Experimental Farm, Department of Horticulture, Assam Agricultural University during 2021-2023. During the course of study, seven numbers of potting media using mound soil of a subterranean termite species, Odontotermes obesus were prepared in various combinations with garden soil, sand and FYM and tested along with a control. Experimental analysis as regards to physico-chemical and biological parameters of different potting media revealed superiority of T7 (1 part termite soil + 1 part sand + 2 parts FYM) in terms of soil pH (7.15), organic carbon (2.13%), available nitrogen (526.02 kg ha-1), available phosphorus (56.60 kg ha-1), available potassium (708.19kg ha-1), dehydrogenase enzyme activity (18.21µg TTF g-1 soil 24 hr-1), Phosphomonoesterase (PME) activity (46.68 54µg p-nitrophenol g-1 soil h-1) and urease activity (3.39µg NH4-N g-1 soil 2 hr-1) . Whereas the potting mixture: T4 (2 parts termite soil + 1 part garden soil + 1 part FYM) registered superiority in terms of PME activity (50.54µg p-nitrophenol g-1 soil h1), Fluorescein diacetate (FDA) activity (11.01µg fluorescein g-1 soil h-1) and Soil Microbial Biomass Carbon (SMBC) (262.25µg g-1). Pearson's correlation matrix among the physico-chemical and biological parameters showed significant positive correlation in case of soil pH with Electrical Conductivity (EC) (r=0.86, P=0.01), Water Holding Capacity (WHC) (r=0.72, P=0.05), Dehydrogenase activity (r=0.71, p=0.05) and PME activity (r=0.74, P=0.05). Similarly, EC was significantly correlated with WHC (r=0.80, P=0.05), dehydrogenase activity (r=0.73, P=0.05) and PME activity (r=0.76, P=0.05). Significant correlations were observed in case of WHC and PME activity (r=0.72, P=0.05); organic carbon with phosphorus (r=0.97, P=0.01), potassium (r=0.94, P=0.01) and dehydrogenase activity (r=0.86, P=0.01); nitrogen with urease (r=0.87, P=0.01); phosphorus with potassium (r=0.90, P=0.01), dehydrogenase activity (r=0.87, P=0.01), PME activity (r=0.73, P=0.05); potassium with dehydrogenase activity (r=0.78, P=0.05); SMBC with dehydrogenase (r=0.78, P=0.05), PME (r=0.71, P=0.05),

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FDA activity (r=0.87, P=0.05) and urease activity (r=0.77, P=0.05); dehydrogenase with PME (r=0.80, P=0.05), FDA (r=0.71, P=0.05) and urease (r=0.74, P=0.05) and finally PME with FDA activity (r=0.85, P=0.01).

Efficacy of different essential oils against aphid (*Aphis craccivora*) in green gram

Siranjib Sonowal

Green gram, Vigna radiata (L) Wilczek is a significant pulse crop in India. It offers a protein-rich diet with 211 calories and 14.2 grams of proteins, along with essential minerals, iron and fiber. However, the crop faces production losses due to insect pests, especially aphids, which hinder its early growth stages by continuously sucking cell sap, leading to leaf drying and hampering vegetative growth. The increasing concern over the adverse environmental impact of chemical pesticides has led to the exploration of alternative and eco-friendly pest control measures. Essential oils are a viable alternative to other botanical extracts used as pesticides due to their widespread availability and relative affordability. In this study, we investigated the efficacy of essential oils derived from neem, clove, mint, garlic, ginger and eucalyptus as potential biopesticides against Aphis craccivora Koch, a destructive pest of green gram. The nymph and adult mortality rates were evaluated at different concentrations (1%, 3%, and 5%) after 4, 12, 24, 48 and 72 hours of treatment. Neem oil exhibited the highest nymph mortality of 96.67%, 100%, 100% at 1%, 3% and 5%, respectively. Mint oil also displayed notable efficacy with mortality rates of 73.33%, 73.33%, and 83.33% at 1%, 3%, and 5% concentrations, respectively after 72 hours of treatment. Clove and garlic oils exhibited moderate nymph mortality while eucalyptus oil showed the lowest impact on nymph mortality. All oils demonstrated significantly higher mortality rates compared to the control group. Similar trends were observed in adult mortality rates, with neem oil demonstrating the highest efficacy (56.67% at 1%, 73.33% at 3%, and 76.66% at 5%). Mint oil also exhibited notable adult mortality rates. Conversely, eucalyptus oil showed the lowest mortality rates among all treatments. Furthermore, treatment with essential oils reduced the total development period of A. craccivora compared to the control group, with neem and mint oils resulting in the shortest development periods. The nymphal duration was significantly shorter in the treatment groups, with clove oil exhibiting the shortest 1st nymphal duration. Neem, mint, and garlic oils also contributed to shorter nymphal periods. Additionally, reproductive performance was affected by the treatments, with mint oil resulting in the shortest reproductive period

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and neem oil leading to the lowest number of offspring produced by a single female. The total number of offspring was significantly lower in the treatment groups, with the control group having the highest number. The importance of essential oils in pest control lies in their eco-friendly and sustainable attributes, offering effective alternatives to harmful chemical pesticides. As we look to the future, further research and development in harnessing the potential of essential oils hold promise for safer and more environmentally conscious pest management strategies.

Combined effect of entomopathogenic fungus with botanicals and insecticides against *Helopeltis theivora* Waterhouse (Hemiptera: Miridae)

Sudeshna Ray

The compatibility of a native entomopathogenic fungus, Cordyceps javanica with three different botanicals viz., neem oil, pongamia oil and jatropha oil and insecticides viz., Clothianidin 50 WDG, Thiamethoxam 25 WG and Profenofos 50 EC at three different concentrations viz., recommended dose (RD), half of the recommended dose and more than the recommended dose during 2022-23 in Physiology Laboratory, Department of Entomology, AAU, Jorhat following poison food technique (Nene & Thapliyal, 1978). Results revealed that among all the tested botanicals and insecticides at three different concentrations, half of the RD of each botanical and insecticide exhibited maximum mycelial growth, conidial density and sporulation than RD and more than the RD. Among the botanicals, at half of the RD (0.5%) neem oil showed the lowest inhibition per cent (31.19) followed by pongamia oil (43.58%). However, among the insecticides, at half of the RD (0.01%) Clothianidin 50 WDG exhibited the lowest inhibition per cent (12.84) followed by Thiamethoxam 25 WG (30.50%). The present study also showed varying levels of compatibility of C. javanica with respect to botanicals and insecticides and their doses which could be proved through T toxicity model classification. Among the botanicals, neem and pongamia oils were found to be compatible at half of the RD, with respect to T values which signify toxicity values above 60. Moreover among the insecticides, Clothianidin 50 WDG was found to be compatible with C. Javanica at all three doses (0.01, 0.02 and 0.04%) based on T values whereas Thiamethoxam 25 WG was found to be compatible only at half of the RD and RD (0.01 and 0,02%). The four best compatible combinations i.e. C. javanica (1x 107 conidia ml -1) +Clothianidin 50 WDG (0.01%), C. javanica (1x 107 conidia ml -1) + Thiamethoxam 25 WG (0.01%), C. javanica (1x 107 conidia ml -1) + Neem oil (0.5%) and C. javanica (1x 107 conidia ml-1) + Pongamia oil (0.5%) were tested for their efficacy against H. theivora along with their individual RDs. Results revealed that compatible combinations of EPF and insecticides, C. javanica + Thiamethoxam 25 WG recorded the highest per cent (100) mortality of H. theivora

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followed by C. javanica +Clothianidin 50 WDG (88%) at 72 HAT as compared to the individual recommended dose of insecticides. Whereas EPF and botanicals, C. javanica + Neem oil recorded 70 per cent mortality of H. theivora followed by C. javanica + Pongamia oil (40%) compared to their individual RDs after 120 hours of treatments. Among all the treatments, less number of feeding punctures per twig were recorded in C. javanica + Thiamethoxam 25 WG treated twigs (20.6 nos.) followed by C. javanica +Clothianidin 50 WDG (25.8 nos.) after 18 hours of treatment, whereas control showed the highest number of punctures (73.8 nos.) at 18 HAT. Moreover, no phytotoxic symptom was recorded by the selected treatments for tea leaves.

An Appraisal of Group Dynamics of Farmer Producer Organizations (FPOs) promoted by Assam Agricultural University in the Lower Brahmaputra Valley Zone of Assam

Amrita Singha

The study entitled "An Appraisal of Group Dynamics of Farmer Producer Organizations (FPOs) promoted by Assam Agricultural University in the Lower Brahmaputra Valley Zone of Assam" was carried out in six districts of the Lower Brahmaputra Valley agro-climatic zone of Assam to study the personal and socioeconomic profile of the members of the Farmer Producer Organizations (FPOs), measure the Group Dynamics Effectiveness of the FPOs and identify the constraints perceived by them. A descriptive research design, following an ex post facto approach, was utilized for the study through a multi-stage, purposive cum random sampling design to select 120 respondents from eight sampled FPOs. Data was collected with the help of a pretested, semi-structured research schedule, using the personal interview method. With respect to the personal and socio-economic profile of the respondents, the study revealed that majority of the respondents (FPOs members) were middle aged with relatively high level of formal education. Majority of the respondents belonged to the small family size category with medium level of annual income ranging from Rs. 33190.00 to Rs. 379867.00. Majority of the respondents were found to have low to medium level of socio-political participation. With respect to material possession, the respondents were by and large distributed evenly across low, medium and high categories. Findings on the Group Dynamics Effectiveness indicators indicated that majority of the members of the FPOs perceived medium level of participation, team work, group atmosphere, interest and motivation, group cohesiveness, group communication, interpersonal trust, empathy, task functions, conformation to group norms and achievement of FPOs. Following a similar trend, majority of the respondents perceived decision making process to be somewhat participatory. The overall categorization of respondents based on their perceptions on the indicators of Group Dynamics Effectiveness revealed that majority of them perceived Group Dynamics

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Effectiveness of FPOs to be medium. In so far as the perceived constraints of FPOs were concerned, altogether 35(thirty five) expressed constraints were grouped into seven major constraint categories, viz, organizational, socio-political, economic, marketing, infrastructural, technical and human resource. An assessment of the comparative strengths of the constraint categories revealed that economic constraints was the most pressing with the highest mean value of 2.31. The other constraints in decreasing order of perceived importance based on their corresponding mean values were human resource constraints (2.29), technical constraints (2.18), infra-structure constraints (2.11), marketing constraints (2.04), organizational constraints (1.85) and socio-political constraints (1.73) respectively. Motivation, management & leadership training at formative stage of FPO, inclusion of business activities capable of delivering economic benefits to members, ensuring a culture of consensus based action, ensuring accountability and promoting team work, capacity building in programme building & implementation, diversification for risk minimization on the basis of profile strengths etc. are some of the general recommendations of the study.

A Study on the Extent of Adoption of Recommended Package of Practices by the Farmers involved in Commercial Cultivation of Assam Lemon in Tinsukia District of Assam

Anannya Gogoi

Since the north-eastern region of India is thought to be the origin of many Citrus species, Assam is home to a variety of indigenous citrus fruits. The Assam lemon, also known as the Kaji nemu (Citrus limon L. Burm), is one of the most common and well-liked citrus fruits in this area. This native Assamese lemon has a distinctive quality that is primarily due to its place of origin, Assam. The Assam lemon fruit is commonly used in food, beverages, industries and for medicine purpose. It is larger in size than a typical lemon. It frequently produces seedless fruits with 9–12 segments since it prefers to grow fruit in bunches. The study entitled "A Study on the Extent of Adoption of Recommended Package of Practices by the Farmers involved in Commercial Cultivation of Assam Lemon in Tinsukia District of Assam" was undertaken in Tinsukia district which was selected purposively as it is the citrus belt of the state. Three blocks Kakopather, Dhola and Saikhowa development block was selected purposively. Two villages from each blocks were selected randomly. Therefore, from each village 20 respondents were selected purposively who were involved in cultivation of Assam lemon commercially. So, a sample of 120 respondents were selected for the study. The study revealed that highest percentage of the respondents (57.50%) belonged to 35-55 year age group and (49.17%) of them having education level of up to middle school pass. About (51%) of the respondents belonged to medium sized family of 5-7 members. As regards to operational land holding, majority (65%) of the respondents mainly belonged to small farmer to marginal farmer category and majority (76.67%) of them had an area under Assam lemon cultivation between 0.85 ha – 3.09 ha. Moreover, majority (60.83%) of the respondents had annual family income between Rs 3.4 lakh to Rs 5.1 lakh while (71.67%) of the respondents had annual income from Assam lemon cultivation between Rs 1.1 lakh to Rs 2.8 lakh. About (67.50%) of the respondents had hired farm labour and (69.17%) of the respondents had marketing experience of more

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than 8 years and (54.17%) of the respondents follow the marketing channel of producer-wholesaler-retailer-consumer. Mostly (68.33%) of the respondents had low level of extension contact while (77.50 %) of them had medium level of mass media exposure and about (58.30%) of the respondents had training exposure of only one time.

Perception of Rural Youth Towards Farming as an Enterprise

Bhuyasi Sarmah

Rural youth are precious human assets who can play an important role in the developmental activities as well as in agriculture of a nation. India has the largest population of youth referred to as Gen-Z. As most of the youth in India are living in rural areas it is important for the rural youth to have clear understanding and a correct perception towards farming and its allied activities. The present study is entitled as of "Perception of rural youth towards farming as an Enterprise" was conducted in Jorhat and Morigaon districts of Assam by following Ex-Post-Facto research design. The main objective of the study were to study the socio-economic and psychological characteristics of rural youth, to measure the perception of rural youth towards farming as a profitable enterprise, to enlist the problems faced by the rural youth in taking farming as an entrepreneurial activity. A multi stage purposive cum random sampling design was used to select 120 respondents from 4 villages of both the districts. The primary data for the study was collected during March-May, 2023 through personal interview method with the help of a structured schedule. Karl Pearson's correlation coefficient, chi square test and descriptive statistics were also used. The findings revealed that majority (40.83%) belonged to 25-29 years age group and were male (57.5%) and unmarried (80%). Majority (50.83%) had education up to higher secondary with single type (70%), medium sized family (65%) and (80.83%) had marginal operational land holding. The main occupation of majority (30.83%) of respondents' families was farming with annual family income for highest percentage of respondents (40%) ranged between Rs.100000-300000 and majority (52.50%) of respondents had no occupation with no annual income (52.5%). It also revealed that preferences of livelihood of majority of the respondents (32.5%) were agriculture business with medium farming (45.83%) and no entrepreneurial (41.67%) experience respectively. Finding also revel as that majority (80.83%) had read/watch farm related article/video in social media and YouTube and (51.67%) had no membership in any organization. Majority (77.5%) had no extension contact and (51.66%) got only one day training exposure. Majority (75.83%) had had medium level of attitude towards farming and majority (84.17%) had medium level of perception towards farming as an enterprise.

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Correlation and Chi-square table revealed that age, size of operational land holding, farming experience, entrepreneurial experience, training exposure, attitude towards farming, annual family income showed positive and significant relationship and educational level, preferences of livelihood, gender, mass media exposure, membership in social organization showed significant association with perception of rural youth towards farming as an enterprise. Problems of timely information and advice (Rank I), lack of support from family/friends/relatives (Rank II), unavailability of inputs in time (Rank III) were the first three ranked problems mentioned by the respondents in taking farming as an entrepreneurial activity. Government and extension workers should encourage and target these rural youth to take more active part in farming and its ailed activities .Therefore greater effort should be geared to form organized groups for easy accessibility in organizing seminars for them and also provision of other extension packages. Youth is the future of a Nation and rural youth are the future of farming and rural enterprise. If concern authorities seek to provide welfare to the Nation then the time to act is now.

Study on management orientation and performance of Muga silk entrepreneurs in Kamrup district of Assam

Bikash Ch Das

The present study entitled as "Study on management orientation and performance of Muga silk entrepreneurs in Kamrup district of Assam" was carried out with the following objectives: 1. To measure the management orientation of muga silk entrepreneurs 2. To assess the performance of muga silk entrepreneurs 3. To identify the problems faced by muga silk entrepreneurs in terms of marketing, production and management Kamrup district of Assam was selected purposively for the present study because the production of silk handloom weaving in Assam is centred in Kamrup district, accounting for approximately 70 percent of the state's silk post-cocoon activities. The Kamrup district of Assam is consist of 14 blocks and out of which Sualkuchi, Rani, Rampur and Boko were selected purposively for the study because muga silk weaving is highly concentrated in these areas. Among the selected 4 blocks highest muga silk entrepreneurs are concentrated in Sualkuchi followed by Rani, Rampur and Boko. Hence, following a convenient sampling from Sualkuchi (50), Rani (20), Rampur (15) and Boko (15) were selected for the study. The profile variables selected for this study were age, family type, education level, annual income, organizational pattern, experience, source of finance, social participation, mass media exposure, exposure to training. Meanwhile, the descriptive variables selected for the study were management orientation and performance of entrepreneurs. Findings revealed that majority of the respondents (87.00%) belonged to middle aged category. Majority of the respondents (52.00%) had formal education up to higher secondary and there were not any respondents from illiterate, can read only category in the study area. Majority of respondents (41.00%) had 22-24 years' experience in the enterprise. Majority of the respondents (93.00%) have their own enterprise. Majority of them (75.00%) had medium annual net income level ranging from Rs 413835.54 - Rs 644725.01. Majority of them (68.00%) had medium exposure to training. Majority of the respondents (60.00%) have their own financial resources and rest (40.00%) depends

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on banks and other financial institutions. Majority of them (53.00%) had medium level of mass media exposure. The findings revealed that the majority of the respondents (59.00%) had medium level of planning orientation followed by those having low (26.00%) and high (15.00%) level of planning orientation. It was also found that majority (54.00%) of respondents had medium level of production orientation followed by high (32.00%) and low (14.00%) level of production orientation. Also, majority (51.00%) had medium level of market orientation followed by high (35.00%) and low (14.00%) level of market orientation. Overall majority (55.00%) of respondents had medium management orientation followed by high (33.00%) and low (12.00%) level of management orientation. In the study area, the enterprise is performing in such a way that every 1 rupee invested is generating a net profit of 48 paisa. In this study the PCI (Problem Confrontation Index) of individual problem ranged from 0 to 300, where 0 indicating no problem confrontation and 300 indicating high problem confrontation. It can be observed that among the computed PCI values for production problems, "Irregular supply of muga yarn from muga farms units and local vendors" had the highest value of 267 and ranked first as frequently faced problem faced by entrepreneur followed by "Lack of technology upgradation (255)" and "Unavailability of weaving machine parts locally (203)". Also, the problems faced by entrepreneurs in terms of marketing includes tough competition with powerloom silk enterprise, availability of low-quality similar silk in market, price fluctuation of muga yarn, customers are unaware of product features like quality, color etc, lack of government support and knowledge about proper platform to advertise product globally, limited access to market information, and low profit from the enterprise. As regards to the computed PCI values for management problems, "Lack of hired weavers" had the highest value of 240 and was ranked first as frequently faced problem as perceived by entrepreneur.

Effectiveness of Rice Demonstration under APART in Jorhat & Sivasagar district of Assam

Himadri Borgohain

With the motive of long-term agriculture transformation in Assam, Govt. Of Assam started the project "Assam Agribusiness Rural Transformation Project" or APART. The study entitled "Effectiveness of Rice Demonstration under APART in Jorhat and Sivasagar district of Assam" was conducted in Jorhat and Sivasagar district. For measuring effectiveness three dimensions were selected which were change in area under rice cultivation, change in production and productivity and change in income. The extent of adoption of stress tolerant rice varieties and various techniques of crop establishment were also studied. The study revealed that majority of the respondents i.e 61.66 belonged to the middle aged group of 35 – 50 years. More than 3/4th i.e., 87.50% of the respondents were male while only 12.50% of respondents were female.31.6% of respondents had secondary level of education. The findings indicate that majority of the respondents i.e. 53.33% belonged to the medium size family with 5 to 7 members. 34.17% had small land holding of 1-2 hectare followed by 31.66% of respondents with marginal land holding of size less than 1 ha. The majority of 87.50% of respondents had medium level of annual income between Rs 1.97 lakhs to Rs 5.07 lakhs. Based on farming experience it was observed that majority of respondents with 70.83% had medium level of farming experience of 5-14 years. The majority of the respondents (59.16%) had medium level of extension contact. About 58.33% of respondents had medium level of training exposure (2-5 trainings) followed by 24.16% of the respondents had high level of training of more than 5 trainings. 50.00% of the respondents had medium level of exposure to mass media. It was observed that 96.6% of the respondents had fully adopted the STRV's which were demonstrated to them in the later years. It was observed that majority of 63.79% of the respondents had medium level of adoption for STRV's and their recommended practices. 21.55% of the respondents had high and 14.65% of the respondents had low level of adoption. It was observed that there was no significant relationship between independents variables and production under rice cultivation. In case of income, there was significant relationship between age of respondents and operational land holding with income from rice

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cultivation at 5% probability level. Again it was found that at 0.01 probability level there was significant relationship between farming experience and income from rice cultivation. Similarly, age, extension contact, training exposure and mass media exposure had significant relationship with extent of adoption of STRV's at 5% probability level. Farming experience had significant relationship with extent of adoption at 1% probability level. The major problems faced by farmers were high cost of machines (71.66%), lack of technical knowledge (59.16), high cost of fertilizers (55.83%), Lack of necessary equipment (46.66%), lack of enthusiasm (34.16%), lack of conviction in the new technology (32.5%), unavailability of seeds (28.33%), disease and pest infestation (21.66%), weak extension programme (20.00%), unavailability of local labour (14.16%), lack of awareness about the benefits (10.83%) and damage due to flood (3.33%).

A Study on Entrepreneurial Behaviour of Watermelon Growers of Central Brahmaputra Valley Zone (CBVZ)

Kangkana Bharadwaj

The present study entitled "A Study on Entrepreneurial Behavior of Watermelon Growers of Central Brahmaputra Valley Zone (CBVZ), Assam" was carried out with following objectives: 1. To analyse the Entrepreneurial Behaviour of Watermelon growers of the Central Brahmaputra Valley Zone. 2. To determine the factors influencing Entrepreneurial Behaviour of watermelon growers. 3. To identify the problems faced by the watermelon growers in relation to scientific watermelon cultivation. The study was undertaken in both the districts of Central Brahmaputra Valley Zone (CBVZ) i.e. Nagaon and Morigaon. A purposive cum random sampling design was used to select 180 respondents from 18 villages of both the districts. The primary data for the study was collected during February-April, 2023 through personal interview method with the help of a structured schedule. The findings of the study revealed that majority (66.11%) of the respondents belonged to middle-aged category, majority (38.34%) of the respondents had secondary level of formal education and comes relatively from medium sized family (53.33%). The study also revealed that majority of the respondents (41.12%) were small farmers with medium (68.34%) annual family income. Majority of the respondents had medium (69.45%) farming experience in watermelon cultivation. It is viewed that majority 76.12 per cent of the respondent did not get any training on watermelon cultivation. 72.22 per cent of the respondents had medium level of mass media exposure. In case of source of information majority of the respondents‟ main source of information was social media. Medium level of labour availability within household is viewed in the study area. About 62.22 per cent of the respondents had moderately favorable attitude towards watermelon cultivation. In case of various components related to entrepreneurial behaviour, the study revealed that majority (77.22%) of the respondents had medium level of innovativeness, medium level of achievement motivation (51.67%), moderate decisionmaking ability (67.78%), medium level of risk orientation (68.88%), medium level of coordinating ability

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(61.11%), moderate level of planning ability (47.77%), medium level of information seeking behaviour (73.33%), medium level of cosmopolitness (58.88%) and medium level of self-confidence (64.44%). The overall entrepreneurial behaviour of watermelon growers were found medium (68.33%) followed by low entrepreneurial behaviour (17.22%) and high entrepreneurial behaviour (14.45%). To determine the factors influencing entrepreneurial behaviour of the watermelon growers, multiple regression analysis was used where annual family 8 income, net annual income from watermelon cultivation, training exposure, attitude towards watermelon cultivation were found to contribute significantly towards variation in the entrepreneurial behaviour of watermelon growers at 0.01 level of probability. Operational land holding and farming experience in watermelon cultivation contribute significantly towards variation in the entrepreneurial behaviour of watermelon growers at 0.05 level of probability. The contributory factors may be given more emphasis by the concerned agencies while formulating any project or related programmes on watermelon cultivation in the study area. With regards to the major problems, the study showed that „High cost of quality inputs‟ was the most important problem (ranked first) faced by the watermelon growers followed by perishable nature of watermelon, adverse effect of natural calamities, non availability of quality seed and non availability of irrigation facility, lack of credit facility, pest attack, lack of extension services. It is imperative to call for attention from government, policy makers, and planners to design effective watermelon production policy/strategy that would ensure to overcome the problems faced by the farmers for promoting watermelon production and to ensure economic development.

A Study on Effectiveness of Tribal Sub Plan on Poverty Eradication in Dhemaji district of Assam

Karishma Doley

The study entitled "A Study on Effectiveness of Tribal Sub Plan on Poverty Eradication in Dhemaji district of Assam" was carried out in Dhemaji district of Assam with a view to study the effectiveness of TSP on poverty eradication. The specific objectives of the study were: 1. To study the profile characteristics of tribal beneficiary and non-beneficiary of the study area. 2. To measure the poverty level of the beneficiary and non- beneficiary tribal people in the project area. 3. To identify the barriers of the development of the respondents as perceived by them. The study was conducted in Dhemaji district as it is one of the highest tribal population districts of Assam. All the sub-divisions of Dhemaji district were selected for the study. A purposive and random sampling method was followed for the study. The total sample size was 160 consisting of 80 beneficiary and 80 non-beneficiary tribal farmers in the study area. For the present study a total of 12 independent variables, 1 dependent and 1 descriptive variable were selected. Data pertaining to the study were collected through personal interview method during March-April, 2023. Appropriate statistical techniques were used for analysis of data. The findings with respect to the selected profile characteristics of the respondents indicated that majority of the respondents (58.75 % beneficiaries and 53.75 % non-beneficiaries) belong to middle aged category i.e. 35 years to 55 years. In case of beneficiary respondents 35% had high school level of education and 36.2 % of nonbeneficiary respondents had middle school level of education. More than half (60 percent) of the beneficiaries were male while only 40 per cent of the beneficiaries were female. The tradition of joint family system in tribal community was being restored by nuclear families. 63.75 percent of the beneficiary respondents belonged to nuclear family and the remaining 36.25 percent belonged to joint family. In case of nonbeneficiary respondents (57.4 %) belonged to nuclear family and the remaining 42.5 percent respondents belonged to joint family. More than 60 % have nuclear family status and the family size is less than 4 members in the family of the respondents. The major occupations of both the category of respondents were only cultivation, which was one of the reasons of poverty in the area. The poverty level for both beneficiary and non-

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beneficiary respondents was measured using the Global Multi dimensional Poverty Index. The Index includes three dimensions viz., Health, Education and Living Standards with ten indicators such as nutrition, child mortality, years of schooling, school attendance, cooking fuel, sanitation, drinking water, electricity, housing, assets. Among the 10 indicators the deprivation of improved cooking fuel (21.92 % in beneficiary and 19.71 % in nonbeneficiary) and deprivation of improved sanitation (17.3 % in beneficiary and 17.06 % in non-beneficiary) were two leading contributors to multidimensional poverty index in the study area. The index score of the tribal respondents showed that poverty level of beneficiary (0.146) and non-beneficiary (0.245) is significantly different. The association with the perceived poverty level of the beneficiary was found significant in case of education (r=-0.286), Occupation (r=-0.335), annual income (r=-0.650), Extension contact(r=-0.259) and social participation (r=-0.160) were found to have negative and significant relationship with the deprivation score of the beneficiary group of respondents. The findings also revealed that age(r=0.124), family type(r=0.111), family size(r=0.110), operational land holding(r=0.125), farming experience(r=0.125) were found to have no significant relationship with the deprivation score of the beneficiary respondents of the study area. The barriers of development stated by the beneficiaries of TSP included delay in obtaining approved benefits/input supply, Non-availability of suggested inputs e.g. varieties/breeds locally after project period, Distance from village to KVK is more, Unavailability of proper guidance regarding adoption of improved agricultural technology, Lack of knowledge about the varieties of crops/ breed of poultry provided, Lack of own capital, Lack of irrigation facilities, Frequent transfer of scientific staff from KVK/RARS, , Need of constant follow up of respective officer, High cost of feed for animals and birds, Lack of knowledge regarding various benefits under TSP, Lack of technical knowledge regarding plant protection appliances, Excessive formalities for institutional credit facilities, Lack of knowledge regarding various documents requires, Lack of technical knowledge regarding use of agricultural inputs, Dominance by few local individuals. Thus, it is concluded that strategies need to be formulated for further refinement of projects aimed at tribal agriculture development in the study area.

A Study on perception of Assam Agricultural University students towards farming as a means of livelihood

Kaviya S

The study entitled "A Study on Perception of Assam Agricultural University Students Towards Farming as a means of Livelihood" was carried out in all three campuses with faculty of agriculture in Assam Agricultural University i.e., CoA, BNCA and SCSCA. The research was carried out with the objective to study the perception of agricultural students towards farming as a means of livelihood, to identify the factors influencing the willingness of students to take up farming as a means of livelihood and to find out the difficulties faced by students while selecting farming as a means of livelihood. A proportionate stratified sampling design was followed for selecting a total of 300 respondents from 3rd year and 4th year students. Data were collected with the help of google form sent through mail during April-May, 2023. The findings of the study revealed that all the students were in the age of 20-24, 55.33% and 44.67% of the students were males and females. 47.33% and 52.66% of respondents were 3rd year and 4th year. Most of the students (72%) were had obtained CGPA of 7.00 to 8.50.16% of respondents had selected agronomy as their elective subject. 56% and 44% of respondents were from rural and urban background. About 63% of the respondents had small (1-4) family.46.67% and 51% of students mother and father were graduated and almost half (49%) of the fathers were government employment and most of the mothers were housewife. About 72% of respondent's family had medium level of annual income. 61% of students had operational land holding for farming, among 74% of the students had marginal land holding. More than two-fifth (45%) of students had very-low level of resource availability. Around 71% of respondents had no farming experience and 63% of students had contact with Agri professionals. 73%, 64%, 68%, 72% and 67% of the respondents had medium level of achievement motivation, self-confidence, risk orientation, mass media exposure and agricultural business anxiety, respectively. Nearly two-third (65%) of students had medium level of perception towards farming as a means of livelihood. Most of the student's perception towards farming was "It develops

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awareness about the surrounding environment". Family size, Achievement Motivation, Self-confidence, Risk orientation, Mass media exposure and Agricultural Business Anxiety were significantly related with perception towards farming as a means of livelihood. The association of elective subject, parent's education, parent's occupation and farming experience with the perception of students towards farming as a means of livelihood was found. Majority of the respondents (83%) were willing to take up farming career and most of the students were willing to grow ornamental plants. Binary logistics regression revealed that academic performance, annual income of family, operational land holding, farming experience, achievement motivation, self-confidence, risk orientation and agricultural business anxiety were the factors that influencing the willingness of students to take up farming as a means of livelihood. The major difficulties faced by students while selecting farming as a means of livelihood were risk of crop failure, chronic fluctuation of prices of agricultural products, high cost of cultivation and lower returns and unpredictable climate change. Some of the suggestions given by students to overcome the problems were financial assistance from government, regulation of prices of agricultural produces, improvement of quality of rural life and infrastructure. So, efforts should be made by government, policy makers and planners to reduce the enormity of the problems given by the agricultural students while selecting farming as a means of livelihood. Key words: Agricultural students, Farming, Perception, willingness, Factors, Livelihood.

A study on technological gap in adoption of recommended maize cultivation practices by the shareholders of Nameri Valley Farmer Producer Company in Sonitpur District of Assam

Maitrayee Dutta

The study entitled 'A study on technological gap in adoption of recommended maize cultivation practices by the shareholders of Nameri Valley Farmer Producer Company in Sonitpur district of Assam' was carried out with the following objectives: 1. Determine the extent of technological gap in adoption of recommended maize cultivation practices by the shareholders of Nameri Valley 2. Identify the factors influencing the extent of technological gap in adoption of recommended maize cultivation practices by the shareholders of Nameri Valley FPC 3. Identify the constraints in production and marketing of maize as perceived by the shareholders of Nameri Valley FPC Nameri Valley Agro Producer Company Limited which is located at Balipara in Sonitpur district of Assam was selected for the study. It was started in the year 2021. In this producer company, members are the primary producers of maize. The study intended to examine the extent of technological gap in adoption of recommended maize cultivation practices. From a total of 122 shareholders, a sample of 80 shareholders were selected as respondents by following proportionate random sampling technique. 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, correlation co-efficient, multiple regression analysis and t-test were the statistical techniques used for analysis and interpretation of data. Altogether 16 independent variables, viz., age, education level, family type, occupational status, institutional linkage, operational land holding, experience as a maize grower, exposure to training on maize cultivation, net annual income from maize cultivation, net annual farm income, availability of working capital for maize cultivation, farm mechanization, knowledge on scientific practices of maize cultivation, economic motivation, risk orientation, degree of commercialization of maize and 1 dependent variable viz., extent of technological gap in adoption of recommended maize

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cultivation practices were included in the study. A structured schedule was prepared to measure the extent of technological gap in adoption recommended maize cultivation practices. Findings believed that majority of the respondents (43.75%) belonged to the middle aged group while 35.00 per cent of the respondents belonged to the young aged group. Majority of the respondents (25.00 %) had higher secondary/ P.U level of education followed by (68.75%) respondents who belonged to the nuclear family with (33.75%) of the respondents who had cultivation + skilled labour type of occupation. Majority of the them (75.00%) had membership of one organization followed by 15.00 per cent of the respondents with membership of two or more organization. An equal proportion of the respondents (48.75 %) belong to the marginal and small land owners, also an equal proportion of respondents 1.25 per cent belong to the semi medium and medium category. Majority of the respondents (62.50%) had 6 years to 12 years of experience as a maize grower followed by 23.75 per cent respondents who had above 12 years of experience as a maize grower. Majority of them (65.00 %) were exposed to 1 day training on maize cultivation followed by (58.75%) of respondents who had medium net annual income from maize cultivation. (72.50%) had medium net annual farm income and (48.75%) of the respondents had medium level of availability working capital for maize cultivation. Majority of the respondents (60.00%) had medium level of knowledge on maize cultivation practices followed by 21.25 per cent of the respondents with low level of knowledge on maize cultivation practices. Majority of the respondents (72.50%) had medium level of economic motivation with medium level of risk bearing ability (63.75%). Majority of the respondents (60.00%) had medium degree of commercialization, followed by 25.00 per cent of the respondents with low degree of commercialization. With regards to technological gap majority of the respondents (61.25%) had medium overall technological gap in adoption of scientific practices of maize cultivation followed by 18.75 per cent respondents with low overall technological gap in adoption of scientific practices of maize cultivation. 20.00 per cent was found with high technological gap in adoption of scientific practices of maize cultivation. The maximum average technological gap was found in insect control practices (75.00 %) followed by seed treatment with fungicide and total number of irrigation with average technological gap scores being 60.00 per cent and 37.50 per cent respectively. 35.00 per cent of the respondents had full gap in application of phosphatic fertilizer followed by 25.00 per cent of the respondents who had full gap in recommended interculture practices. 18.75 per cent of the respondents had full gap against the recommended seed rate and seed treatment with biofertilizer respectively. 16.25 per cent of the respondents had full gap in application of potassium fertilizer. 15.00 per cent of the respondents had full gap in application of nitrogenous fertilizer after sowing and adoption of recommended insect control practices respectively. None of the respondents had full gap in recommended seed rate practices of maize cultivation.

A Study on Entrepreneurial Behaviour of Nursery Owners in Assam

Penchen Tshyoza Bhutia

Nursery is a place where plants are propagated, cared for, grown, and then sold for use in commercial or residential gardens. Improved quality seedlings are raised under ideal circumstances until they are ready to be planted on a small or large scale. Nurseries are presently becoming popular economic agro-based enterprises and commercial ventures in horticultural sector. It has established its credibility by increased production, creating jobs in both rural and urban areas, and increasing exports significantly. To be profitable, establishing a nursery is a long-term endeavour that demands preparation and skill. New breed of entrepreneurs who are well versed in the modern principles of business management and who have the desirable attitude, values and behaviour are required to show a significant outcome in this sector as success of any enterprise depends on entrepreneur's efficiency and effectiveness. Understanding nursery owners' entrepreneurial behaviour will allow change agents and extension machinery to intervene to correct, modify, alter, or promote appropriate behavioural changes that will allow nursery owners to pursue their business profitably and sustainably. The study was undertaken in three districts of Assam namely, Jorhat, Nagaon and Golaghat which were selected purposively as it is located in close proximity to the only Agricultural University in the state. A sample size of 90 was taken using convenience sampling. 30 nurseries were selected from each district under the study. Primary data for the current study was collected in the month of April- June. The findings of the present investigation revealed that majority of the respondents (55.56%) belonged to the middle-aged category. Most of the respondents (46.67%) had high level of education. Majority (56.67%) of the respondents belonged to small sized family while 91.1% of the respondents had marginal land holding. Most (62.22%) of the respondents belonged to medium income category. Majority (80%) of the respondents had easy access to labour available on both weekdays and weekends. The study also revealed that most (52.22%) of the respondents had medium level experience in nursery business while majority (71.11%) of the respondents had medium level of training exposure and had attended 1 -3 number of trainings conducted by various external

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sources. In terms of various parameters related to entrepreneurial behaviour the study reveals that majority (74.44%) of the respondents had medium level of innovativeness, medium level of achievement motivation (57.78%), moderate decision-making ability (68.89%), medium level of risk orientation (51.11%), moderate level of coordinating ability (57.78%), moderate level of planning ability (60.00%), medium level of information seeking behaviour (77.78%) and medium level of self-confidence (86.67%). With the help of Entrepreneurial Behaviour Index (EBI), entrepreneurial behaviour of nursery owners was calculated and came into the conclusion that majority (68.89%) of the respondents had moderate entrepreneurial behaviour followed by high entrepreneurial behaviour (17.78%) and low entrepreneurial behaviour (13.33%). The problems stated by the respondents included non-availability of desired inputs at the right time, high cost of inputs, lack of knowledge about proper techniques of marketing, lack of knowledge on proper utilization of land under nursery and many more. In terms of natural calamities high rainfall was stated as the most occurring problem for the outdoor nurseries though measures have been taken to overcome the problem. On the other hand, flood was stated as a major problem by almost all the nursery owners of Nagaon district. By overall evaluation of problems, problems related to inputs ranked first followed by land utilization problems, problems related to storage, institutional problems, marketing problems, transportation problems, problems related to natural calamities, social problems and personal problems.

A study on managerial ability of the members of Agnigarh Producer Company Limited in Sonitpur district of Assam with reference to commercial litchi production

Samar Thakuria

The study entitled "A study on managerial ability of the members of Agnigarh Producer Company Limited in Sonitpur district of Assam with reference to commercial litchi production" was conducted with the following objectives: 1. Measure the managerial ability of the members of Agnigarh Producer Company Limited with reference to commercial litchi production 2. Find out the factors influencing managerial ability of the members of Agnigarh Producer Company Limited with reference to commercial litchi production 3. Identify the constraints faced by the members of Agnigarh Producer Company Limited in management of litchi orchard The study was undertaken in Sonitpur district of Assam which was selected purposively, as the Farmer Producer Company dealing with commercial litchi production was operating in this district. FPC namely, Agnigarh Producer Company Limited of Sonitpur district was selected purposively for the study. A sample of 80 respondents was selected from the 13 selected villages following a proportionate random sampling technique. The primary data for the study were collected by the personal interview method with the help of a structured research schedule. The primary data for the study were collected during the month of February, 2023 and June, 2023. Keeping in view the objectives of the study, 18 independent variables and 1 dependent variable were included in the study. The independent variable included in the study were Age, Education level, , Size of operational land holding, Area under litchi cultivation, Annual net farm income, Litchi yield, Farm mechanization, Irrigated area under litchi cultivation, Level of farm wage payment related to litchi cultivation, Experience in litchi cultivation, Social participation, Adoption of recommended litchi production technology, Achievement motivation, Orientation towards the competition, Attitude towards modern agriculture, Risk orientation, Extension contact, Exposure to training on litchi cultivation. The dependent variable included in the study was the managerial ability of the members of

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Agnigarh Producer Company Limited with reference to commercial litchi production which was measured by using the scale developed by Jadav (2005). Extensive literature was browsed for seeking additional information on the conceptual framework of the dependent variable. Findings revealed that majority of the respondents (43.75%) belonged to middle aged category. Majority of the respondents (41.25%) had formal education up to higher secondary/PU level and there were not any respondents from illiterate, can read only category in the study area. Majority of respondents (41.25%) belonged to small farmer in land holding category. Majority of the respondents (50.00%) were having area from 0.10 to 1.5 ha under litchi orchard with medium annual net farm income ranging from Rs 94278.31 to Rs 156528.93. Majority of the respondents (60.00%) had medium level of litchi yield, medium level of farm mechanization (70.00%) and medium level of irrigated area under litchi cultivation (77.50%). Majority of them (80.00%) had medium level of farm wage payment related to litchi cultivation. Majority of respondents (53.75%) had 9- 19 yearsof experience in litchi cultivation. Majority of the respondents (55.00%) were belonged from having membership in one organization. Majority of them (70.00%) had medium level of adoption of recommended litchi production technology, medium level of achievement motivation (68.75%), medium level of orientation towards the competition (67.50%), medium level of attitude towards modern agriculture (63.75), medium level of ii risk orientation (67.50%), medium level of extension contact (63.75) and high level of exposure to training on litchi cultivation (50.00%). Findings revealed that the majority of the respondents (61.25%) had medium level of managerial ability index. The mean score (56.62%) indicated that on an average the respondents had medium level of managerial ability index with standard deviation of 15.69. The value of co-efficient of variation (27.72) indicated that the respondents were relatively homogenous with respect to their level of managerial ability index.Majority of the respondents (50.00%) had medium level of knowledge on scientific practices of litchi,medium level of planning ability (63.75%), medium level of organizing ability(45.00%),medium level of supervising ability (72.50%),medium level budgeting ability(50.00%), medium level of coordinating ability (53.75%),medium level communication ability (60.00%).Majority of them(56.25%) had medium level of controlling ability,medium level ofdecision making ability (52.50%),medium level of human relationship ability (61.25%). Findings revealed that Mean supervising ability score (70.93) indicated that on an average the respondents had high level of supervising ability (ranked first),mean communication ability score (62.49)indicated that on an average the respondents had high level of communication ability (ranked second),mean decision making ability score (61.62) indicated that on an average the respondents had high level of decision making ability(ranked third).Mean organizing ability score (61.60) indicated that on an average the respondents had high level of organizing ability, mean human relationship ability score (60.62) indicated that on an average the respondents had medium level of human relationship ability, followed by mean controlling ability score (59.68) indicated that on an average the respondents had medium level of controlling ability, mean budgeting

ability score (58.53) indicated that on an average the respondents had medium level of budgeting ability, mean coordinating ability score (56.81) indicated that on an average the respondents had medium level of coordinating ability which were ranked Fourth, fifth, sixth, seventh, and eight respectively. Similarly, the mean planning ability score (53.74) indicated that on an average the respondents had low level of planning ability. The mean knowledge in scientific practices of litchi score (49.78) indicated that on an average the respondents had medium level of knowledge in scientific practices of litchi which were ranked ninth and tenth respectively. Findings of correlation analysis indicated that out of the 18 selected independent variables, 12 independent variables were significantly correlated with the managerial ability of the members of FPC. All these 12 independent variables viz., education level (0.687), size of operational land holding (0.520), area under litchi orchard (0.327), annual net farm income (0.686), level of wage payment related to litchi cultivation (0.404), experience in litchi cultivation (0.634), adoption of recommended litchi production technology (0.704), achievement motivation (0.716), attitude towards modern agriculture (0.465), risk orientation (0.793), extension contact (0.810) and exposure to training on litchi cultivation (0.587) showed significant and positive relationship with the managerial ability of the members of FPC at 0.01 level of probability. The findings of the regression analysis indicated that out of 12 independent variables, only 5 variables, viz., educational level (1.819), experience in litchi cultivation (0.415), achievement motivation (1.001), extension contact (1.588) and exposure to training on litchi cultivation (3.334) were found to contribute significantly towards variation in the managerial ability of the members of FPC. Two variables viz., educational level, experience in litchi cultivation showed significant contribution towards the managerial ability of the members of FPC at 0.05 level of probability. Three variables viz., achievement motivation, extension contact and exposure to training on litchi cultivation iii showed significant contribution towards the managerial ability of the members of FPC at 0.01 level of probability. The 12 independent variables fitted in the linear regression analysis could predict 92.30 per cent of the variation in the managerial ability of the members of FPC. Findings revealed that "High incidence of bats and birds" got the highest score (PCI-217) and hence was the 1st ranked problem of the majority of the respondents. Followed by "Litchi yield loss due to weather condition" which got the 2nd highest scores (PCI-200) and hence ranked as the 2nd major problem. “High cost of labour' was another problem faced by members of Agnigarh Produce Company Limited in management of litchi orchard which was ranked third on the basis of the 3rd highest score (PCI-199). "Scarcity of labour in time" was ranked 4th among problems faced by the respondents while with a PCI score-189. "Lack of irrigation facility" got the 5th rank among the problems based on the score of PCI-178 as mentioned by the respondents.

A Study on Pradhan MantriFasal Bima Yojana in Jorhat district of Assam

Sanskrita Borah

Crop insurance is an important crop loss coverage facility that helpsfarmers and agricultural producers guard against losses due to natural calamities. OneNation-One Scheme is the theme of Pradhan Mantri Fasal Bima Yojana (PMFBY).PMFBY provides widespread insurance coverage againstfailure of thecrops andhelps stabilize the income of the insured farmers. There is a very small number ofstudies done on PMFBYas this schemewasimplementedin 2016, therefore thisstudy was undertaken to understand PMFBY inthe Jorhat district of Assam whichwas selected purposively with the objectives to delineate the profile of the insuredfarmers, study the status of PMFBY in Jorhat district of Assam and the constraintsfacedbythefarmersduringtheclaim.

A sample of 120 insured farmers was selected from the two blocks oftheJorhatdistrictnamelyJorhatblockandTitaborblockfollowingarandomsampling technique. The data for the study were collected by the personal interviewmethod with the help of a structured research schedule keeping in view the objectivesof the study. The data for the study were collected during April 2023 and May 2023.Owing to the findings, the majority of respondents (72.5%) were male farmers and amaximum (65.83%) of the respondents were between the ages of 35 to 55 years. Themajority of respondents (28.33%) had completed high school education, and38.33%of respondents had 21 to 30 years of farming experience with a maximum number ofrespondentsbelongingtothesmallfarmercategory(51.67%).Themajorityofrespondents (59.16%) had a family income of between Rs 3.27 lakh– 5.25 lakhannually. Additionally, it was found that the majority of respondents (77.5%) had amediumextensioncontact,withAEA&FarmerfriendrankingI.

A maximum of 87.5% of respondents had medium access to sources ofinformationaboutPMFBY,withinformationfromfellowfarmers,neighbors&farmer friends ranking highest. Additionally, it was observed that the respondents hadreceived a maximum of 3 – 4 PMFBY training (50%) and their degree of satisfaction with PMFBY was moderately favorable (73.33%). Between 0.36 ha–0.94 ha (51.67%) is the maximum area insured under PMFBY.

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Department: Extension Education

Major Adviser: Dr. C.Deka

Thestudy'sevaluationofPMFBYstatusfrom2018to2023shows claimed received in the year 2018-2019 is15.83%,2019-20is0%(duetoCovid pandemic),2020-21is31.67% &2021–22 is0%respectively.Theclaim settlement ratio of the following was 38.77% in 2018-19, 53.52% in 2020-21&0 % in 2021 – 22. It has been noted that delayed payment (78.33%) accounts for themajority of timely payments under PMFBY. In the Jorhat district of Assam, PMFBYhas a moderate status (71.67%). The majority of the independent variables were foundto have having positive coefficient of correlation and have a significant associationwith the Status of PMFBY in Jorhat district. Only a few variables like gender, familytype, family size, farming experience, andannual family income were not foundsignificant. The major problem faced by the insured farmers was delay in the paymentof insurance claims during the claim settlement process, individual assessment not being followed in the scheme, a more challenging PMFBY process, Improperassessment of crop loss, Lack of awareness, and unavailability of source for details.Moreover, unavailability of surveyors at the time of crop loss, lack of communicationand coordination between banks and farmers,lack of coordination between nodaldepartments and allied departments, lack of technical facilities for assessment of croploss,andlackofbankingfacilitiesinruralareas.

Impact of mechanization on beneficiary farmers under APART project in North Bank Plains Zone of Assam

Suhail Alom

The Assam Agricultural University,Jorhat launched the World Bank aided project "Assam Agribusiness and Rural Transformation (APART)" during 2016-17. Since inception, the project is providing farm mechanization interventions to improve farm mechanization level in Assam. Considering the efforts made towards farm mechanization, it was felt imperative to understand the impacts of the APART project on farm mechanization. Hence, the present study – "Impact of mechanization on beneficiary farmers under APART project in North Bank Plains Zone of Assam" was conducted to find out whether the project is truly achieving its objectives. The objectives of the study were to measure the extent of mechanization by beneficiary farmers under APART project; assess the impact of mechanization on the beneficiary farmers under APART project and find out the problems faced by the project staff in effective implementation and by beneficiary farmer in adoption of the mechanization interventions. The study was carried out in Lakhimpur, Sonitpur and Darrang districts of North Bank Plains Zone (NBPZ) of Assam. A total of 100 beneficiary farmers were selected as respondents for the study. For the present study, 10 profile variable, 5 descriptive variables and 2 inhibitive variables were selected. The data were collected with the help of research schedule by personal interview method. Appropriate statistical techniques were used for analysis of data. The study revealed that majority of respondents 65.00 per cent belonged to 38-57 years category. Majority of respondents 27.00 per cent had middle school level education followed by primary level by 24.00 per cent. Majority of the respondents 75.00 per cent were found to have single family. A total of 70.00 per cent had medium land holding. Among the respondents, 41.00 per cent were found to have low innovativeness and 59.00 per cent of the respondents had medium level of scientific orientation. Majority of the respondents 55.00 per cent had 'only cultivation' as main occupation .Likewise majority of respondent 40.00 per cent received 2-days training and (majority 78.00 per cent)had medium degree of information

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Department: Extension Education, BNCA

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exposure, Out of the all respondents 59.00 per cent of the respondents reported that the labor were not readily available for farm operations. To measure the extent of mechanization, 3 crops were selected viz., Sali rice, toria and potato. Highest MI was for potato 84.87 per cent followed by Sali rice 74.65 per cent . Toria showed lowest MI i.e. 51.29 per cent among the three selected crops in the study areas. Distribution of respondents according to MI ii showed that majority of respondents 72.00 per cent belongs to medium mechanization category. Out of the 10 profile variables, education level (r=0.665), innovativeness (r=0.534), training exposure (r=0.654), Occupational status (r=0.205), labour availability (r=0.729), degree of information exposure (r=0.369) and scientific orientation (r=0.279) were significantly and positively correlated with Mechanization Index (MI) at 1% level of probability. Size of land holding (r=-0.754) was found to be negatively correlated with Mechanization Index (MI) and the correlation is significant at 1% level of probability. All the profile (predictor) variables taken together explained the variation in the Mechanization Index (MI) 88.10 per cent (adjusted 2=0.881). For Sali rice, average area before mechanization was 1.04 ha and which increased to 1.44 ha after mechanization and the difference (t=19.622) was significant at 1% level of probability for the study area. Likewise the average production of Sali rice before mechanization was 41.70 q which increased to 79.20 q after mechanization. The difference (t=21.079) was significant at 1% level of probability for the study area. The average productivity was found to be 40.10 q/ha before mechanization and 55.00 q/ha after mechanization in Sali rice. The 't' value was found to be significant at 1% level of probability for productivity (t=19.063). For toria average area before mechanization was 0.34 ha and area was increased with the application of mechanization that is 0.52 ha.The 't' value was found to be significant at 1% level of probability for the study area (t=26.798).The average production of toria before mechanization was 2.68 q which was increased to 5.77 q after mechanization. The 't' value was found to be significant at 1% level of probability for the study area (t=28.436). The productivity was found 2.68 q/ha before mechanization and 5.77 q/ha after mechanization. The 't' value was found to be significant at 1% level of probability for the study area (t=16.201).For potato average area before mechanization was 0.92 ha and area was increased with the application of mechanization that is 1.24 ha. The 't' value was found to be significant at 1% level of probability for the study area (t=24.226). The average production of potato before mechanization was 65.50 q which was increased to 245.64 q after mechanization. The 't' value was found to be significant at 1% level of probability for the study area (t=16.670). The productivity was found 71.20 q/ha before mechanization and 198.10 q/ha after mechanization. The 't' value was found to be significant at 1% level of probability for the study area (t=23.931).Finding reveal that the mean cropping intensity before mechanization was 131.42 per cent and after mechanization it increased to 140.93 per cent. The significance of mean cropping intensity before mechanization and after mechanization was tested by t-test (t=8.451) and iii was significant at 1% level of probability. The major constraints faced by the project staff in effective implementation of the mechanization intervention were - Lack

of awareness on mechanization benefits leading to less adoption of farm machineries (Rank I); Problem in getting consensus of a group of farmers over fixing time and date of training programme due to pre-occupied time schedule of farmers (Rank II) ; Problem in regular monitoring of fields and activities of farmers due to limited staff, distance and limited transport facilities (Rank III) ; Varied responses and level of adoption among farmers' (Rank IV) ; Large scale demonstration of machineries suffered due to small land holding in different villages (Rank V) and Non availability of organized farmers groups at village level creates problem during execution of the project (Rank VI).Major constraints faced by beneficiary tribal farmers in adoption of the mechanization intervention were - High fuel cost to run machineries (Rank I); Small and scattered land holding causing difficulties in management during peak crop season (Rank II); Non availability of required farm machinery at peak season as less number of farm machineries are available compared to demand (Rank III); Long distance between crop fields and fuel pumps leading high procurement cost (Rank IV); Non availability of trained person to maintain machines locally (Rank V) and Machineries of low quality leading frequent repairing (Rank VI).

A study on Entrepreneurial behaviour of agri-input dealer in upper Brahmaputra valley zone of Assam

Trishnamoni Hazarika

Agriculture is the backbone of economy because of its high share in employment and livelihood generation. Agricultural inputs are the inputs like, seeds, fertilizers, pesticides, equipments, animal feeds, machineries etc.that are used in farm production. The person who provides agricultural inputs along with some agro advisory services to the farmers are the Agri Input Dealer. The agri-input dealers play an important role in ensuring that farmers access their necessary inputs for improving productivity in their respective farms. While purchasing the inputs, farmers seek for information from agri input dealers about the usage of inputs, both in terms of quality and quantity. The study was undertaken in two districts of Assam namely, Jorhat and Golaghat. A descriptive research design, following an ex-post facto approach was utilized for the study through a simple, purposive, and random sampling design. A total of 130 respondents were selected for the study. 40% respondents from each district were selected. With respect to profile characteristics of the respondents, the study revealed that majority of the respondents (63.846 %) belonged to the middle-age category. Near about half of the respondents (46.93%) had completed graduation and PG level of education. Majority (60%) of the respondents belonged to small sized family. Most of the respondents (40.77%) had 6-10 years of experience as an agri-input dealer. Around half (54.62%) of the respondents received 1-2 nos. of training programmes. Majority (80.76 %) of the agri-input dealers have received training on pest and disease control in agriculture. Around half (50.769%) of the respondents had marginal land holding and one third (33.85%) of the respondents had 2-4 lakhs of annual income from dealership. With regards to entrepreneurial behaviour of the respondents, the study revealed that majority (64.62%) of the respondents had medium level of innovativeness, medium level of achievement motivation (53.85%), medium decision making ability (72.3%), medium level of risk orientation (63.845%), medium level of co-ordinating ability (56.93%), medium level of planning ability (50.00%), medium level of information

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Department: Extension Education

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seeking behaviour (69.23%), medium level of cosmopoliteness (63.07%) and medium level of self-confidence(63.85%). With the help of Entrepreneurial Behaviour Index (EBI), entrepreneurial behaviour of agri-input dealers was calculated and came into the conclusion that majority (64.62%) of the respondents had medium entrepreneurial behaviour followed by high entrepreneurial behaviour (16.93%) and low entrepreneurial behaviour (18.46%). To determine the relationship between entrepreneurial behaviour and some selected independent variables, correlation and multiple regression analysis was used. Among 7 independent variables, 5 variables viz. age, education, years of experience as an agri-input dealer, nos. of training received, annual income received from dealership showed significant relationship with the entrepreneurial behaviour of agri-input dealers at 0.01 level of probability. In multiple regression analysis, it was found that among 7 independent variables, 5 variables viz. age, education, years of experience as an agri-input dealer, nos. of training received, annual income from agri-input business contribute significantly towards variation in the entrepreneurial behaviour of agri-input dealer at 0.01 level of probability. With regards to problem, the study showed that86.92% of respondents were facing problem due to complex procedure for procurement of inputs for the farmers. To combat this problem, any other procedure of maintaining log record other than Aadhar linking must be initiated by the government or must fix the glitches in the current system.83.07% were facing problem due to less demand of agri-inputs which is because of erratic rainfall which disturbs the cultivation practices of farmers in their fields. Proper irrigation facilities should be provided to the farmers to deal with this problem. Other problems faced by the input dealers are- “loss incurred by them due to lack of getting quick information about banning of pesticides”, “unscrupulous sale of agri inputs by the non licensees to the farmers”, “more market competition” etc.

Organic nutrient management in Okra (*Abelmoschus esculentus* (L.) Moench.)

Ankita Baro

An experiment entitled "Organic nutrient management in Okra (*Abelmoschus esculentus* (L.) Moench.) was carried out at the Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali during 2022-2023 with the following objectives (i) To study the effect of various organic nutrients on growth, yield and quality of Okra, (ii) To sort out the suitable organic nutrient combination for Okra. The experiment was laid out in Randomized block design with 3 replications incorporating 16 treatments viz., T1: FYM @20 t/ha, T2: Vermicompost @5 t/ha, T3: Neem cake @2 t/ha, T4: Poultry Manure @5 t/ha, T5: FYM @10 t/ha + Vermicompost @2.5 t/ha, T6: FYM @10 t/ha + Neem cake @ 1 t/ha, T7: FYM @10 t/ha + Poultry manure @2.5 t/ha, T8: Vermicompost @2.5 t/ha + Neem cake @ 1 t/ha, T9: Vermicompost @2.5 t/ha + Poultry manure @2.5 t/ha, T10: Neemcake @1 t/ha + Poultry manure @2.5 t/ha, T11: FYM @10 t/ha + Biofertilizer Consortia, T12: Vermicompost @2.5 t/ha + Biofertilizer Consortia, T13: Neem cake @1 t/ha + Biofertilizer Consortia, T14: Poultry manure @2.5 t/ha + Biofertilizer Consortia, T15: FYM + Recommended NPK, T16: Untreated Control. In the present study, the inorganic treatment T15 was found to perform best in terms of growth and yield. Significantly the highest plant height (66.02 cm and 94.00 cmat 45 DAS and at 60 DAS, respectively), internodal length (8.73 cm at 60 DAS), length of leaf (17.98 and 20.25 at 45 DAS and 60 DAS respectively), breadth of leaf (20.23 and 22.74 at 45 DAS and 60 DAS respectively) and number of functional leaves per plant (12.71 and 16.52 at 45 DAS and 60 DAS respectively) were recorded in T15. Among organic treatments, the highest plant height (65.70 cm and 90.70 cm at 45 and 60 DAS respectively), internodal length (7.86 cm at 60 DAS), length of leaf (17.84 and 19.54 at 45 DAS and 60 DAS respectively), breadth of leaf (20.04 cm and 22.04 cm at 45 DAS and 60 DAS respectively) and number of functional leaves per plant (12.16 and 16.06 at 45 DAS and 60 DAS respectively) were recorded in treatment T1. All the physiological parameters viz. area of a leaf, leaf area per plant, leaf area index, total leaf chlorophyll content, chlorophyll stability index and relative leaf water content were recorded significantly

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highest in inorganic treatment (T15). Among the organic treatments these parameters were found best in T1 whereas the lowest was recorded in T16 (Control). The minimum days for appearance of the first flower (30.12 days) and days to first harvest (37.12 days) were recorded in treatment T11 and maximum harvest duration wasrecorded in T15 (41.43 days). Again, the maximum number of fruits per plant (18.99), fruit length (14.10 cm), fruit girth (6.55 cm), fruit volume (18.42 cc), the weight of individual fruit (15.71 g), fruit yield per plant (0.29 kg) and yield per hectare were recorded in treatment T1. However, the fruit yield per hectare was significantly highest in inorganic treatment T15 (14.12 t/ha). Among all the treatments the highest vitamin A (375.06 I.U) and vitamin C (29.00 mg/100g) were recorded in organic treatment T5 and minimum fiber content was recorded in T12 (9.76 %). Minor incidences of pests and diseases were observed and it was controlled effectively at the initial stage by applying proper organic fungicide and insecticide. Considering the highest B:C ratio (2.53:1) and with superior morphophysiological attributes among the organic treatments in T1, it could be advised to the grower of this region to apply FYM @20t/ha in Okra to get a good crop harvest with quality fruit.

Growth performance of low chilling varieties of apple (*Malus pumila*) under different nutrient levels in Assam

Antara Sharma

A field investigation was carried out during the period 2022-23 to assess the effect of varieties and nutrient level on growth characters, physiological parameters, leaf and soil nutrient status of apple (Malus pumila) in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. The experiment was laid out in Factorial Randomized Block Design with four replications considering three low-chilling apple varieties viz. V1 (HRMN-99), V2 (Dorsett Golden) and V3 (Anna) and five different nutrient levels viz. N1 [FYM 5 kg/plant (Control)], N2 (5 kg FYM+ 50 g urea+ 70g SSP+ 40 g MOP/plant), N3 (5 kg FYM+ 100 g urea+ 140g SSP+ 80 g MOP/plant), N4 (5 kg FYM+ 150 g urea+ 210g SSP+ 120 g MOP/plant) and N5 (5 kg FYM+ 200 g urea+ 280g SSP+ 160 g MOP/plant). The findings of the experiment revealed that the variety V1 exhibited the highest significant plant height (52.67 cm, 101.05 cm, 124.43 cm and 179.76 cm), stem girth (3.91 cm, 5.08 cm, 6.35 cm and 9.91 cm), leaf area (35.33 cm2 , 50.24 cm2 , 56.18 cm2 and 63.34 cm2) and leaf area index (1.33, 2.04, 2.20 and 2.42) at 90, 180, 270 and 360 DAP respectively. However, the highest number of branches (6.05, 8.75, 10.20 and 14.65) were observed in V2 which was statistically at par with the variety V1. Amongst various nutrient levels, N4 showed the superior performance in terms of plant height (56.78 cm, 115.26 cm, 143.75 cm and 192.03 cm), stem girth (4.51 cm, 6.04 cm, 7.33 cm and 11.30 cm), number of branches (7.00, 10.25, 11.83 and 17.25), leaf area (42.66 cm2 , 56.53 cm2 , 63.27 cm2 and 69.38 cm2) and leaf area index (1.53, 2.28, 2.44 and 2.61) at 90, 180, 270 and 360 DAP respectively. Among the physiological parameters, the leaf relative water content (63.46% and 71.90%) in variety V1 and (68.81% and 81.77%) under nutrient level N4 were observed to be significantly highest both at 30 and 45 DAT respectively. The total leaf chlorophyll content showed similar trends with the highest (1.58 mg/g fresh wt. and 1.68 mg/g fresh wt. of leaf sample) in variety V1 and (1.72 mg/g fresh wt. and 1.81 mg/g fresh wt. of leaf sample) under nutrient level N4 at 30 and 45 DAT respectively.

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Department: Horticulture

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The leaf nutrient status with respect to leaf N (2.39% and 2.27%), leaf P (0.25% and 0.22%), leaf K (1.75% and 1.71%), leaf Ca (1.45% and 1.65%) and leaf Mg (0.32% and 0.39%) were found to be highest in the variety V1 at 30 and 45 DAT respectively. The nutrient level N4 exhibited the highest significant leaf N (2.66% and 2.50%), leaf P (0.29% and 0.25%) and leaf K (1.84% and 1.83%) at 30 and 45 DAT respectively. However, the nutrient level N3 was found to be superior in terms of leaf Ca and Mg concentrations which was statistically par with N4 at both the studied intervals after application of respective treatments. Analysis of the soil nutrient status after the experiment resulted in significantly highest organic carbon content, available N, P205 and K20 in variety V3 and nutrient level N5 while the highest exchangeable Ca and Mg were observed under the influence of variety V1 and nutrient level N4. Interaction of varieties and nutrient levels also recorded significant effect for most of the growth parameters with the highest obtained under the combination of variety V1 and nutrient level N4. Therefore, based on the results of the present investigation, the low-chilling variety HRMN-99 at nutrient level of 5 kg FYM+ 150 g urea+ 210g SSP+ 120 g MOP/plant can be recommended for apple cultivation under Assam condition in the first year of its plantation.

Crop Regulation in lemon var. Assam lemon (*Citrus limon* L. Burm.) by pruning

Anwesha Goswami

The present investigation entitled "Crop regulation in lemon var. Assam lemon (*Citrus limon* L. Burm)" by pruning" was conducted during 2022-2023 at the ICR farm for field experimentation and in the laboratory for qualitative analysis of fruits in the Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali with three objectives: (a) to study the effect of pruning on growth, yield and quality of Assam lemon, (b) to study the effect of time of pruning on growth, yield and quality of Assam lemon and (c) to make the fruits available during the lean period particularly during November to February. The experiment was laid out in RBD with 3 replications and 12 treatments. Each treatment consisted of two plants and accordingly 72 plants were selected for conducting the experiment. Pruning considered as treatments were carried out from 1 st May, 2022 to 15th October, 2022 at 15 days interval. The results revealed that both the pruning and time of pruning significantly influenced the vegetative growth and production of Assam lemon fruits. Among the treatments, the highest increase in plant height (18.82%) and number of laterals (4.62) per primary shoot was observed in T1 (pruned on 1stMay). Leaf production per terminal shoot was highest (19.33) in T2 (pruned on 15 May) closely followed by T1 (19.22). Shortest duration (18.66 days) for new shoots emergence after pruning was recorded in T6 (pruned on 15th July) while longest period (26.50 days) was observed in plants pruned on 15th October (T12) but the plants under this treatment produced first flower buds within shortest period (43.83 days) from the date of pruning. Days required to attain maturity of fruits from flower bud emergence was lowest (141.5 days) in plants pruned on 1 st May (T1). Average number of hermaphrodite flowers (96.09) male flowers (96.70) and total number of ((192.79) were highest in T12 (pruned on 15th October) and plants under this treatment also recorded the highest fruit set (58.44%), fruit retention (92.01%), average number of fruits per plant per month (51.55) and number of fruits per plant per year (360.85). These values were found to be the lowest in plants pruned in May (T1 and T2). Plants pruned on 1st May (T1) recorded the highest values of fruit weight (168.33g), volume of fruit (184.83cc) and fruit length (9.21cm) while thinnest

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peel (2.95mm) and the highest pulp-peel ratio were recorded in T12 (pruned on 15th October). Among the treatments, T12 (pruned on 15th October) was found to be efficient in terms of quality like highest juice content (35.66 %), TSS (6.330Brix) and ascorbic acid (37.95 mg/100ml) contents. From the present investigation, it was evident that mature fruits could be harvested from November onwards from the plants pruned during May-June. Though total production was lower in these plants as compared to the plants pruned during October (recommended practice) but because of higher prices per fruit during lean period (Nov-Feb), the benefit: cost ratio was also higher than the plants pruned during October from which fruits were harvested from April onwards.

Effect of Planting Geometry and Nutrient Management on Growth, Yield and Quality of Yard Long Bean (*Vigna unguiculata* ssp. Sesquipedalis)

Bedanta Sharma

A field experiment was conducted during 2022-2023 at the experimental farm, Department of Horticulture AAU, Jorhat to study the effect of planting geometry and the impact of nutrient management on growth, yield and quality of yard long bean (variety Red Ribbon). The experiment was laid out in factorial randomized block design (FRBD) consisting of two factors viz., spacing and nutrient dose with three replications. The two spacing were S1 (60 cm × 45 cm) and S2 (60 cm × 30 cm) with five nutrient doses of T0 (control), T1 (15:35:20 kg NPK/ha + 4 t FYM/ha), T2 {15:35:20 kg NPK/ha + 2 t vermicompost/ha + biofertilizer (rhizobium + PSB)}, T3 (25:50:30 kg NPK/ha + 4 t FYM/ha) and T4 {25:50:30 kg NPK/ha + 2 t vermicompost/ha + biofertilizer (rhizobium + PSB)}. The treatments brought significant influences on the various parameters except a few. The growth parameters like number of branches (21.76), number of leaves/plant (87.00), number of pickings (9.73) days to initiation of 50 % flowering (35.49) and days to first picking (43.89) performed their best in the spacing S1 whereas the maximum vine length (198.39 cm) was observed in S2. The maximum values for yield attributing parameters like length of pod (39.60 cm), girth of pod (2.13 cm), weight of green pod (10.60 g), number of pods per plant (42.42), pod yield per plant (0.35 kg) and for quality and biochemical parameters like carbohydrate (7.99 %), protein (2.97 g/100g), fibre content (3.04 %) and anthocyanin content (26.53 mg/100g) were observed in the spacing S1 whereas the maximum pod yield per plot (3.66 kg) and pod yield per hectare (169.48 q) were observed in S2. In case of nutrient dose, the maximum vine length (223.00 cm), number of branches (24.00), number of leaves per plant (106.00), number of pickings (10.50), length of pod (43.17 cm), girth of pod (2.23 cm), weight of green pod (11.00 g), number of pods per plant (47.88), pod yield per plant (0.44 kg), pod yield per plot (4.33 kg) and pod yield per hectare (200.62 q) were observed in the nutrient dose T4 with T3 being at par in many of the parameters. The

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maximum carbohydrate content (8.11 %), protein content (3.11 g/100g) and anthocyanin content (29.31 mg/100g) were observed in nutrient dose T4 while the maximum ascorbic acid content (9.98 mg/100g), fibre content (3.43 %) and ash content (0.66 %) were observed in T3. The maximum values for soil parameters like organic carbon (0.64 %), available N (253.2 kg/ha), available P (39.7 kg/ha) and available K (141.0 kg/ha) were observed in T4 whereas the maximum soil pH (5.23) was observed in T0. The interaction of both the factors also brought significant influences on the parameters with the parameters like number of branches (25.00), number of leaves per plant (107.67), number of nodes (73.67), number of pickings (10.67), length of pod (45.33 cm), girth of pod (2.37 cm), pod yield per plant (0.46 kg), carbohydrate content (8.23 %) and protein content (3.23 g/100g) performing the best in the treatment interaction T4S1 while vine length (228.00 cm), pod yield per plot (4.96 kg) and pod yield per hectare (229.63 q) recorded their maximum values in T4S2. Computation of economics of production revealed that the maximum gross return (Rs. 918518.52) and net return (Rs. 704693.52) were also observed in T4S2 but the highest B:C ratio (3.53) was observed in T3S2.

Effect of different concentrations of foliar nutrition in the growth, yield and quality of gerbera

Bishwa Protim Hazarika

The present investigation entitled "Effect of different concentrations of foliar nutrition on the growth, yield and quality of gerbera" was conducted during 2022-23 at IcR farm for field experimentation, for the assessment of three objectives: (a) to study the effect of foliar nutrition on the growth, yield and quality of gerbera, (b) to study the reaction of different varieties against plant parasitic nematode under different treatments and (c) effect of different foliar nutrition in varieties. The experiment was laid out Factorial RBD with 3 replications and 24 treatment combinations viz. Different concentrations of foliar sprays [T0: (Control), T1: (3g/L NPK + 20g/L micronutrient), T2: 4g/L NPK + 20g/L micronutrient), T3: 5g/L NPK + 20g/L micronutrient)] and 6 varieties [V1: Pride of Sikkim, V2: Arka Krishika, V3: Pink Melody, V4: Orange Sunburst, V5: saffron and V6: Red Seven]. The study revealed that the morphological parameters, phenological parameters, quality parameters and plant parasitic nematode populations were influenced by different concentrations of foliar sprays and the different varieties. The morphological parameters like plant height at 30,60 and 90 DAP, plant spread at 60 DAP, number of leaves at 30,60 and 90 DAP, Leaf area at 60 DAP and Leaf area index at 60 DAP was observed highest under T3 and lowest in T0 and among the different varieties V2 recorded the maximum plant height, plant spread and No. of leaves. Whereas, V1 recorded the maximum leaf area and leaf area index. The phenological parameters like days to first flower emergence (101.80 days) and days to open the first flower (10.73 days) showed minimum value under T3 and the maximum was recorded under T0. Similarly, parameters like flowering duration (137 days), No. of flowers per plant (20.22) and No. of flowers per m2 (115.14) was recorded maximum under T3 and minimum under T0. Among the varieties, V1 recorded the days for the emergence of the first flower (99.82 days), recorded the longest flower duration (135.16 days), the maximum no. of flowers per plant (12.80) and per m2 (114.57). Whereas V5 took the minimum number of days to open the first flower (10.23 days). The quality

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parameters like flower diameter (9.03 cm), stalk length (41.93 cm), the longevity of flowers in the field (15.19 days) and vase life (8.61 days) were observed maximum under T3. Among the varieties, the V4 recorded the maximum diameter (10.54 cm), maximum longevity in the field (16.20 days) and maximum vase life (8.06 days). Whereas, V1 recorded the maximum stalk length (46.57 cm). For the leaf characteristics like chlorophyll content (1.84 mg g-1 FW), leaf NPK content (N= 2.63%, P= 0.48% & K= 4.32%) was recorded maximum under T3. In between all the varieties, V1 recorded the maximum chlorophyll content (1.50mg -1 FW) and V2 recorded the maximum leaf NPK content (N= 2.83%, P= 0.28% & K= 3.55%). Significant differences were observed among the different concentrations of foliar sprays and among the different varieties in relation to the population of plant parasitic nematodes. the minimum population of plant parasitic nematodes (443.44) was observed under T3. Among the varieties, V2 recorded the minimum population of plant parasitic nematodes (562.25). From the present experiment, it can be concluded that T3 (5g/L NPK + 20g/L micronutrient) is found to be the most effective dose in regard to growth, yield and quality for all the varieties, as well for the resistance of the plants towards plant parasitic nematodes. However, out of six varieties, Pride of Sikkim, Arka Krishika, Orange Sunburst and Pink Melody were found to perform better in terms of number of flowers, diameter, vase life etc.

Organic nutrient management in cucumber (*Cucumis sativus* L.)

Boishali Kalita

A field experiment was conducted during 2022 at the experimental farm, Department of Horticulture, AAU, Jorhat to standardize the organic nutrient requirements and to study the effect of organic nutrients on fruit quality of cucumber. The experiment was laid out in a randomized block design (RBD) consisting of seven treatments in three replications. The treatments were T0: Control, T1: FYM 10t/ha, T2: FYM 5t/ha, T3: FYM 5t/ha+ Microbial consortium, T4:Vermicompost 5t/ha, T5:Vermicompost 2.5t/ha and T6: Vermicompost 2.5t/ha + Microbial consortia. The highest plant height (1.94m) was recorded in the treatment T4 which was at par with treatment T6 with a value of 1.93m at 30 days after sowing (DAS). At first flowering the highest plant height (3.44m) was obtained in the treatment T6 and was at par with the treatment T3, T5, T4 and T1 with values 3.38m, 3.32m, 3.31m and 3.23m, respectively.The highest internodal length (12.03cm and 12.27cm) at 30DAS and at first flowering were recorded in T0. Maximum number of primary branches (2.70 and 4.70) at 30DAS and at first flowering was exhibited by the treatments T1 and T6, respectively. Minimum days for appearance of first male flower (47.33), first female flower (54.33) and the lowest node for appearance of first female flower (6.45) were observed in the treatment T6. The highest male flowers per plant (99.00) were found in T2, whereas female flowers per plant (13.98) and male-female flower ratio (8.34) were the maximum in the treatment T1. Minimum number of days to first fruit harvest (66.33) was recorded in T6. The highest fruits per plant (10.92) and fruit set percentage (94.82) were exhibited by the treatment T4. Maximum fruit length (23.10cm) and fruit weight (267.67g) were obtained in T4 however, maximum fruit diameter was observed in T4 and T1 with a value of 7.50cm. Fruit volume (304.91cc) and shelf life (8.17 days) of fruits were recorded maximum in T4. The highest fruit yield per plant (2.92kg), fruit yield per plot (26.28kg) and total yield (243.33q/ha) were recorded in T4. Among the quality parameters moisture content (96.58%) was maximum in T1 and vitamin C content (4.63mg/100g) was maximum in T1 and T4. The highest ash (0.82%), protein (8.40%) and carbodydrates (1.07%) content were recorded in the treatment T4 however,

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the crude fibre content (0.72%) was found maximum in T3. The highest total chlorophyll content (1.05mg/100g) of fruit peel was obtained in T3. Among the soil parameters soil pH (4.88) in T1, organic carbon (0.92%) in T4 and microbial biomass carbon (296.60 µgg-1 soil 24 hr-1) in T6 were found maximum. Available N (283.93kg/ha), available P (50.01 kg/ha) and available K (162.97kg/ha) after harvest were maximum in the treatment T4. The highest net return (Rs. 594067.00) was obtained in the treatment T4 with a benefit cost ratio of 2.31. However, the highest benefit cost ratio was exhibited by the treatment T1 (2.83) with a net return of Rs. 566033.00 due to lower cost of FYM in T1.

Performance of orange fleshed sweet potato (*Ipomea batatas* L.) genotypes for yield and yield attributing characters

Dokka Vara Vinod

The present investigation was carried out with the principle objective to study the variability, heritability, character association and path analysis for morphological and quality parameters in orange-fleshed sweet potato genotypes at an Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the year 2022-2023. Analysis of variance revealed significant differences for all the morphological and quality characters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha), total soluble solids (°Brix), total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days). High PCV, GCV and high heritability in conjunction with high genetic advance as per cent of mean were observed for morphological parameters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), fresh weight of tuber (g), dry weight of tuber (g), diameter of tuber (cm), number of tubers per plant, marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha) and quality parameters like total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days) indicates the preponderance of additive gene action governing the inheritance of these characters and offers the best possibility of improvement through simple selection procedures. Correlation study revealed that yield can be improved by selecting genotypes having more vine weight per plant, fresh weight of plant, dry weight of plant, fresh weight of tuber, dry weight of tuber and diameter of tuber. The highest positive direct effects on marketable tuber yield per plant was shown by fresh weight of whole plant, plant dry matter content, dry weight of tuber and diameter of tuber. The highest negative direct effects were exhibited by vine weight per plant, dry weight of whole

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plant, tuber dry matter content and number of tubers per plant. Characters having high positive direct effects along with positive significant correlation with marketable tuber yield per plant can be directly selected and simultaneously the characters which show high positive indirect effects can also be selected for the improvement of yield.

Effect of edible coating in Assam Lemon (*Citrus limon* Burm.) during storage

Juman Das

The Northeast region of India is a rich treasure of different Citrus species. Assam lemon is one of the important Citrus species and it is indigenous to Assam. The main storage problems of lemon fruits are browning & shrinking of peel, loss of green colour, loss of firmness, and reduced juice content. Providing non-hazardous edible coating would permit the possibility to reach the distant markets in fresh form. Use of CMC (Carboxy Methyl Cellulose) as exterior coating along with Sodium Benzoate and Bees Wax coating can increase the shelf life of Assam Lemon. The present investigation was carried out in the Laboratory, Department of Horticulture, Assam Agricultural University, Jorhat during the year 2022 -2023 with the objectives to evaluate the effect of edible coating on the qualitative changes of Assam lemon during storage and to find out the suitable edible coating treatment for shelf life extension. The treatments includes combination of Carboxy Methyl Cellulose, propylene glycol, sodium benzoate viz., To (Control), T_1 (1% CMC + 2% Propylene Glycol), T_2 (3% CMC + 2% Propylene Glycol), T_3 (5% CMC + 2% Propylene Glycol), T_4 (1% CMC + 2% Propylene Glycol + Sodium Benzoate 500 ppm), T_5 (3% CMC + 2% Propylene Glycol + Sodium Benzoate 500 ppm), T_6 (5% CMC + 2% Propylene Glycol + Sodium Benzoate 500 ppm), T_7 (Bees wax 1%), T_8 (Bees wax 2%). The fruits were stored in corrugated fibre boxes. Physical, biochemical and sensory evaluation was done at every 5 days interval. Different observations recorded were physiological loss in weight (%), fruit weight (g), specific gravity, juice content (%), peel browning (%), days to colour change, TSS (0Brix), titrable acidity (%), TSS/acid ratio, reducing sugar (%), nonreducing sugar (%), total sugar(%), ascorbic acid (mg/100 ml), pectin (%), chlorophyll (mg/g), colour, texture and microbial analysis (log cfu/ml).The highest juice content was recorded in T_5(39.59%),the highest TSS was recorded in T_5(6.270Brix), the highest specific gravity was observed in T_6(1.02), the highest titratable acidity was recorded in T_5(3.42%) on 25th day of storage. The results of the experiment revealed that the application of treatments had significant effect on various biochemical parameter of lemon fruit during storage. The treatment T_5 (3% CMC + 2% Propylene

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Glycol + Sodium Benzoate 500 ppm) showed better results followed by T_6 (5% CMC + 2% Propylene Glycol + Sodium Benzoate 500 ppm) during storage. T_5 treatment (3% CMC + 2% Propylene Glycol + Sodium Benzoate 500 ppm) was superior as an edible coating and retained better quality with extended storage life as compared to all other treatment.

Biochemical characterization of some Citrus germplasm of Assam

Kareena Saikia

Ten genotypes representing each of the five groups of Citrus were collected from AAUCitrus and Plantation Crops Research Station, Tinsukia and Regional Research Centre for Citrus (CCRI, ICAR), Biswanath Chariali. Morphological characterization of fruits was carried out as per the descriptors developed for Citrus by IPGRI (1999), Rome, Italy and the results indicate the presence of significant variability among genotypes. Biochemical characterization revealed that moisture content ranged from 92.51% to 84.30% in the pulps and from 83.32% to 70.20% in the peels. Juice pH, TSS and titratable acidity ranged from 3.90 to 2.60, 11.40 to 5.30 °Brix, and 0.97% to 4.71% respectively in different genotypes. The ash content varied from 2.83% to 5.96% in the pulps and from 2.53% to 5.69% in the peels. Similarly, the reducing sugar in the juice varied from 2.06% to 6.72% and non-reducing sugar varied from 0.48% to 4.15%. The total sugar percentage ranged from 9.36%-2.54% in the juice. The crude protein content was found to be high and ranged from 5.60%-9.16% in the pulps and 5.60%-13.83% in the peels. Organic acid and water-soluble vitamins were quantified using Ultra High-Performance Liquid Chromatography (UHPLC) and it was revealed that citric acid was present in the maximum amount followed by malic acid. Among the water-soluble vitamins, the thiamine concentration was found to be the highest. Quantification of the minerals was carried out by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The results show that both major and minor minerals were present in significant amounts in both the peel and pulp of the Citrus species. The essential oil content (%) was estimated and it was found to range from 0.26% to 0.83% in the fresh peel of the Citrus genotypes. Analysis of the essential oil that was carried out by Triple Quadrupole Gas-Chromatograph Mass-Spectroscopy (TQGC-MS/MS) showed the presence of D-limonene, α-pinene, ß-pinene, γ -terpinene, α-terpineol, terpinene-4-ol, linalool as the major compounds. Aromatherapeutic, antioxidant, antifungal and insect-repellent compounds such as eucalyptol, thymol, geraniol and nerol were also reported in certain species.

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Major Adviser: Dr. Pritom K. Borthakur

Effect of Pre-harvest Application of NAA, Ca, and B on Fruit Drop, Yield and Quality of Thailand Ber (*Ziziphus mauritiana*)

Karishma Paswan

The present study was carried out to investigate the beneficial effects of the pre-harvest spray of NAA, calcium, and boron on fruit drop, yield, and quality of Thailand ber (Ziziphus mauritiana) at the Experimental Farm, Department of Horticulture, AAU, Jorhat-13 during 2022-2023. The spraying with NAA @ 20 ppm+ B @ 0.5%) resulted maximum fruit set (4.68%), lesser fruit drop (53.28%), the highest yield (18.12 kg/tree). CaCl2 @ 1% spray gave maximum shelf life (13.5 days) with the minimum PLW. The highest B: C ratio (1.81) was found in NAA @ 20 ppm+ B @ 0.5 % application based on the economics of cultivation indicating that spraying of NAA 20 ppm in combination with B 5% is the most profitable approach for minimizing fruit drop and maximizing production.

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Major Adviser: Dr. Ananta Saikia

Effect of different growing media on growth, quality and yield of strawberry (Fragaria x ananassa) under vertical farming system

Marjana Medhi

The present investigation entitled "Effect of different growing media on growth, yield and quality of strawberry (Fragaria x ananassa) in vertical planting system" was conducted during 2022-23. The experiment was conducted for the assessment of three objectives: (a) to study the effect of different growing media on growth, yield and quality of strawberry in vertical system, (b) to standardize suitable growing medium for cultivation of strawberry in vertical system and (c) to study the occurrences of disease. The experiment was laid out in RBD with 3 replications and 14 treatments i.e. growing media of different components and ratio. Each treatment consisted of 10 plants and accordingly 420 plants of strawberry cv. Winter Dawn were collected for conducting the experiment. Among the treatments, the highest plant height (22.47cm), plant spread (29.71cm), number of leaves per plant (19.37), leaf length (5.96 cm), leaf breadth (5.42 cm), days to first flowering after planting (47.97days) and the lowest root length (17.15cm) and crop duration (160.83 days) was recorded under T1 (Soil + vermicompost @ 1:1). The lowest plant height (17.82cm), number of leaves per plant (15.21) and plant spread (25.61 cm), leaf length (5.15cm), leaf breadth (5.11cm), number of crowns per plant (3.18), days to first flowering after planting (37.50days), days to maturity after fruit set (35.30 days) and highest root length (18.82 cm) were recorded in T5 (Soil + vermiculite @ 1:3) and T8 (Soil + Perlite @ 1:3), respectively. T14 (Soil + Cocopeat + perlite + vermiculite @ 1:1:1:1) recorded the longest crop duration (173.87days). The highest fruit length (4.79cm), fruit weight (23.66g), non-reducing sugars (2.50%), anthocyanin content (27.77mg/100g) and lowest titratable acidity (0.46%) were recorded under T5 (Soil + vermiculite @ 1:3). The highest fruit diameter (4.48 cm), number of fruits per plant (21.31), fruit production (502.82g/plant), yield (558.69 q/ha), TSS (8.05°Brix), total sugars (7.82%), reducing sugars (5.34%) and ascorbic acid content (39.97mg/100g) were observed under T8 (soil + Perlite @ 1:3). The lowest fruit length (3.22 cm), fruit diameter (3.10cm), no. of fruits per plant (12.44),

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fruit weight (17.33g), fruit production (285.69 g/plant), TSS (6.15°Brix), total sugars (6.92%), non- reducing sugars (1.81%), ascorbic acid content (36.15mg.100g) and reducing sugars (4.68%) were recorded under T1 (soil + vermicompost @ 1:1) and T2 (soil + cocopeat @ 1:1) respectively. Among the different parameters of soil, T8 (soil + perlite @ 1:3) recorded the highest pH (6.62) and lowest nitrogen (324.16kg/ha) and phosphorus (23.15kg/ha) content and lowest bulk density (0.41g/cm3). Plants grown in T14 (soil + cocopeat + perlite + vermiculite @ 1:1:1:1) recorded the highest water holding capacity (88.05%) and potassium content (358.80 kg/ha) and the lowest water holding capacity (56.65%), highest nitrogen (345.32 kg/ha) content and bulk density (0.91 g/cm3) was recorded in T1 (soil + vermicompost @ 1:1). The highest electrical conductivity (2.10 dS/m) and organic carbon (1.56%) were recorded in T10 (soil + vermicompost + perlite @ 1:1:1) and T11 (soil + vermicompost + cocopeat @ 1:1:1), respectively. Diseases namely, foot rot, pestalotia leaf spot, angular leaf spot and cercospora leaf spot were recorded during the vegetative phase whereas diseases like grey mould and phytopthora fruit rot were recorded during different stages of fruit development. The B:C ratio was found to be maximum (1.76) in T7 (soil + perlite @1:1).

Standardization of organic nutrient dose and plants per pole in Dragon fruit

Mukesh Kumar Sahu

The present investigation was carried out in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the period of 2021-2023 to study the "Standardization of organic nutrient dose and plants per pole in dragon fruit". The experiment was laid out in factorial randomized block design with three replications, consisting of two factors i.e. nutrient level and number of plants per pole. The four levels of nutrient during first year were N1 (FYM @ 15kg + VC @ 5kg + RP @ 200gm + PSB @ 100gm), N2 (FYM @ 15kg + EC @ 5kg), N3 (FYM @ 15kg + MOC @2kg + RP @ 200gm + PSB @ 100gm) and N4 (FYM @ 15kg + MOC @ 2kg + EC @ 2kg) were applied and during second year N1 (FYM @ 20kg + VC @ 10kg), N2 (FYM @ 20kg + EC @ 10kg), N3 (FYM @ 20kg + MOC @ 4kg) and N4 (FYM @ 20kg + MOC @ 4kg + EC @ 4kg) were maintained along with three different number of plants per pole i.e., P1 (two plants), P2 (three plants), P3 (four plants) were selected. The treatment consist of twelve different treatment combinations i.e. T1 (P1N1), T2 (P1N2), T3 (P1N3), T4 (P1N4), T5 (P2N1), T6 (P2N2), T7 (P2N3), T8 (P2N4), T9 (P3N1), T10 (P3N2), T11 (P3N3) and T12 (P3N4), respectively. The results of the experiments revealed that effect of different treatments showed statistically significant effects on plant growth, quality, biochemical analysis and soil parameters. However, the maximum plant growth parameters viz., plant height (cm), flower per pole (nos.), fruit per pole (nos.) and yield (t/ha) were recorded in the treatment T9 i.e. application of FYM @ 15kg + VC @ 5kg + RP @ 200gm + PSB @ 100gm during first year and application of FYM @ 15kg + EC @ 10kg during second year with four plants per pole. While, minimum plant height (cm) was observed in T12 i.e. application of FYM @ 15kg + MOC @ 2kg + EC @ 2kg during first year and FYM @ 20kg + MOC @ 4kg + EC @ 4kg with four plants per pole and minimum number of flower per pole (nos.), fruit per pole (nos.) and yield (t/ha) were recorded in the treatment T3 i.e. P1N3 (application of FYM @ 15kg + MOC @2kg + RP @ 200gm + PSB @ 100gm during first year and application of FYM @ 20kg + MOC @ 4kg during second year with two plants per pole, respectively. There was no significant difference among different

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treatment combinations for biochemical parameters like reducing sugar, total sugar, total soluble sugar, ascorbic acid and titratable acidity (%) of fruits. The maximum TSS value (15.36 and 15.80 °Brix), ascorbic acid (7.80 and 8.26 %) and titratable acidity (0.078 and 0.067 %) were recorded in the treatment T1 (P1N1), during both the years. The highest B:C ratio 5.73 was found in treatment T9 (P3N1) followed by 5.11 in T11 (P3N3).

Morpho Physico-Chemical Study of Some Indigenous Leafy Vegetables

Nazmin Sultana

The present investigation entitled "Morpho physico-chemical study of some Indigenous leafy vegetables" was carried out during 2022-2023 at the Instructional cum Research Farm and in the laboratory, Department of Horticulture, Biswanath college of Agriculture, AAU, Biswanath Chariali. The prime objectives of this experiment were: (i) Study of the morphological characters of indigenous leafy vegetables. (ii) Study of the nutritional and biochemical constituents of indigenous leafy vegetables and (iii) Study of the occurrence of diseases and pests in some indigenous leafy vegetables. The experiment was laid out in simple CRD with three replications and fourteen treatments. Total fourteen numbers of different Indigenous leafy vegetables (ILVs) were selected such as Masundari (Houttuynia cordata), Pirali Paleng (Talinum triangularae), Bhedailota (Paederia foetida), Nol-tenga (Tetrastigma leucostaphylum), Khutura (Amaranthus viridis), Saru Manimoni (Hydrocotyl rotundifolia), Matikandori (Alternanthera sessilis), Madhuhuleng (Polygonum chinense), Xukloti (Pogostemon heyneanus), Leheti saak (Celosia argentea), Mandhania (Eryngium foetidum), Brahmi (Bacopa monnieri), Babori saak (Glebionis coronaria) and Ponounuwa (Peperomia pellucida). The result revealed that maximum (11.50 cm) leaf length was recorded in Mandhania (Eryngium foetidum), while Xukloti (Pogostemon heyneanus) recorded significantly higher leaf width (8.30 cm) and leaf area (41.08 cm2). Other morphological parameters such as leaf shape, leaf margin, leaf apex and plant type also significantly differed among the plant species. Among the species, a significant variation in biochemical parameters, and antioxidant activity were recorded. Highest moisture content (92.80 %) was found in Ponounuwa (Peperomia pellucida). Whereas, the highest level of Ascorbic acid (719.82 mg/100g) and Vitamin A content (8685.00 IU) were found in Khutura (Amaranthus viridis). Protein content was found highest (4.80 g/100g) in Pirali paleng (Talinum triangularae). Out of fourteen leafy vegetables, Nol-tenga (Tetrastigma leucostaphylum), Bhedailota (Paederia foetida) and Leheti saak (Celosia argentea) had higher amount of total phenol (259.10 mg/100g), total flavonoids (288.90 mg/100g) and total alkaloids (3.18 %) respectively. Among the selected plant

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species, maximum calcium (2109.00 mg/100 g) and magnesium (4037.00 mg/100 g) was found in Bhedailota (Paederia foetida). Similarly, highest potassium content of 8958.36 mg per 100g was observed in Pirali paleng (Talinum triangularae) while khutura (Amaranthus viridis) recorded maximum iron content of 396.17 mg per 100g. The highest total leaf chlorophyll (2.49 mg/g fw) was found in Masundari plant (Houttuynia cordata) and maximum total antioxidant activity (24.06 ug/ml) was found in Matikanduri (Alternanthera sessilis). Thus from the present study, it was found that more or less almost all the selected indigenous leafy vegetables studied under this experiment have good sources of vitamins, minerals, phyto-chemicals and antioxidant properties. However, among the fourteen species, Khutura, Matikanduri, Saru-manimuni, Nol-tenga, Bhedailota, Pirali paleng and Masundari were found to be rich in vitamins, minerals and phyto-nutrients with high antioxidant property.

Effect of different growing media and sowing dates on seedling growth of Bhut Jolokia (*Capsicum chinense* Jacq)

Pritam Phonglo

The present experiment entitled "Effect of different growing media and sowing dates on seedling growth of Bhut Jolokia (Capsicum chinense Jacq)" was conducted during 2022-2023 at the Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali with two objectives (a) To find out the suitable growing media and sowing dates of Bhut Jolokia seedlings based on morpho-physiological parameters and (b) To study the incidence of pest and disease on Bhut jolokia seedlings. The design of the experiment is Factorial RBD with 3 replications and 30 treatment combinations viz. 6 growing media [M1: Sand + Cocopeat + decomposed cow dung (2:1:1), M2: Sand + Cocopeat + Vermicompost (2:1:1), M3: Sand + Cocopeat + Forest Soil (1:1:1), M4: Sand + Cocopeat + Vermicompost + Perlite (1:1:1:1), M5: Sand + Cocopeat + Vermicompost (1:1:1) inoculated with Microbial Consortium @ 1g/100g, M6: (Control) Sand + Garden soil + decomposed cow dung (1:1:1)] and 5 sowing dates (S1: Middle of August'22, S2: Middle of September'22, S3: Middle of October'22, S4: Middle of November'22, S5: Middle of December'22). The study revealed that the morphological, phenological and physiological traits were influenced by different sowing dates and growing media treatments. The germination per cent was significantly higher in S3 (75.87 %) and M4 (84.25 %). The Morphological parameters like seedling height at 20 and 30 DAE, number of green leaves per seedling at 40 DAS, shoot length (cm) at transplanting was observed to perform better under S1 whereas seedling height at 10 DAE perform better under S2 and root length at transplanting under S3 and among the different growing media, all the morphological parameters were recorded highest in M6. Similarly, the phenological parameters like days to seedling emergence (8 days) and days to emergence of 1st leaf (14.42 days) was lowest under S1 whereas the number of days to transplanting (43.56 days) was found to be lowest in S2. The physiological parameters like seedling vigour index perform better under S3 and M6, Fresh weight and leaf area was higher in S2 and M6, dry weight in S1 and M6 whereas RLWC and total leaf

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chlorophyll content perform better under S3 and M4. The B:C ratio was maximum in S3M6. And the incidence of disease (damping off) was recorded highest in S3M2. Therefore, M6 media and S2 sowing can be recommended for seedling production in Assam condition.

Growth, Yield and Quality of Rose (*Rosa hybrida*) as influenced by fertilizer doses under polyhouse

Priya Biswas

An experiment was carried out during the period of 2022-23 to study the effect of different NPK fertilizer doses on growth, yield and quality of rose in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. The experiment was laid out in Factorial Randomized Block Design with three levels of nutrients i.e N,P,K.. Each of these has three levels N(N1,N2,N3) where N1(10 g N/m²),N2(20 g N/m²) and N3(30 g N/m²).Similarly, P has three levels where P1(10 g P2O5/m²),P2(20 g P2O5/m²) and P3(30 g P2O5/m²).Again K has three levels where K1(10 g K2O/m²),K2(20 g K2O/m²) and K3(30 g K2O/m²) which replicated three times. Planting of the grafted plants were done in the month of May,2022.The results revealed that, among the N levels, N2 recorded highest plant height(44.53 cm,63.86 cm and 84.99cm), highest number of leaves per plant (69.53,111.74,152.65),maximum leaf area(37.68,43.66,45.46 cm²),plant spread(24.82 cm,28.18cm,31.16 cm) in 60 DAP, 90 DAP and 120 DAP. Among the different phosphorus levels P1 recorded highest plant height (43.65 cm,64.42 cm and 85.58 cm),number of leaves per plant(68.01,110.09,148.54),plant spread (23.76 cm,27.70cm and 30.93 cm) in 60 DAP,90 DAP and 120 DAP. Again among the different K levels,K2 recorded highest plant height of (63.01 cm, 84.29 cm) in 90 DAP and 120 DAP.K2 recorded highest plant spread (23.71 cm and 28.03 cm) in 60 DAP and 90 DAP. Among the different flower characters,N2 recorded highest bud length(3 cm),stalk length(30.34 cm),flower diameter(6.61 cm),number of flowers per plant (10.63)and vase life(9.43).Among the P levels,P1 recorded highest stalk length (29.80 cm),highest flower diameter(6.49 cm) and number of flowers (10.24).Among the different K levels,K3 recorded maximum stalk length(29.44 cm) and number of flowers(10.36).Among the physiological parameters, N2 recorded highest chlorophyll content and again P2 and K2 recorded highest chlorophyll content both before and after flowering. Leaf nitrogen was found highest in N3,P1 and K2 before and after flowering. Leaf phosphorus was found maximum in N2,P1,K2 before and after flowering. Soil nitrogen was found highest in N3,P3 and K1, Soil phosphorus was found maximum in N3, P3 and K1 and Soil potassium was found

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highest in N1,P2 and K3 level before flowering and in N1,P3,K3 after flowering.Among the interaction treatments,N2P1K3(T12) showed best results in terms of most of the growth and flower characters.The treatment N2P1K3 was found to be best with highest bud diameter (3.15 cm),stalk length(33.69 cm),numbers of flowers per plant per month (14) and minimum days to full bloom(57.33 days) and B:C ratio of 3.98.

Effect of Plant growth substances on Growth, Sex expression and Yield of Zucchini (*Cucurbita pepo* L.) under protected condition

Rimjim Baruah

An experiment was carried out under a naturally ventilated polyhouse at the experimental farm, Department of Horticultural, Assam Agricultural University, Jorhat, during 2022-23 on the topic 'Effect of Plant growth substances on Growth, Sex expression and Yield of Zucchini (Cucurbita pepo L.) under protected condition'. For the experiment the variety of zucchini used was Joy F1 Hybrid. The experiment was laid out in a randomized block design with three replications. There were total of ten treatments namely, T1(Control),T2 (150ppm Ethrel),T3(250ppm Ethrel),T4 (350ppm Ethrel),T5 (50ppm NAA),T6 (75ppm NAA),T7(100ppm NAA),T8(100ppm MH),T9 (150ppm MH), T10 (200ppm MH). The treatments were applied to various growth stages i.e. two leaf, three leaf and four leaf stages. Treatments significantly affected most of the growth and yield attributing parameters, but not the quality parameters except ash content. The best treatment was found to be T3 (250ppm Ethrel), which improved plant height (121.16 cm), plant spread (1.57 m), petiole length (140.95 cm), days to emergence of the first female flower (41.93 days), nodal position of first female flower (2.53), number of female flowers (20.27), fruits per plant (20.13), yield per plant (6.65 kg), yield per plot (86.44 kg), and yield per 500m 2 (33.71 q) . The highest female to male sex ratio of 1.47 was also found in 250 ppm Ethrel (T3) followed by 1.38 in 350 ppm Ethrel (T4). Ethrel treatments performed better than NAA and MH treatments, and NAA was better than MH. The highest benefit-cost ratio of 2.74 was obtained from T3, followed by T4 with 2.64. Therefore, T3 can be recommended to the farmers for zucchini cultivation under protected conditions.

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Major Adviser: Dr. Deepa Borbora Phookan

Effect of mulch materials and PGR on growth, yield and quality of Papaya (*Carica papaya* L.)

Romit Rabha

The present investigation was carried out in the Experimental Farm, Department of Horticulture, Assam Agricultural University Jorhat during the period of 2022-2023 to study the Effect of mulch materials and PGR on growth, yield and quality of Papaya (Carica papaya L.) The experiment was laid out in Factorial Randomized Block design consisting of two factors viz. mulch material and different levels of PGR with two replications where Sinta variety was utilized. The three mulch materials used were M1 (Silver black mulch), M2 (Paddy straw mulch) and M3 (No mulch) with six different levels of PGR were C1 (GA3 @150 ppm), C2 (GA3 @ 200 ppm), C3 (Ethrel @ 150 ppm), C4 (Ethrel @ 200 ppm), C5 (NAA @ 150 ppm) and C6 (NAA @ 200 ppm) which was applied at 45, 90 and 145 days interval. The eighteen treatment combinations were T1 (GA3 @ 150 ppm + Silver black mulch), T2 (GA3 @ 150 ppm + Paddy straw mulch), T3 (GA3 @ 150 ppm + No mulch), T4 (GA3 @ 200 ppm + Silver black mulch), T5 (GA3 @ ppm 200+Paddy straw mulch), T6 (GA3 @ 200 ppm + No mulch), T7 (Ethrel @ 150 ppm + Silver black mulch), T8 (Ethrel @ 150 ppm + Paddy straw mulch), T9 (Ethrel @ 150 ppm +No mulch), T10 (Ethrel @ 200 ppm + Silver black mulch), T11 (Ethrel @ 200 + Paddy straw mulch), T12 (Ethrel @ 200 + No mulch), T13 (NAA @ 150 ppm + Silver black mulch), T14 (NAA @ 150 ppm + Paddy straw mulch), T15 (NAA @ 150 ppm + No mulch), T16 (NAA @ 200 ppm + Silver black mulch), T17 (NAA @ 200 ppm + Paddy straw mulch) and T18 (NAA @ 200 ppm + No mulch). The treatments had significant influences on the various parameters except few. The plant growth parameters viz., plant height (120.17 cm, 150.67 cm & 172.73 cm at 180, 210 & 240 DAT), flowers per plant (120.57), fruits per plant (30.10) and the fruit yield (122.20 t/ha) in papaya plant treated with C2 were observed to be significantly higher than the other PGR treatments and the lowest plant height (101.07 cm, 131.59 cm & 155.65 cm at 180, 210 & 240 DAT), flowers per plant (106.44), fruits per plant (25.82), fruit yield (85.09 t/ha) were recorded in C3 treated plants. Similarly, among the yield attributing characters the highest value was recorded to be 114.53 (t/ha) in treatment M1 and the lowest yield (82.25 t/ha) was recorded in treatment M3 (No mulch). For

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biochemical analysis, treatment C4 (Ethrel @200 ppm) showed highest values of TSS (15.26 ◦Brix), total sugar (9.49 %) and reducing sugar (7.26 %) and least for titratable acidity (0.138%) which was followed by C3. The lowest value of TSS (13.31 ◦Brix), total sugar (8.40 %) and reducing sugar (6.58 %) and highest value of titratable acidity (0.161 %) was found in treatment C5. The treatment C2 resulted the highest value of ascorbic acid (64.00 mg/100g) which was at par with C1 and the lowest value of ascorbic acid (61.33 mg/100g) was recorded in treatment C3. Computation of production of economics revealed that the highest B:C ratio (3.37) was found in treatment T4 (GA3 @ 200 +Silver black mulch) followed by T5 (GA3 @ 200+Paddy straw mulch) that is 3.03.

Integrated nutrient management in Amaranthus

Sandeep Indurthi

A field experiment was conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat in the year 2023 to study the effect of integrated nutrient management on growth, yield and quality of amaranthus. The experiment was laid out in a randomized block design (RBD) with three replications. The treatment combinations were T0: Control, T1: 100% RDF (60:30:20kg NPK/ha) + FYM 5t/ha, T2: 100% RDF + Vermicompost 4t/ha, T3:100% RDF+ Vermicompost 2t/ha + PSB + Azotobacter, T4: 75 % RDF +FYM 5t/ha, T5: 75 % RDF + Vermicompost 4t/ha,T6:75 % RDF + Vermicompost 2t/ha +PSB + Azotobacter,T7: 75 % RDF instant mixture with incubated vermicompost 1t/ha and T8: 100% RDF instant mixture with incubated vermicompost 1t/ha. The characters studied were plant height, plant width, total leaves per plant, fresh weight of individual leaf, dry weight of individual leaf, weight of leaves per plant, weight of stem per plant, plant weight, leaf to stem ratio, stem girth, number of branches per plant, days to harvest, leaf yield, stem yield and crop yield per hectare. Among the treatments, the treatment T8 recorded maximum plant height (47.08cm, 66.62cm and 85.85cm), plant width (23.73cm, 33.80cm and 44.75cm) at 30DAS, 45DAS and at harvest, respectively. Maximum number of leaves (78.00) was exhibited by T8 and was at par with treatment T3 (77.77). The highest fresh weight (0.99g) and dry weight (0.23g) of individual leaf were recorded by the treatment T8. Maximum weight of leaves (68.42g/plant), weight of stem (90.17g/plant), plant weight (158.59g/plant) and leaf to stem ratio (0.76) was exhibited by T3. Among different treatments, the treatment T8 showed maximum stem girth (2.4 cm), number of branches (6.79) and maximum number of days to harvest (54 days). The highest leaf weight (6.84kg), stem weight (9.02kg) and plant weight (15.86kg) per plot was observed in the treatment T3. Similarly, maximum leaf yield (142.54q), stem yield (187.85q) and crop yield (338.62q) per hectare were also exhibited by the treatment T3. The integrated application of organic, inorganic and bio-fertilizers influenced the nutritional content of amaranthus significantly. The highest vitamin C (74.17mg/100g) and crude fibre (0.91%) content was exhibited by the treatments T7 and T4, respectively. Maximum calcium (9.86%) and iron (23.4mg/100g) content was observed in the treatment T8. Soil parameters viz., soil pH, organic matter and available nitrogen

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were maximum in T3 with values 5.39, 0.93% and 269 kg/ha, respectively, however, available phosphorus and available potassium were maximum in T6 with values 37kg/ha and 140kg/ha. Economic analysis showed that the highest net return (Rs. 338942.00) was found in the treatment T8 with a benefit cost ratio of 4.06. Even though the treatment T3 exhibited the highest yield but the benefit- cost ratio (3.34) was smaller than T8 due to higher cost of production in T3.

Shelf life evaluation of processed Assam lemon (*Citrus limon* Burm.) juic

Srishtty Kashyap

Assam lemon, commonly known as “Kaji nemu” is an indigenous pride fruit of Assam. Due to the state's favorable climate, Assam lemons are readily available all round the year, with production peaking from April-September. This causes a market oversupply, which drives down the market price. Due to their physiological weight loss, these fruits are difficult to store for an extended period. Moreover, fresh fruit quality degrades along with the decrease in juice content across the storage. Therefore, focusing on juice processing of Assam lemon fruit may assist to prevent losses incurred by citrus growers as a result of the aforementioned issues. Based on this concept, the present investigation was framed and carried out to evaluate the shelf life of the processed Assam lemon juices in response to various treatments and to find out the economics of their preparation and preservation. Eight different treatments were prepared in matured (90-110 DAFS) and ripe (120-150 DAFS) lemon juices. Among the eight treatments T1 and T2 were untreated matured and ripe juice whereas T3, and T4 were treated with KMS. T5 and T6 were pasteurized and T7 and T8 were preserved by a combination of KMS and pasteurization in both matured and ripe juices, respectively. All the treatments were stored in refrigerated condition. The evaluation of the physico-chemical and sensory parameters was carried out for 180 days at intervals of 30 days while the microbial evaluation was carried out at intervals of 15 days. Regarding physico-chemical changes during storage of the Assam lemon fruit juices, samples T7 and T8 showed better results for TSS and titrable acidity which kept on increasing throughout the storage period whereas the pH and ascorbic acid kept decreasing. It was noticed that T8 had higher TSS and titratable acidity but lower pH and ascorbic acid content than that T7. The highest scores for overall acceptability, colour, mouthfeel, and taste were recorded in treatment T8 followed by T7 which showed means higher than the global mean on the initial day. The untreated, KMS-treated, as well as solely pasteurized juices, were discarded after 90, 120, and 150 days respectively after they crossed the microbial permissible limit. Highest B: C ratio was observed in treatment T2 (2.18) followed by T4 (2.16) as they had comparatively lesser treatment expenses. However,

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after considering the shelf life of the above treatments, they only persisted for 90 and 120 days, respectively. Interestingly, T8 had a B: C ratio of 1.78 but remained consumable for 180 days. Hence, it might be safe to establish that treatment T8 resulted in the highest shelf life with better retention of the physico-chemical and sensory parameters maintaining a decent B: C ratio. The investigation recommends that ripe Assam lemon juices given combined heat and chemical treatment can be effectively.

Impact of different organic manures on green fruit and seed production of Okra

Sunita Dhar

The present study entitled "Impact of different organic manures on green fruits and seed production of Okra" was carried out to analyse the effect of different doses of organic manures viz., Farm Yard Manure (FYM), Vermicompost and Enriched compost alone or in combination with Microbial consortia on the growth characteristics, fruit yield and seed production. The experiment was conducted during 2022 in the Organic Block of Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat-13 with treatments comprising of FYM 10 t/ha (T1), FYM 5 t/ha (T2), FYM 2.5 t/ha + Microbial consortia (T3), Vermicompost 5.0 t/ha (T4), Vermicompost 2.5 t/ha (T5), Vermicompost 2 t/ha + Microbial consortia (T6), Enriched compost 2.0 t/ha (T7) and untreated control (T8) which were applied at the time of final land preparation. The experiment was laid out in Randomised Block Design (RBD) with three replications. Height of plants was the highest under treatment T6 (Vermicompost 2 t/ha + Microbial consortia) whereas number of leaves, leaf area, stems girth, plant fresh weight and dry weight were recorded the maximum under T7 (Enriched compost 2.0 t/ha). The fruit yield parameters such as fruit weight (14.60 g), fruit volume (18.03 cc), fruit yield per plant (202.93 g) and total yield (95.74 q/ha) were also maximum under T7 (Enriched compost 2.0 t/ha). However, the highest Net Return of 2,08,800.00 per ha from tender fruits was produced with application of Vermicompost 2 t/ha + Microbial consortia (T6) leading to the maximum Benefit: Cost ratio of 3.80. The seed yield per plant, total seed yield, seed viability percentage was higher with treatment T6 while the lowest was recorded in T8 (Untreated control). The seed vigour at harvesting time and after 3 months of storage was the highest in Vermicompost 5.0 t/ha (T4) while Vermicompost 2 t/ha + Microbial consortia (T6) could retain higher vigour till 6 months of storage. Economic analysis of using organic manures for okra seed production showed FYM 2.5 t/ha + Microbial consortia (T3) to yield maximum B: C ratio of 6.32, followed by 6.09 with sole application of FYM @ 10 t/ha (T1). Thus, it can be concluded from the present experimental analysis that plant growth and fruit yield parameters were significantly enhanced by Enriched Compost 2 t/ha (T7) but was not statistically superior to Vermicompost 2 t/ha + microbial Consortia (T6). However,

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computation of production economics revealed that Vermicompost 2 t/ha + microbial Consortia (T6) to be the most remunerative for tender fruit production. For organic seed production and seed quality attributing characters, fortification of 2.5 t/ha of FYM with microbial consortia (T3) proved to be most profitable.

Response of Rough lemon (*Citrus jambhiri* Lush.) germplasm towards transient waterlogging conditions

Tonmoy Tamuli

The present investigation was carried out in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the period of 2022-23 to evaluate the performance of five rough lemon germplasms under transient waterlogged conditions. The experiment was laid out in Factorial Completely Randomized Block design with three replications consisting of five germplasm (G1, G2, G3, G4, G5), two inundation periods {I1(7 days) and I2(15 days)} and three flooding treatments {F1(75%), F2 (100%), F3 (125%)}. The germplasm were collected from different districts of Assam. The results revealed that at the end of I1, most plant biomass increased with G2 showing the highest increase. However, after end of I2, biomass reduction was observed, with G1 being the least affected. All germplasms showed higher reductions in biomass as flooding percentage increased, with F3 resulting in the maximum reduction. At the end of I1 there was an increase in root diameter except for some germplasm, root volume and number of adventitious roots. G4 showed the highest increase in root diameter, volume, and number of adventitious roots after I1 period. Root length was not affected by the inundation periods. In contrast, after I2 there was a reduction in root diameter, with G4 being least affected. However, root volume and number of adventitious roots increased for G4. Additionally, as flooding percentage increased, root diameter and growth decreased, with F3 causing the maximum decrease. Root volume and number of adventitious roots increased with increase in flooding % with F3 recording the highest increase. Chlorophyll content was negatively impacted by both inundation periods and percentage of flooding. G4 showed the least susceptibility to loss of chlorophyll at the end of 7 and 15 days. All germplasm showed reduced N, P, K, Zn, Mn, Cu content with the increase in inundation period and also percentage of flooding with I2 resulting in a higher reduction. G4 was the least susceptible to N, P and Zn loss overall. G5 had the least reduction in K, Cu and Mn content. Starch in leaves increased with prolonged inundation and higher flooding levels. G4 exhibited the highest content at treatment end. Conversely, starch content decreased with longer

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inundation and higher flooding levels. G4 was least affected at the end. Prolonged inundation and higher flooding levels led to increased leaf yellowing, wilting and leaf shedding. G4 showed the least number of yellow leaves, wilting and leaf shedding. G5 exhibited the best recovery potential among all germplasm, with the greatest root length after recovery. The plants showed better recovery after 7 days of inundation compared to 15 days. F1 resulted in the best recovery among the germplasm. From this investigation Germplasm 4 which was collected from Biswanath district (Rangamari) was found to be superior among all the germplasm in many morphological as well as physiological characters and thus G4 can be recommended for planting in waterlogging prone areas.

Soilless culture of tomato in naturally ventilated polyhouse under Assam condition

Varsha Kumari

A field experiment was conducted at the Experiment Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the year 2022 to study the possibility of cultivating tomato on soilless growing media under a naturally ventilated polyhouse. The experiment was laid out in a randomized block design with 5 treatments and 4 replications. The treatments comprised of media containing cocopeat, vermiculite, perlite, sand and loam soil in various proportions. The study revealed that tomatoes were luxuriant on Loam soil: Sand: Vermicompost (1:1:1) medium with maximum plant height (140.68 cm), primary branches (6.19), plant fresh weight (177.90 gm), fruit weight (70.80 gm), crop duration (124.56 days), shorter duration to flowering (42.5 days), TSS (5.65 °Brix), minimum bacterial wilt infection (6.19 %) with final higher residual N, P, K contents of 2.58, 2.51, 2.64% respectively in the spent growing medium. Maximum plant dry weight (25.80 gm), fruit set (48.24%), fruits/cluster (8.36), fruits/plant (71.74), yield/plant (4.88 kg), total yield (66.26 q/500sqm), ascorbic acid (40.07 mg/100gm) and harvesting latitude (43.08 days) was recorded by Cocopeat: Sand: Vermicompost (5:2:3) medium, whereas themaximum days to first harvest (83.75 days) and blossom end rot incidence (45 %) were recorded by Cocopeat: Vermiculite: Perlite (3:1:1). Chlorophyll content (2.50 mg/100gm) and fruit volume (73.10 cc) were highest in Sand: Vermicompost (1:1). Flowers per cluster (3.91) and shelf life (12 days) were maximum in Cocopeat: Vermicompost (1:1). The economic analysis indicated that is Loam soil: Sand: Vermicompost (1:1:1) gave a maximum benefit-cost ratio of 2.20. These findings suggest that Cocopeat: Sand: Vermicompost (5:2:3) medium may be the preferred choice for optimizing growth and yield, although Loam soil: Sand: Vermicompost (1:1:1) is economically advantageous.

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Major Adviser: Dr. Ananta Saikia

Development of gluten-free biscuits using rice, soy okara and elephant apple pomace

Anandita Lahkar

Future years are going to witness a marked rise in the demand for gluten-free (GF) foods, as the prevalence of gluten-related disorders is rising globally. In the present study, two set of GF biscuits (using Bora chaul and Komal chaul) were prepared. In the first set of biscuit formulation, Bora chaul was used on the basis of 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% (w/w) substitution of soy okara respectively and were accordingly coded as B1, B2, B3, B4, B5, B6, B7, B8, B9, B10. Similarly, in the second set of biscuit formulation, Komal chaul was added as 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% (w/w) replacement of soy okara respectively and were accordingly coded as K1, K2, K3, K4, K5, K6, K7, K8, K9 and K10. In both the formulations, T0 bearing only wheat flour (i.e. absence of rice or okara) served as the control; while S0 served as the formulation containing 100% soy okara alone (i.e. absence of rice and refined wheat flour). The products' physical, proximate and organoleptic properties were evaluated. In Bora chaul-soy okara biscuits, bulk density ranged from 0.54±0.01 g/cm3 (B1) to 0.49±0.01 g/cm3 (B10) which were higher than T0 (0.42±0.01 g/cm3). Minimum spread ratio of samples was observed in S0 followed by B1 with B6 to B10 in close proximity to T0. In B1 to B10, ash content, crude protein and crude fibre content ranged within 2.20±0.02% to 1.96±0.03%, 12.36±0.13% to 5.89±0.17%, and 11.98±0.36% to 3.59±0.33%, respectively, and were higher than those of T0. Total carbohydrates and energy value were lowest in S0 and highest in B9 and B10. Likewise, Komol chaul-soy okara biscuits' bulk density ranged from 0.56±0.00 g/cm3 (K1) to 0.50±0.01 g/cm3 (K10) and were higher than those of T0 and S0. Spread ratio of samples were intermediate to that found for T0 (maximum) and S0 (minimum), with K7 to K9 comparable with T0. Mineral content ranged from 2.21±0.02% to 1.94±0.01%, crude protein between 13.03±0.20% to 6.28±0.36%, crude fibre within 12.1±0.04% to 3.95±0.21% and total carbohydrates from 47±0.57% to 70.34±0.09%. Energy value was observed lowest in K4, and highest in K9 and K10, which were slightly lesser than that of T0. Based on sensory scores, it was deduced that replacement of soy okara upto 30% in Bora chaul biscuits and upto 40% in Komol chaul biscuits can

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result in satisfactory products. Production of these kind of nutrient-dense gluten-free baked goods would prove suitable for valorization of soy okara as-well-as provide fibre-rich snacking option for gluten sensitive consumers.

Preparation of starter culture from different sources of Gundruk & Gundruk fermentation from waste leaves of cabbage

Jyotiraditya Mahanta

Gundruk is an ethnic fermented food produce by fermenting leafy vegetables primarily valued for its uniquely appetizing taste and flavor. From nutritional standpoint, Gundruk can be considered as a concentrated source of minerals, vitamins, therapeutically active compounds and probiotics. During this present investigation, effort towards finding the possibility of improving the production technology of fermenting Gundruk from waste leaves of cabbage has been made. 3 different samples of Gundruk were collected from 3 different districts of Assam (Jorhat, Biswanath and Sonitpur), from which 6 different bacterial strains were isolated (coded as JR1, JR2, BN1, BN2, SP1 and SP2) characterized and screened for Gundruk fermentation as starting culture. Along with these starting cultures, a mixture of microbial isolates directly isolated from the collected Gundruk samples by soaking them with sterilized distilled water and keeping in shaking incubator overnight at room temperature and 200rpm (coded as JR3, BN3 and SP3). These mixture cultures were also used directly for Gundruk fermentation as stating cultures, separately. Proximate analysis of all the final Gundruk products produced after 14 days of fermentation and sun drying was carried along with the raw waste cabbage leaves (used as substrate). The results obtained after the proximate analysis showed that the crude fiber and moisture contents of all the Gundruk samples decreased considerably over the non-fermented leaves to a level of 8.61 percent and 8.13 percent from 12.67 percent & 82.3 percent, respectively. But, all the other minerals (Potassium, Phosphorus, Iron, Calcium, Magnesium, Sodium and Zinc) as well as the ash contents found to be increased considerably in fermented products over the non-fermented one. Gundruk product fermented using bacterial isolates showed increased level of mineral profile than the Gundruk fermented naturally. The highest level of K (257.29mg/100g), P (43.59mg/100g), Mg (33.79mg/100g) and Ca (63.79mg/100g) were found in product treated with the bacterial isolate BN1 (isolated from Biswanath-Gundruk). This increase in the minerals content of the Gundruk product might be associated with the presence of more numbers of lactic acid

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Major Adviser: Dr. Tankeswar Nath

bacteria in the added starting cultures which facilitate the process of fermentation leading to the release of more minerals. Microbial load was evaluated in each final product and it was found that the product inoculated with bacterial mixture SP3 (prepared from Sonitpur-Gundruk) used as starter culture showed the highest microbial growth (7.17 log cfu/g)) over all the treated and absolute controlled-products. Sensory evaluation of all the final fermented products was carried out by 20 evaluators using 9-point hedonic rating scale. The highest scoring in terms of flavor, taste and overall appearance goes with the product treated with bacterial isolate JR2 (isolated from Jorhat-Gundruk) as starting culture as. However, there were no considerable difference found among the different products in terms of color and appearance. From the present investigation it can be concluded that it is possible to prepare Gundruk with acceptable quality characteristics using readily available seasonal leafy vegetables, specifically unused leaves of cabbage as well as known bacterial isolates, isolated from naturally fermented Gundruk product under controlled conditions. However, to make it commercialized product it needs more investigation in details like standardization of starter culture, evaluation of more leafy vegetables, standardization of procedures for storage as well as packaging and estimation profitability etc.

Mechanical de-seeding of Roselle and its effects on quality of brewed Roselle tea

Nani Gopal Mudoi

The manual deseeding of Roselle istime-consuming and labour-intensive process. Dealing with bulk quantities manual, deseeding can result in loss of edible parts of calyx due to human error and drudgery. Therefore, considering the need and expectations of the small-scale manufactures of Roselle products, an efficient, low-cost, fast deseeding design was developed and compared with hand/manual deseeding. The developed machine has a foot paddle and link mechanism. Coil spring mechanism has been provided for return action of the punching tool to its original position. The machine cost was estimated to be Rs.1800/-. The rate of deseeding by the machine was 2.5 kg/h with minimum broken percentage producing good quality of deseeded calyces. When compared with manual deseeding, it was found that manual deseeding capacity was 1.5 kg/h apart from quality degradation of the calyces. Brewed Roselle tea was taken for quality tests to see the effect of mechanical deseeding against manual deseeding. Mechanically and manually deseeded whole calyx and powder (dried at 80 °C) were selected as treatments. The quality parameters like Anthocyanin (monomeric), Total phenol content, Total flavonoid, Antioxidant activity, Total soluble solids, Colour, Sensory Analysis, Bulk density, True density, Porosity were determined for both mechanical and manual deseeded calyces and powders. The highest mean of monomericanthocyanin content was found in mechanically deseeded powder and whole calyces' tea (39.83 mg/ml and 16.59 mg/ml), same trend was observed for the phenol content (26.03 mg/ml and 14.58 mg/ml), flavonoid content (24.37 mg/ml and 16.56 mg/ml) and antioxidant activity (88.70% and 87.60%). Sensory assessment of the Roselle tea revealed that mechanically deseeded whole calyx dried at 80 °C was highly accepted and judged best among other Roselle tea samples. Mechanically deseeded calyces dried at 80 °C exhibit higher porosity (51.41%) and lower bulk density (0.69 gm/cm3), which plays important role for production of tea or herbal infusion of dried Roselle because a lower bulk density allows for better infusion and extraction of flavours and compounds. The result obtained from the quality parameters opened up a possibility having a good impact on the small-scale manufactures, marginal farmers and

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Department: Horticulture, FST

Major Adviser: Dr. Abhijit Borah

Self-help groups (SHGs) for having a good quality Roselle's products and smooth deseeding operation with the deseeder.

Development of Biodegradable Bioplastic from Banana Peels

Nilakshi Talukdar

The development of biodegradable bioplastic has gained significant attention in recent years due to its potential as a sustainable solution for plastic waste management. The present study was to develop bioplastic from banana peels and characteristic its physical properties. The biofilm was prepared from banana peels by casting method using glycerol (10%) as a plasticizer and corn starch as co-biopolymer. Five banana peel bioplastics (T1 - T5) were prepared with different concentrations of corn starch (2%, 4%, 6%, 8% and 10% respectively) and the bioplastic (T0) without corn starch was taken as a control. Based on the study, the thickness of the bioplastic was recorded in the range of 0.38 mm - 0.59 mm. The bioplastic (T4) with 8% corn starch was found to have the highest tensile strength of 0.388 MPa as compared to other treatments. The highest water solubility was observed in the bioplastic (T5) with 10% corn starch. At different temperatures (250C, 300C and 350C), the water vapour transfer rate (WVTR) of the bioplastic were studied. The best result for WVP was observed in T5 where the concentration (10%) of corn starch was highest. The biodegradability of the films was determined by carbon dioxide evolution. There was a gradual increase in carbon dioxide evolution from day 7th to day 90th. After 90 days the net carbon dioxide evolution was recorded as 0.5190 g for T4 (corn starch 10%). Lastly, the microbial growth was detected only after 60 days of storage. The study revealed that the treatment T4 (Glycerol 10% and 8% corn starch) is found to be the best among the treatments considering its highest tensile strength (0.388 MPa), elongation percent (9.77%), maximum load (2.48 N), intermediate solubility (34.12%), thickness (0.56 mm), susceptibility to microbial contamination and biodegradability. Effects of concentration of corn starch showed positive effect on water vapor transmission rate of the bioplastics. By using bioplastic, the environmental pollution can be reduced as well as the waste banana peels can be turned into a new value-added biodegradable plastic product.

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Department: Horticulture, FST

Major Adviser: Dr. Robin Chandra Boro

Phytochemical analysis of dried leaves of *Paederia foetida*

Prapti Saikia

With advancing gain of interest in medicinal herb due to its health benefits, dryingof leaves play an important role in packaging and preservation. Being highly perishable, drying of P. foetida leaves can be utilised for its widespread use. The present study was carried out to identify the impact of drying methods on phytochemical content andantioxidant activity of P. foetida leaves. Different drying techniques utilised in the studywere oven drying at 40ºC, 50ºC, sun drying, solar drying and shade drying. Preliminaryphytochemical screening of ethanolic extract revealed presence of phenol, flavonoid, tannin, glycoside and terpenoid. Impact of drying methods on phytochemical content was foundsignificant. Moisture content of dried sample ranged from 11.18% in oven dried sample @50ºC to 12.76% in shade dried sample. Total phenolic, flavonoid and tannin contents variedfrom 10.97- 16.46 mg GAE/g, 2.22- 8.39 mg QE/g, 4.25- 4.90 mg TAE/g respectively withhighest amount in solar dried sample. Ascorbic acid content was retained most in oven driedsample @50 ºC with 8.4 mg/100 g and lowest in shade dried sample with of 7.2 mg/100 g. Total antioxidant activity ranged from 10.30-15.69 mg AAE/g with maximum activity insolar dried sample. Scavenging activity using DPPH free radical portrayed a gradual increase in activity with increased concentration of sample extract. Highest inhibition was recordedfor solar dried sample. Solar dried sample was found best amongst the drying treatments onretention of bioactive compounds and antioxidant activity.

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Department: Horticulture, FST

Major Adviser: Dr. Samindra Baishya

Pectin-based microencapsulation of probiotics for improving survival in gastro-intestinal tract

Pratyasha Gogoi

The probiotic organisms exert various health benefits. The viability of probiotics is reduced while passing through the stomach and upper intestine because of the low pH. In this study, pectin was extracted from lemon peels and pumpkin, and microcapsules were made by encapsulation of probiotic microorganism species *Lactobacillus plantarum*, *L. delbrueckii* and *Pediococcus pentosaceous* with plant-based pectin through emulsification. The degree of esterification was highest in lemon pectin (66.10%) with the highest encapsulated bead yield of 13.08g/g pectin. The initial probiotic cell count of L. *plantarum, L. delbrueckii* and *P. pentosaceous* was 9.54, 9.61 and 9.51 log cfu/ml respectively. The microcapsules of L. delbrueckii gave the highest viability attributed to its higher tolerance to acid. The microcapsules of *L. plantarum, L. delbrueckii* and *P. pentosaceous* achieved encapsulation yields of 84%, 86% and 83% from lemon pectin and, 81%, 83% and 83% from pumpkin pectin respectively. However, results of simultaneous incubation in simulated gastric and intestinal fluid revealed a slight reduction in the viability of encapsulated cells remaining within 5 log cfu/ml. The microencapsulated beads were observed under the inverted microscope to detect the presence of bacteria after gram staining which showed grampositive cells. No difference was detected in the bead appearance by environmental scanning electron microscopy, except that the pectin beads made from lemon peel pectin resulted in lesser severe wrinkles on the surface. The overall study indicated that the most stable microcapsules were made from lemon peel pectin with the potential for industrial application.

Abstract of M.Sc. thesis

Department: Horticulture, FST

Major Adviser: Dr. Ananta Saikia

Development of nanoparticlebased food emulsion to stabilize curcumin in aqueous food medium

Priyanka Gade

Emulsions are thermodynamically unstable bi-phase systems whose basic components include a continuous phase, a dispersed phase, and an emulsifier. Emulsifier is an amphiphilic compound that immediately adsorbs to freshly formed oil droplets and prevents their aggregation. Based on the nature of origin, emulsifiers are classified into natural and synthetic emulsifiers; as the latter is often associated with carcinogenic properties, now researchers are heading towards identifying and exploring natural emulsifiers (without derivatizing or modifying the chemical composition). Among natural compounds/molecules that can act as emulsifiers, proteins are of great interest because of their wide functional properties. Even though these protein molecules can stabilize emulsions in the initial period, in the long term they tend to de-stabilization. Conjugation of proteins to other bioactive molecules like polyphenols can enhance their functionalities, thereby improving the stability of protein-stabilized emulsions. In this study, rapeseed protein-tea polyphenol (P-P) nano-conjugates were created, which were then used at different concentrations (0.25% to 1.5% (w/v)) to fabricate emulsions (namely E1 (0.25%), E2 (0.5%), E3 (0.75%), E4 (1.0%), E5 (1.25%), and E6 (1.5%)) by using curcumin containing oil (5 mg curcumin/ml of oil) and aqueous medium (200 mM phosphate buffer, pH-7.0). The synthesized emulsions were exposed to various storage and thermal processing conditions (4℃, 25℃, 90℃, and 121℃), and subsequently, their physico-chemical characteristics were analyzed. Emulsifying capacity and centrifugal stability were found to increase with an increase in conjugate concentration. Droplet size of emulsions increased throughout the storage period; samples stored at 4℃ (without any thermal pre-treatment) recorded smaller diameter, and sterilized emulsions (stored at 4℃) recorded larger size. Zeta potential showed higher negative values for emulsions stored at 4℃ (without any thermal pre-treatment) and lower values for the sterilized samples (stored at 4℃). Values of zeta potential were seen to increase with the storage period. Creaming was observed in E1 (0.25%) of emulsions stored at 4℃ and E1 (0.25%) & E2 (0.5%) of emulsions stored at 25℃ (without any thermal pre-treatment) from the storage period of 24 h, whereas

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Major Adviser: Dr. Manashi Das Purkayastha

thermally treated emulsions (stored at 4℃) with low concentrations of conjugates started to show creaming tendency from the storage period of 168 h (7 days). Entrapped curcumin was recorded more in samples stored at 4℃ (without any thermal pre-treatment), and the least was noted in the sterilized emulsions (stored at 4℃). Values of loading efficiency of curcumin and DPPH scavenging activity also followed the same pattern. There is a significant difference.

A Biotechnological Approach to detect the Mycotoxigenic Fungi in Food and Feed Grains

Snigdha Chetia

Mycotoxigenic fungi, which encompass species from genera like Aspergillus, Fusarium, and Penicillium, produce secondary metabolites such as mycotoxins that can contaminate various crops, leading to severe economic losses and posing health risks to both humans and animals. Detecting the presence of mycotoxigenic fungi and monitoring the mycotoxins levels in food products helps ensure food safety and prevent health risks. Early and rapid detection, coupled with the ability to simultaneously identifymultiple contaminants at a single point of time, can be an effective management strategy. Towards this goal, the present work aimed at developing a rapid molecular technique for simultaneous detection. Various corn and paddy samples were collected from different households and storehouses located in and around Jorhat. Three different protocols were tested for genomic DNA extraction from the samples,including, the CTAB method, SDS method, and Qiagen Kit method. Although, both the SDS and kit extraction methods yielded good quality genomic DNA with an A260/A280 ratio of 1.80 and 1.76, respectively,the SDS method was chosen for subsequent work due to its costeffectiveness. Fivetoxin gene coding for mycotoxigenic fungi namely, Aspergillus flavus (PepO), Aspergillus parasiticus(PAR), Aspergillus carbonaerum(CARBO), Fusarium proliferatum (PRO), and Fusarium verticilliodes (VER)were designed from distinct genomic regions based on their prevalence in previous studies ensured the detection of relevant mycotoxigenic fungi. The in-silico optimization process using the fast PCR tool verified the efficiency of the designed primer sets.Additionally, gene-specific primers were designed for toxins like AflatoxinB1, Fumonisin, Ochratoxin, and Zearalenone and validated for their accuracy through a simplex PCR. Following validations, the primer sets were taken in combination of two and three sets for multiplex PCR amplification. The following primers A. flavus (PepO)andA. parasiticus (PAR); A. flavus (PepO) and A. carbonarius (CARBO);F. proliferatum (PRO)andF. verticilliodes (VER);AflatoxinB1(aflR) and AflatoxinB2(nor1); AflatoxinB1(omtA) and Ochratoxin (otaB); Fumonisin(fum13) andZearalenone (ZEA13) were optimized and tested to identify the presence of fungus as well as the toxin-producing gene in corn and paddy samples. The results showed that specific amplifications of A. flavus, A.

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parasiticus, F. proliferatum, and F. verticilliodes in corn grains produced amplicons of various sizes, corresponding to 200bp, 430bp, 585bp, and 578bp, respectively, appearing as distinct bands in an electrophoresis gel, with no non-specific product. Aspergillus. flavus and A. Parasiticus were the only contaminants detected in paddy grains. Multiplex PCR conditions were optimized for detection of mycotoxigenic fungi and mycotoxins this study. Optimizing conditions for amplification of more mycotoxigenic fungi together with genes involved with their biosynthesis will make this technique for effective for rapid diagnostic and certification programs.

Development and Standardization of Banana Pseudostem Juice Based Ready-to-Serve Beverage Blended with Roselle and Pineapple Juice

Tanushree Nath

Blended RTS was made using banana pseudostem (Musa spp) c.v Bhimkol, roselle (Hibiscus sabdariffa) and pineapple (Ananas comosus).The research was carried out in the Food Processing Laboratory, Dept. of Food Science and Technology Programme. The study was done to develop a beverage from the mentioned fruits as they are rich in nutrients and dietary fibre. The RTS beverage was made by combining 10% juice, 10% T.S.S, 0.2-0.3% citric acid and 70ppm of sodium benzoate as preservative. The combined juice was then filled in glass bottles (200ml) and stored in refrigerated condition for 60 days. The experiment was conducted by using two-factorial completely randomized design (CRD) and the product was analyzed for physico-chemical composition, sensory qualities, and microbial evaluation at an interval of 10 days till 60 days of storage at refrigerated temperature. The present study revealed that the physico-chemical parameters like pH decreased significantly from 0 to 60 days. The acidity, TSS, total phenols and total carbohydrates content was found to increase significantly from 0 to 60 days. The ascorbic acid content significantly decreased during storage. However, significant degradation in colour properties and organoleptic score was observed in the beverages during the storage period of 60 days. Based on organoleptic, physico-chemical, and microbial evaluation T2 consisting banana pseudostem 80%: pineapple 10%: roselle 10% was found to be the best blended RTS beverage which can be stored in good conditions up to 40 days in refrigerated temperature. Owing to medicinal properties of banana pseudostem, there is a great demand for blended RTS beverages with pineapple and roselle as one of the constituents. The developed RTS beverages can be produced commercially as there is a great potential for utilization and commercialization of developed blended RTS as natural health drink.

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Department: Horticulture, FST

Major Adviser: Dr. Pritam Borthakur

Study on comparative field efficacy of AAU developed microbial formulations against Meloidogyne incognita causing root-knot disease of okra

Angshuman Hazarika

Pot experiment was carried out during Kharif 2022 in the Net House of Department of Nematology, AAU, Jorhat-13 to evaluate the efficacy of five AAU developed bioformulations viz.,Bio-Veer, Bio-Monas, Biofor-Pf2, Biogreen and AAU Bioguard against Meloidogyne incognita in okra under Net house condition. 2000 cc capacity pots were filled with sterilized pot mixture of soil: sand : clay @ 2:1:1. Bioformulations were applied in the pots as per the treatments viz., T1 : Bio-Veer @20g/kg soil; T 2 : Bio-Monas @ 20g/kg soil; T 3 : Biofor- Pf2 @ 20g/kg soil; T4 : Biogreen @ 20g/kg soil; T5: AAU Bioguard @ 20g/kg soil one week prior to sowing the seeds. One untreated control was kept for comparison. Three to four leaved okra seedlings were inoculated with freshly hatched second stage juvenile of M. incognita 1J2/g of soil. The experiment was terminated at 60 days after sowing. It was revealed that all the AAU developed bio-formulations significantly increased the growth of okra and reduced the nematode infestation. However, Biogreen exhibited the best result in increasing the plant growth parameters and reducing the nematode infestation, followed by and Biofor-Pf2. Two promising AAU developed bio-formulations (Biogreen and Biofor-Pf2) were tested under field condition in a naturally infested field of M. incognita in okra during Kharif 2023. The treatments were: T1 : Application of Biogreen @ 1.5 tons/ha; T2 : Application of Biogreen @2 tons /ha; T3 : Application of Biofor Pf2 @ 1.5 tons/ha; T4 : Application of Biofor Pf2 @ 2 tons/ha; T5 : Application of decomposed cowdung @ 2 tons/ha; T6 : Chemical control (Fluensulfone 2% Gr @ 1 kg ai/ha) T7 : Control. The experiment was conducted in 3mx4m size plots following RBD. The result revealed that both the bio-formulation was effective in increasing plant growth parameters of okra and reducing the infestation of M. incognita. Amongst the bio-formulations, application of Biogreen @ 2t/ha gave the best result in increasing plant growth parameters of okra and reducing the infestation of M. incognita followed by application of Biogreen @ 1.5 t/ha.

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Department: Nematology

Major Adviser: Dr. Debanand Das

Bio-intensive management of *Meloidogyne incognita* in green gram, *Vigna radiate*

Jarine Maio

A laboratory experiment was carried out for in-vitro efficacy of six different plant extracts viz., Azadirachta indica, Lantana camara, Polygonum hydropiper, Eclipta prostrata, Ricinus communis and Tinospora cordifolia on the mortality of second stage juveniles (J2) of Meloidogyne incognita. Various concentrations of aqueous leaf extracts of 25%, 50% and 100% were assessed with exposure time period for 24, 48 and 72 hrs. All the extracts showed significant effect on the mortality of M. incognita over control (distilled water). Among the plant extracts L. camara and A. indica showed maximum percent mortality at 100% concentration after 72 hrs of exposure time. The minimum mortality of M. incognita was observed in T. cordifolia at all concentrations. No mortality was recorded in control (distilled water). Studies on the effect of different plant extracts, Neem seed kernel powder, Trichoderma harzianum and Nimitz on green gram for the management of M. incognita under net house condition showed that all the treatments increased in plant growth parameters and reduced number of galls, eggmasses per root system and nematode population in pot compared to the untreated control. Among the seed treatments, T. harzianum @ 5ml/g of seed showed maximum increase in plant growth parameters with reduced number of galls, eggmasses per root system and nematode population in soil.

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Department: Nematology

Major Adviser: Dr. Aparajita Borah

Microbial characterization of root knot nematode (*Meloidogyne incognita*) infected rhizosphere

Jitendra Doley

Present study was carried out to characterize the microbes associated with rootknot nematode infected rhizosphere and also to evaluate their biocontrol potential against two important nematode pests i.e., Meloidogyne incognita and M.graminicola in laboratory condition. A total of 40 numbers of bacteria/fungal/actinobacteria were isolated from nematode infested rhizospheric soil collected from Golghat, Nagaon and Majuli districts of Assam. The isolates ANKBF1 and AMRCF2 were identified as Penicilium cetrinum and Aspergillus terreus respectively and isolate AGKOB1 was identified as Bacillus pumiluson the basis of molecular characterization. To evaluate their biocontrol potential, culture filtrates of all the isolated bioagents were tested for egg hatching inhibition and second stage juvenile mortality of root-knot nematode and rice root-knot nematode under laboratory condition. Studies revealed that all the isolates of bacterial, fungal and actinobacterial exhibited maximum egg hatching and juvenile mortality of root-knot nematode (M. incognita and M. graminicola) in 25, 50 and 75 percent concentration of filtrates at 12, 24, 48 and 72 hours of exposure under in-vitro condition. However, the efficacy was varied among the isolates. Among the identified isolates the maximum egg hatch inhibition (54%-61.17%) and the nematode (M. incognita and M. graminicola) juvenile mortality (92.67%-96.33) with low LC50value (20.71%-13.01%) was observed in 75% concentration of fungal isolate ANKBF1 viz, Penicilium cetrinum as well as bacterial isolates AMRCF2 viz, Bacillus pumilus at 72 hrs of exposures. This was followed by isolate AMRCF2 (Aspergillus terreus) prevent egg hatching range from (49.17%-50.50%) at high concentration @ 75 percent and caused 73.67%-82% J2 mortality of root knot nematodes after 72 hrs with LC50 value 25.12%-31.78%.

Abstract of M.Sc. thesis

Department: Nematology

Major Adviser: Dr. N. Borgohain

Management of *Meloidogyne incognita* in black gram using of botanicals

Lirbon Timungpi

Studies on the efficacy of chopped leaves for the management of Meloidogyne incognita in black gram under net house condition showed that all the treatments were effective in increasing plant growth parameters shoot length, fresh weight and dry weight of shoot, fresh weight and dry weight of root in black gram. All the treatments significantly decreased number of galls, egg masses and final nematode population in soil. The treatment with water hyacinth 1.5% (w/w) was found to be effective in increasing plant growth parameters in black gram and reducing the number of galls, egg masses and final nematode population in soil. All the nine varieties viz., SBC-50, SBC-51, SBC-47, Manab, Beki, Kolong, Sonkush, SBC-40, and IPU-31 of black gram were found to be susceptibile to Meloidogyne incognita.

Abstract of M.Sc. thesis

Department: Nematology

Major Adviser: Dr. Bornali Mahanta

Bio-management of Root-knot nematode, *Meloidogyne incognita* in Okra

Manjeet Lourembam

In the present study on screening of okra varieties against root-knot nematode, Meloidogyne incognita, all the nine varieties of okra viz., Kashi Lalima, NOH-7100, Laksmi-500, OH-940, Basanti, S-51, Arka Abhay, BHS-280 and Pusa sawni were found to be susceptible to M.incognita. In the study on the efficacy of essential oil for the management of root-knot nematode, M.incognita in okra under net house condition showed that all the treatment were effective in increasing plant growth parameters shoot length, fresh weight and dry weight of shoot and root in okra. All the treatments significantly decreased numbers of galls, egg masses and final nematode population in soil. The treatment with Nimitz@1.5g/pot showed maximum increase in plant growth parameters with reduction of galls,egg masses and nematode population in soil.Among the different treatments with essential oils, seed treatment with Neem oil@20%v/w was found to be most effective in increasing plant growth parameters with reduction in numbers of galls, egg masses and nematode population in soil.

Abstract of M.Sc. thesis

Department: Nematology

Major Adviser: Dr. Aparajita Borah

Management of phytonematodes in tomato (*Solanum lycopersicum* L.) by poultry manure

Narmadha K

Studies were carried out to evaluate the efficacy of poultry manure at different doses against root-knot nematode, Meloidogyne incognita and other phytonematodes in tomato under field condition. Effect of poultry manure on soil available nutrients and soil microbes were also recorded. Poultry manure was applied in the field at 7 days before transplanting of seedlings. The treatment Poultry manure @1500 kg/ha was found to be best in reducing the phytonemtodes population in soil including Meloidogyne incognita, which results in improved plant growth and yield of tomato over control. Nimitz (Fluensulfone 2G) being an nematicide remained at par with the treatment Poultry manure @1500 kg/ha in reducing plant parasitic nematodes in soil. Effect of different doses of poultry manure on soil available nutrients showed that the treatment Poultry manure @1500 kg/ha was found to be best in increasing the available nutrients like Nitrogen, Phosphorus and Potassium in soil which was followed by Poultry manure @1000 kg/ha over control. Studies on effect of different doses of poultry manure on soil microbes revealed that application of Poultry manure @1500 kg/ha increased the population of total fungi and bacteria in soil which was 5.36% and 5.32% over control respectively. Poultry manure at increased rates was inversely proportional to the phytonematodes population in soil and directly proportional to plant growth, yield, available nutrients and microbes in soil. Keywords: Poultry manure, Management, Phytonematodes, Nutrients, Microbes, Soil.

Abstract of M.Sc. thesis

Department: Nematology

Major Adviser: Dr. B.N.Choudhury

Management of *Meloidogyne incognita* in tomato through grafting

Nikita Das

An attempt was made for the management of Meloidogyne incognita in tomato through grafting. Twelve Solanum species were screened against the M. incognita. Of these, S. torvum and S. lycopersicum cv. Hisar Lalit showed resistant reactions against M. incognita whereas S. viarum showed susceptible reaction against M. incognita and the remaining species showed highly susceptible reactions against M. incognita. S. torvum and S. lycopersicum cv. Hisar Lalit were taken as rootstocks for grafting while the tomato cultivars Arka Samrat and Dona-55 were taken as scions. The susceptible and cultivated hybrids, Arka Samrat and Dona-55 were grafted onto resistant rootstocks S. torvum and S. lycopersicum cv. Hisar Lalit. Cleft grafting method was adopted for grafting. The highest success rate of grafting was recorded on Arka Samrat grafted onto S. torvum followed by Dona-55 grafted onto S. torvum. Arka Samrat and Dona-55 grafted onto S. torvum showed maximum reduction in number of galls, egg masses per root system, final nematode population and rate of reproduction with increased number of fruits per plant, fruit weight and total fruit yield per ha followed by Arka Samrat and Dona-55 grafted onto S. lycopersicum cv. Hisar Lalit. Delayed flowering and fruiting were observed in grafted plants as compared to non-grafted plants. This delayed flowering in grafted plants was found to be of advantage as it led to increased yield.

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Department: Nematology

Major Adviser: Dr. Bhabesh Bhagawati

Pathogenicity and management of reniform nematode (*Rotylenchulus reniformis* Linford & Oliveira, 1940) on Tomato (*Solanum lycopersicum*)

Prerana Bhuyan

A survey of plant-parasitic nematode, Rotylenchulus reniformis Linford & Oliveira, 1940 was carried out at the Experimental field of Department of Horticulture, AAU, Jorhat during Rabi and Kharif season, 2022-2023. Analysis of 200 soil and root samples collected from the root rhizosphere of different vegetable, fruit and ornamental crops showed the presence of Rotylenchulus reniformis with 54.2% Frequency of occurrence with 123 mean population density/ 250 cc of soil in vegetable crops, 40.0% Frequency of occurrence with 86 mean population density 250 cc of soil in fruit crops, and 35.0% Frequency of occurrence with 59 mean population density 250 cc of soil in ornamental crops. Pathogenicity of reniform nematode, R.reniformis, was investigated on tomato var. Pusa Ruby by inoculating 10, 100, 500, 1000, 5000 and 10000 nematodes per kg autoclaved soil in root zone of 10 days-old plants. Observations on growth parameters of plants and nematode numbers were recorded at 60 days following inoculation. There was a progressive decrease in the plant growth parameters as the inoculum level of R. reniformis increased. Significant reduction in growth parameters were recorded at 1000 and above nematodes/kg soil. There was a gradual increase in the number of females, egg masses per root system, and nematode population of R. reniformis as the inoculum level increased. The rate of multiplication decreased with increase in the level of inoculation. The threshold level of R. reniformis was found to be 1000 nematodes per kg soil. Investigations were carried out to evaluate the efficacy of two chemical viz., Fluensulfone and Fluopyrum for the management of R. reniformis on tomato (var. Pusa Ruby) under net house condition. All the treatments with chemicals differed significantly from the untreated control. The maximum plant growth parameters in tomato var. Pusa Ruby were recorded in the treatment with Nimitz® (Fluensulfone) @2.5kg/ha followed by, treatment with Carbofuran CG @3.0 kg a.i./ha, treatment with Velum Prime (Fluopyrum) @1000 ml/ha, and treatment with Nimitz® (Fluensulfone) @2.00 kg/ha, treatment with Velum Prime (Fluopyrum) @750 ml/ha. The chemicals suppressed nematode reproduction as indicated by the lower nematode population and

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Department: Nematology

Major Adviser: Dr. Gitanjali Devi

lower numbers of eggs found on the roots of tomato as compared to control. The minimum populations of R. reniformis were recorded with the treatment Nimitz® (Fluensulfone) @2.5kg/ha followed by treatment with Carbofuran CG @3.0 kg a.i./ha, treatment with Velum Prime (Fluopyrum) @1000 ml/ha, treatment with Nimitz® (Fluensulfone) @2.00 kg/ha , treatment with Velum Prime (Fluopyrum) @750 ml/ha.

Gene Expression Analysis of Mitochondrial DNA polymerase in Rice (*Oryza Sativa*)

Anindita Rajkhowa

Rice (*Oryza sativa* L.) is both a major crop species and the key model grass for molecular and physiological research. Adverse climatic conditions such as drought, flood, etc. are one of the major constraints in increasing rice production which has dire consequences for world food security. Plant responds to environmental signals by finetuning of cellular energy metabolism. The genetic control of cellular bioenergetics is split between the nuclear genome and organellar genome and co-regulation of these two genomes are necessary for cellular survival. Rice carries mitochondrial genome of size 491 kb encoding fifty-five protein-coding genes, 6 ribosomal RNA genes, and 26 transfer RNA genes. Mitochondrial DNA is present in multiple copies and inherited maternally in rice. Unlike the nuclear genome, mitochondrial DNA is more prone to oxidative damage because of its proximity to ROS. In many species, mitochondrial DNA copy numbers were observed to either increase or decrease in response to environmental assault. Most of the mitochondrial proteins including the enzyme necessary for mitochondrial DNA replication are encoded by nuclear DNA. It is not well understood how mitochondrial DNA replication and maintenance is regulated in various cells and tissues at different stages of plant development. Environmental stress will also influence these processes. In this study, it was hypothesized that rice organellar DNA polymerase Os08g0175300/Os08g0175600 (Pol IA/ PolIB) will respond to drought stress by changing its expression for quantity and qualitative maintenance of the mitochondrial genome. In the first objective, the hypothesis was tested by looking at the expression of Os08g0175300gene in a high-yielding rice variety Ranjit and an indigenous Bao variety under drought and control conditions. Drought was imposed by withdrawing water from 20 days old seedlings. No significantgene expression change was observed in Ranjit and Bao under drought vs. control conditions measured by semiquantitative RT-PCR. In the second objective, the bioinformatic analysis of Os08g0175300 shows the conserved sequence and domain structure with other plant organellar DNA polymerase and bacterial DNA polymerase. Additional studies in this line will give further clues of plant response to environmental signals for use in future breeding programs.

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Genetic Characterization and Diversity Analysis in brinjal (*Solanum melongena* L.) germplasm

Anuradha Tiwari

Present investigation was executed to study the variability, heritability, genetic advance, genetic diversity, correlation and direct as well as indirect effects of interrelated characters among 30 brinjal genotypes at the Experimental Farm, Department of Horticulture, Assam Agricultural University during 2022-2023. Assessment of genetic variation and related parameters gives an insight to the nature and extent of variation existing in a collection and indicates the possibility of genetic improvement of the crop. Studies on trait relationship emphasises the relative importance of certain traits for improving a population with respect to a complex trait such as fruit yield. Genetic diversity analysis followed by clustering of germplasm gives an idea on choosing genetically dissimilar parents for future hybridization programme. Analysis of variance revealed highly significant genotype mean square for all the characters. High values of GCV were observed for fruit weight, fruit yield per plant, fruit length, fruit girth, fruits per plant, plant height and internode length which indicated sufficient genetic variation among the genotypes. High heritability coupled with high expected genetic advance (%) was observed for plant height, primary branches per plant, days to first flowering, days to 50% flowering, days to first fruit, days to 50% fruiting, fruits per plant, fruit weight, fruit length, fruit girth, internode length, first flowering node number and fruit yield per plant suggesting that these characters were controlled largely by genes showing additive gene action. Based on Mahalanobis D2 statistic, 30 genotypes under study were grouped into 12 clusters. Cluster I and cluster II were the largest clusters comprising of 5 genotypes. Maximum intra-cluster distance was observed in cluster IX. High degree of intra-cluster divergence would produce more segregating material following hybridization of the genotypes of a cluster. Based on inter-cluster distance, maximum distance was observed between cluster II and cluster XI. This will help the breeders to choose the diverse parents for hybridization programme leading to recombination of non-allelic genes. Among the 15 characters, fruit yield per plant, fruit weight and fruits per plant showed maximum contribution towards diversity. These characters can, thus be used for selecting diverse

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parents for hybridization to exploit heterosis or to execute efficient selection in segregating generation. Correlation coefficient revealed that fruit yield per plant had highly significant positive correlation with fruit weight, fruit girth, fruits per plant and primary branches per plant at genotypic level. Hence, genetic improvement of fruit yield can be obtained by direct selection of these independent component traits. Genotypic path coefficient analysis revealed that characters namely fruit girth, days to 50% fruiting, days to first flowering, fruit length, fruits per plant, plant height and leaf chlorophyll content showed positive direct effects on fruit yield. Thus, direct selection of these characters may be effective for fruit yield improvement.

Genetic variability and association analysis for morpho-physiological traits in Niger [*Guizotia abyssinica* (L.f.) Cass.]

Arnab Rajkumar

Niger (*Guizotia abyssinica* (L.f.) Cass) is an important minor oil seed crop in India. In India it occupied an area of about 2.61 lakh hectare with a production of 0.84 MT and productivity of 3.21 q/ha. In Indian it is grown in 10 states with larger area in Chhattisgarh with an area of 0.63 lakh hectare and with, production of 0.11 MT followed by MP, Maharashtra and Odisha. Niger crop is a highly cross pollinated, diploid species (2n=2x=30) belonging to the family Asteraceae. In minimum output & cultural practices, a high net income may be earned with this crop. Due to lesser popularity, the crop remains underutilized among the masses and there is a huge scope for development of new and existing varieties leading to greater income generation for the farmers. The present investigation was undertaken to evaluate 25 genotypes of Niger during the rabi season of 2022-23 under CRBD with 3 replications at the PG Experimental field, B.N. College of Agriculture, Biswanath Chariali. The objectives of the investigation were to study the genetic variability, character association through correlation and path analysis and to assess the genetic diversity in the accessions for fourteen morpho- physiological traits. The analysis of variance (ANOVA) revealed genetic variation in the experimental material. Moderate to high values of PCV and GCV were recorded for the characters viz., Harvest index, Total Chlorophyll content and seed yield and hence, improvement through selection for these traits could be possible. Moderate to high heritability was observed for all the characters. High to moderate genetic advance as per cent mean was observed for all the characters except for plant height, heads per plant and Chlorophyll stability index. Thus, these traits are most likely to be controlled by additive gene action which is very useful in selection. Correlation studies revealed that the characters viz., 50 per cent flowering, days to maturity, head per plant, seeds per plant, 1000 seed weight, Harvest index, chlorophyll stability index at both phenotypic and genotypic levels. Based on per se performance the genotypes viz., Lakhimpur Local 1 had promising mean performance for seed yield.

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Jorhat Local 1 showed promising results for Plant height, no. of internodes, Branches per plant, biological yield. JNC 1 performed better for traits seeds per plant, 1000 seed weight and harvest index. Barpeta Local 1 took less time for flowering and maturity. Based on these traits, Thus, an efficient hybridization programme may be formulated which could pave the way for obtaining basic genetic materials for realizing desired genetic improvement in Niger.

Evaluation of M2 generation in Yellow sarson (*Brassica rapa* L.) var. yellow sarson

Asim Kumar Panda

Yellow sarson (*Brassica rapa* L) var. yellow sarson is an early maturing ecotype of rapeseed belonging to the genus Brassica of the family Brassicaceae, cultivated during the Rabi season in Assam. Rapeseed-mustard stands as the second-most significant edible oilseed after soybean, accounting for 27.8% of the country's oilseed economy. In comparison to Indian mustard, yellow sarson and toria receive less attention of the breeders and less progress has been made in varietal development. Domestication and cultivation under limited area in India, probably had led to genetic erosion for existing genetic variability. Mutation breeding has the advantage to be potent and effective tool to generate a novel induced genetic variability for several qualitative and quantitative traits in rapeseed. In the year 2021-22, two yellow sarson varieties (B9 or Benoy and JYS14-2) were treated with 400 Gy, 600 Gy and 800 Gy of gamma-ray doses (60 Co source) at BARC, Trombay, Mumbai. Single plants were harvested individually in M1 generation. In the present investigation seeds of M1 generation were sown in individual plant progeny rows along with parent row (control) in ICR experimental farm, AAU, Jorhat in Rabi 2022-23 for evaluation of induced genetic variability for morpho-agronomic traits and character inter-relationship in M2 generation. Total of 539 progeny rows of different doses of yellow sarson varieties were compared with their respective control lines. A total of 198 putative mutants were identified from the two irradiated population of B-9 and JYS14-2 varieties. Significant variation between the gamma-ray doses were observed in most of the characters studied, this revealed effectiveness of gamma-rays for induction of quantitative variation in yellow sarson. The shift in mean value revealed the better performance of the 800 Gy dose in most of the traits in both varieties. High heritability coupled with high genetic advance was estimated in seeds per siliqua and maximum root length in JYS14-2 variety. Both Pearson's correlation and Path analysis revealed that biological yield showed a strong positive correlation with seed yield per plant in both the varieties. Path analysis revealed biological yield had a highest positive direct effect on seed yield per

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plant followed by harvest index in both the varieties. The agronomically suited putative mutants should be evaluated in the upcoming generation for validation. After confirmation of the putative mutants, they should be characterized by morphological and molecular markers. The promising mutants should be included in breeding programmes for development of high yielding yellow sarson varieties.

Morphological and molecular characterization for anaerobic germination tolerance in rice

Atreya Saikia

Rice (Oryza sativa L.) is an imperative source of sustenance for more than half of the global population, especially in Asia. Rice's importance to the world lies in its role as a staple food, provider of nutrition, economic driver, cultural symbol, and facilitator of global trade. India is consistently among the top rice-producing countries globally and holds immense significance in India's agricultural sector. Assam, the largest state in northeast India, provides excellent meteorological and physiographic characteristics for rice production, and the crop is cultivated in various agroecological conditions. Based on the variances in physiographic features and climatic conditions it has three major growing seasons: Ahu (Feb /March - June /July), Sali (June /July - Nov /December), and Boro (Nov /December -May /June). There are mainly two methods of cultivation of rice: Conventional puddled transplanting rice and Direct Seeded Rice (DSR). For DSR anaerobic germination (AG) is a very important trait for consistent seedling establishment in the field. Bao and landraces of Assam which are a subclass of Sali rice are mainly cultivated in the floodaffected regions because of their ability to withstand submergence. Although this class of rice can escape flood, through internode elongation but their ability to tolerate hypoxic condition was not evaluated. Contemplating the significance, a total of 222 genotypes along with checks are evaluated for anaerobic germination tolerance in three occurred environments under the Department of Plant Breeding and Genetics along with Assam Rice Research Institute, AAU. For AG screening all the genotypes were placed in a Randomized Block Design with two replication using crates/trays under submergence conditions for 21 days. Anaerobically germinated genotypes were subjected to an analysis of variance and common genotypes were subjected to a pooled analysis of variance which showed significant variance for the traits viz., Germination percentage, shoot length, root length, coleoptile length, fresh weight, dry weight, and seedling vigor index among the genotypes and a significant genotype-environment interaction was also observed. Screening under three different occurred environments revealed 10 genotypes showing a mean germination percentage over 70 %. Among the tested genotypes in the three

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environments, Rongadah Kokuwa and Saru raj recorded the highest mean germination percentage of 85 %. The genetic variability parameters (Genetic coefficient of variability, Phenotypic coefficient of variability, heritability broad sense, Genetic advance percent of mean) for the anaerobically germinated genotypes were evaluated for the traits. High to moderate GCV, PCV, high heritability, and high genetic advance was seen for all the traits from the pooled data for the three environments. A total of 29 genotypes showing good anaerobic germination tolerance and seedling establishment and other four genotypes viz., Ranjit, a susceptible variety, Khao and Nanhi, the resistant checks and IR18L1173 a line, were characterized using 14 SSR markers which were linked with the five QTLs associated with anaerobic germination tolerance. Out of the 14 markers, 8 markers showed polymorphic bands which can be further used for breeding programs or germplasm management. A total of 12 reproducible polymorphic alleles were amplified with an average of 1.64 alleles per locus. The polymorphic information content ranged from 0.30 to 0.85 with an average of 0.64. Based on the marker data dissimilarity-based dendrogram was constructed using the logarithm of the 'Unweighted Pair Group Method with Arithmetic Average' (UPGMA) method which formed a total of major 13 clades/9 clusters. Cluster A consisting of four genotypes showed the highest germination percentage of 71 %. For the genotypes showing anaerobic germination capacity, the probable presence of at least one QTL among the five QTLs was indicated by the similar band amplification with KHO by the polymorphic markers RM 24161, RM 23877, RM 1125, RM 520, RM 21868, and RM 105.

An investigation into the diversity in cultivated groups of rice varieties of Assam for grain and endosperm qualities

Atur Kro

A study was conducted with a view to elucidate the pattern of genetic variation, diversity and character association for 15 quantitative yield and quality traits in a set of 70 rice cultivars belonging to different cultivated varietal groups of Assam. The investigation was carried out during the 2022 Kharif season at Biswanath College of Agriculture, Biswanath Chariali, Assam. Analysis of variance indicated significant variation for all the traits studied. GCV was observed highest for endosperm chalkiness followed by alkali digestion, grain yield per plant, and volume expansion on cooking. All the traits exhibited high heritability (>80%). High heritability coupled with considerably higher magnitude of genetic advance was observed for endosperm chalkiness, alkali digestion, grain yield and volume expansion on cooking. These traits also exhibited higher magnitude of GCV and appeared to be the candidate traits for obtaining high genetic gain on selection. The genotypes were grouped into five diverse clusters based on D2 -analysis and Tocher's method of clustering. The maximum number of genotypes were present in Cluster I followed by Cluster II and Cluster IV while cluster V was mono-genotypic having only Bokul Bora in it. Maximal inter-cluster distance was observed between cluster IV and V followed by between clusters III and VI. Highest contribution to divergence was exhibited by grain length (31.72 %), closely followed by 100-grain weight (25.55 %), and kernel length: breadth ratio (19.88 %). Implication of the per se performance and the inter se genetic diversity was discussed. Haccha (cluster I) was identified as the earliest genotype. Notably, cluster I was home to genotypes like Bahadur, Black rice, Mala, BINA 11, Nunu Bora and Mala, which exhibited highest grain yield per plant. Chaoren Phou (cluster III) displayed the highest per se value for grain length, kernel length, and kernel length to breadth ratio. Ranikajol Joha in cluster III exhibited the highest grain length: breadth ratio. Bokul Bora in cluster V, exhibited the highest 100-grain weight. Hybridization between these genotypes complementing the desired traits along with belonging to diverse clusters

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would yield desirable segregants. Character association studies indicated that Grain yield was significantly and positively correlated with elongation on cooking and volume expansion on cooking. In the present study, positive and significant association of 100–grain weight was observed with grain length, grain breadth, kernel length, and alkali digestion value, indicating that positive relationship of bolder grains with higher grain weight. Bolder grains thus, appeared to have higher AD values or lower GT. Days to maturity displayed significant negative correlations with grain length and kernel breadth. Notably, grain length exhibited negative and significant association with kernel elongation ratio. Similarly, grain length-to-breadth ratio exhibited a significant negative correlation with kernel breadth and volume expansion upon cooking. Path analysis indicated that grain breadth, grain length: breadth ratio, kernel breath, kernel length and breadth ratio, elongation on cooking, kernel elongation ratio, volume expansion on cooking and alkali digestion exhibited positive direct influences on grain yield. On the other hand, days to 50 per cent flowering, days to maturity, 100- grain weight, grain length, kernel length and endosperm chalkiness exhibited negative direct effect on grain yield per plant. The implications of direct and indirect effect of the component traits were discussed in the presentation.

Evaluation of Some Promising M6 Mutant Lines of Indian Mustard [*Brassica juncea* (L) Czern. & Coss.] cv. NRCHB-101 for Seed Yield and Related Trait

Bhaskar Gogoi

Rapeseed and mustard, two well-known oilseed brassica crops, are prominent source of edible oil worldwide. Indian mustard is the predominant oilseed brassica grown in India with high yield potential. In Assam, this crop is not yet popular mainly because of its longer duration compared to the predominant oilseed crop rapeseed toria. Therefore, an attempt had been made to develop early maturing mustard varieties by induced mutagenesis in a popular variety NRCHB–101. In this study, seventeen M6 mutant lines and the parent variety were evaluated for mean performance, genetic variability and character interrelationships. Analysis of variance revealed highly significant genotypic variation for all the observed characters. High coefficients of genotypic and phenotypic variation were found for seed yield per plant and seed yield per hectare. High heritability and high genetic advance were found for seed yield per plant, yield per hectare, number of secondary branches per plant, plant height, foot length and 1000 seed weight, indicating that these characters were probably controlled largely by genes having additive gene action. Correlation analysis at genotypic level revealed that the characters plant height, number of secondary branches per plant and number of siliquae on main shoot had significant positive correlations with seed yield per plant. Path analysis showed positive direct effects of number of siliquae on main shoot, days to maturity, plant height, number of seeds per siliqua, days to 50% flowering and number of primary branches per plant on seed yield per plant. For these yield contributing traits heritability was high for days to 50% flowering, days to maturity and plant height and moderate for number of siliquae on main shoot and number of seeds per siliqua. Therefore, due attention should be given to these characters in selection for high seed yield. All the mutant lines matured in less than 105 days compared to 109 days of the parent variety. The mutant lines L-64, L-95, L-85, L-09, L01 and L-107 were

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promising early maturing and high yielding genotypes, which could be exploited to develop desired varieties of Indian mustard.

Morpho-Agronomic Traits Variability in Gamma Irradiated M2 Populations of Joha Rice (*Oryza sativa* L.)

Debasmita Nath

Joha rice (Oryza sativa L.) is the most important indigenous scented rice of Assam. It is known for its unique aroma, better cooking quality, and excellent taste. However, they suffer from various negative traits. Owing to its significance, there is an urgent need to improve the cultivars by eliminating the negative traits through induction of polygenic variation. The present study was carried out with the five Joha rice cultivars viz., Kunkuni Joha, Manimuni Joha, Kon Joha 2, Joha (Golaghat), Joha (Bihpuria) of Assam to evaluate in M2 generation during Sali 2022. The seeds were exposed to two different doses of gamma rays (250 and 300 Gy) at BARC (Bhabha Atomic Research Centre), Trombay. The irradiated seeds (2000 seeds/dose) were sown along with the controls to raise the M1 generation during Sali 2021. The panicles of the main culms of all the survived plants were harvested individually for evaluation in M1 plant progenies (M2) with intermittent rows of the parent cultivars during Sali 2022. Total 1268 M1 progeny lines of different doses of Joha rice cultivars were compared with their respective control lines. A total of twenty-eight putative mutants with different characteristics were identified in four Joha rice cultivars. High frequency of short statured putative mutants was identified in the present study. Analysis of variance revealed significant difference between gamma-ray doses for most of the characters under study in five Joha rice cultivars, suggesting the effectiveness of the gamma-ray doses in inducing polygenic variation. The mean squares of control vs doses were significant for six characters: culm height, productive tillers, filled grains, spikelet fertility, biological yield and grain yield in Joha (Bihpuria), seven characters: culm height, panicle weight, filled grains, spikelet fertility, 100-grain weight, harvest index and grain yield in Manimuni Joha, eight characters: days to maturity, culm height, productive tillers, panicle weight, 100-grain weight, biological yield, harvest index and grain yield in Joha (Golaghat), eight characters: days to 50% flowering, culm height, panicle length, panicle weight, filled grains, spikelet fertility, biological yield and

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harvest index in Kon Joha 2 and eight characters: culm height, productive tillers, panicle length, panicle weight, filled grains, 100-grain weight, biological yield and harvest index in Kunkuni Joha, suggesting that the irradiated populations were significantly different from the control populations. Positive shift in mean values were observed for few morpho-agronomic traits in different cultivars. High heritability coupled with high genetic advance (%) was observed for spikelet fertility in Kon Joha 2, suggesting that it was governed by genes with additive gene action. Pearson's correlation analysis revealed that spikelet fertility and 100-grain weight showed negative correlation with grain yield in parent populations, whereas these traits showed weak to moderate positive correlation with grain yield in putative mutants and irradiated populations. In the parent population, biological yield/plant showed weak positive correlation with grain yield per plant whereas it was moderate in irradiated populations. Thus, the gamma irradiation is effective in eliminating the negative traits of Joha rice. The investigation further emphasized the significance of mutation induction in producing useful agronomic changes in Joha rice.

Morphological Characterization of Few Genotypes of Soybean [*Glycine max* (L.) Merrill] Under Assam Condition

Debolina Sinha

Soybean [*Glycine max* (L.) Merrill] is a major oil seed crop in the world with versatile nutritional qualities having 20 percent oil content and 38 to 45 percent protein content, and is also rich in amino acids like lysine and tryptophan. The crop presently concentrated in the country's Central zone has a high potential to be extended to the extreme parts of the country by identifying potential varieties and improving existing ones. Morphological characterization of genotypes helps create a database on the grounds of which these can be distinguished and the genetic diversity existing among them can be assessed. In the current study, 40 genotypes of soybean were evaluated in a randomized block design with 3 replications in ICR experimental farm, AAU, Jorhat, Assam. The present investigation incorporated morphological characterization of 40 soybean genotypes along with the assessment of the genetic variability parameters, causal relationship between yield and its components and the pattern of genetic diversity among the soybean genotypes. The Soybean genotypes were characterized for various morphological characters based on the DUS test given by PPV&FRA. Analysis of variance for yield and its components showed the presence of significant differences among all the genotypes for all the 11 quantitative characters under study. In order to assess the extent of variability of seed yield and yield attributing characters among the 40 soybean genotypes, various genetic variability parameters like the genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in a broad sense (h2 bs) and genetic advance as per cent of mean (GAM) were calculated. The associations of yield and its components were analysed by correlation coefficient analysis and further subjected to path coefficient analysis to estimate the direct and indirect effects of each character on seed yield per plant. The seed yield per plant was positively and significantly correlated with 100 seed weight, number of pods per plant, oil content, number of primary branches per plant, harvest index and number of seeds per pod, while it was negatively correlated with plant height, protein content, days to

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50% flowering and days to maturity. Using Mahalanobis D2 statistics and Principal Component analysis, the pattern of genetic diversity among 40 genotypes of soybean was evaluated based on 11 quantitative characters. All 40 genotypes were grouped into four clusters using Tocher's clustering pattern. It was observed that the most contrasting clusters were Cluster II and Cluster IV with a maximum inter-cluster distance between them of 2572.391. The maximum contribution to the genetic divergence was made by 100 seed weight, followed by seed yield per plant and protein content. These characters can, thus be used for selecting diverse parents for hybridization to exploit heterosis or to execute efficient selection in segregating generations. The principal component analysis showed that PC1 and PC2 had Eigen values higher than unity and explained 74.931% of the total variability among the soybean genotypes. This study outlined the potential for further in-depth research to improve soybean genotypes in terms of its major qualitative and quantitative traits.

Characterization and genotype environment interaction in okra

Dixita Rajkhowa

Okra [*Abelmoschus esculentus* (L.) Moench] is an annual vegetable crop belonging to the family Malvaceae. In the present investigation, 14 okra genotypes were evaluated under three different environments at the Experimental Farm, Department of Horticulture, Assam Agricultural University during 2022 to study the variability, heritability, genetic advance, the correlation and causal relationship and the direct and indirect effect of interrelated characters. Stability analysis was also conducted to study the genotype-environment interaction under different fertility conditions. Pooled analysis of variance revealed significant GE interaction and variation among the genotypes for all the characters studied confirming the existence of genetic diversity among the genotypes and indicating that the genotypes under study behaved differently for almost all the characters under diverse environments. Based on the mean performance of yield contributing traits the genotypes Kashi Lalima, IC-27831, JOC3, IC-0620645, JOS-21 were found to be the best performing genotypes and thus can be used in future breeding programmes. High heritability coupled with high GA was obtained for plant height, number of flowers per plant, number of fruits per plant and fruit length suggesting that additive gene action might play a predominant role in the inheritance of these characters and thus, ensuring higher responsiveness to selection. From the correlation studies, it was observed that number of flowers per plant, number of fruits per plant and fruit diameter were positively correlated with yield per plant. So, selection of these independent traits would result in improvement of the overall yield of okra. From genotypic path coefficient analysis, the highest positive direct effect was found in days to 50% flowering which was followed by number of fruits per plant, fruit diameter and days to first harvest. Thus, direct selection of these characters may be effective for fruit yield improvement. From the Stability analysis, the genotype IC0620645 was found to have average stability for yield per plant along with the character number of nodes. Hence, this genotype was most suitable for stable yield performance under a wide range of environments. Other high yielding genotypes Kashi Lalima, IC27831, JOS- 3, JOS-21 were also found to be average stable for characters

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such as number of flowers per plant, number of fruits per plant, fruit diameter, days to 50% fruiting, days to 50% flowering and number of nodes. Environment 3 (N:P:K 60:60:60 kg/ha) was found as the favourable environment for most of the characters. These genotypes which showed stability for yield can be further tested in different seasons and under different agroclimatic regions of the state to be recommended for various breeding programmes.

Evaluation of bao rice (*Oryza Sativa* L.) varieties of Assam for fodder and grain yield

Himashree Devi

Rice (*Oryza sativa*) is an important crop for global food security and staple food for over half of the world's population, mainly in Asia. India holds second position all over the world in terms of rice production. Rice is cultivated in various agro-ecological situations. Deep water rice (bao) are sown in flooded areas where the water depth is maintained above 50 cm.Rice grown in deep water has unique adaptive mechanisms. They have the ability to grow longer with rising level of water. They are also able to survive under heavy flooded condition and give better yield. However, due to increase in plant height the crop become vulnerable to lodging. Leaf cutting during the vegetative stage can provide additional benefit of fodder along with grain yield.Thus, dual-purpose varieties could be beneficial to the resource-poor farmers by providing grain for human consumption and fodder as a livestock feed. Contemplating the significance, a total of 15 genotypes of bao rice were evaluated in a randomized block design at ICR Farm, Assam Agricultural University, Jorhat-13 during kharif season, 2022. In the present study three cuttings were provided and variability parameters, heritability and genetic advance were estimated. Analysis of variance revealed that there is significance variation among all the genotypes for the characters under study. Pooled analysis of variance revealed significant genotype × cutting interaction for the traitsplant height, green forage yield and crude protein content. High GCV and PCV were recorded in grain yield. While moderate GCV and PCV were recorded for the charactersgreen forage yield, dry matter yield, tillers per plant, panicle length, flag leaf length and flag leaf area. Green forage yield, dry matter yield, tillers per plant, panicle length, flag leaf length, flag area, crude protein content and grain yield disclosed high heritability coupled with high genetic advance indicating that this characters were govern by additive genes. Correlation studies reveled that plant height, tillers per plant, panicle per plant, panicle length, grains per plant, flag leaf length, flag leaf area, dry matter yield and grain yield were positively correlated with both green forage yield and grain yield.The character flag leaf length followed by dry matter yield and plant height showed maximum direct effect on green forage yield per plant. While the characters flag

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leaf area, days to 50% flowering, grains per panicle and panicle length revealed maximum direct effect on grain yield. Based on the mean performance, the genotypes Panikekua, Buruli, Kola, Tulsi, Kekua and Pagrow are found to be promising for dual purpose thus further research in multiple locations would be necessary for improvement of these dual purpose high yielding genotypes.

Morphological and molecular characterization of a few genotypes of Yellow sarson (*Brassica rapa* L.)

Jahnavi Bhagat

Plant variety characterization is important for germplasm documentation and registration, use in plant breeding, plant variety protection and variety release procedure. Yellow sarson, a self-pollinated type of rapeseed (*Brassica rapa* L.) is an important oilseed crop mainly grown in the eastern region of India for use as an oilseed and as a condiment. This study was carried out to characterize five genotypes of yellow sarson including three varieties (B9, YSH401, Pitambari) and two breeding lines (AAUJYS14-2 and AAUJYS15-2) by morphological and molecular markers by an experiment in randomized block design with four replications at Assam Agricultural University, Jorhat during Rabi 2022-23. For morphological characterization DUS Test Guidelines for Rapeseed (Brassica rapa L.) was followed. Fourteen of the 24 morphological descriptors showed genotypic differences. There was highly significant variation among the genotypes for all the quantitative characters except for petal width. B9 had short plants, medium seed size and medium oil content; YSH401 had long and broad leaves, AAUJYS14-2 had long siliquae with medium long beaks, AAUJYS15-2 had medium leaf length and breadth, and Pitambari had low oil content, late flowering time, and maturity. However, number of leaf lobes, dentation of leaf margin, petal colour, siliqua texture, seed colour, petal length, petal width, siliqua length and number of siliquae on main shoot turned out to be monomorphic for these genotypes. On the basis of Mahalanobis' D2 analysis the five genotypes were grouped individually into five equidistant solitary clusters. Thus the genotypes were distinct from one another when all the quantitative traits were considered together. Molecular analysis was carried out by 20 random simple sequence repeats (SSR) primers, of which 12 primers showed polymorphism. The PIC value ranged from 0.2 to 0.96 with an average of 0.47. Broadly two clusters were formed on the basis of Jaccard's coefficient of similarity. Cluster A was divided into two sub-clusters, AI (YSH401, AAUJYS15-2) and AII (B9). Cluster B included Pitambari and AAUJYS14-2. Thus the use of molecular markers in conjunction with morphological descriptors could be useful for describing the genotypes distinctly.

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Genetic variability and diversity analysis for morpho- physiological attributes associated with grain yield in finger millet *Eleusine coracana* (L.) Gaert

Ketan Anand

Finger millet [Eleusine coracana (L.) Gaertn.] (2n = 36) is one of the important small millets which is grown for human food, forage, and hay in India. In Assam, small millets including finger millet are cultivated in a limited area mostly by the tribal people of hill districts. Considering the enormous gap between its potential yield and realized yields, there is ample scope for enhancement of its productivity through breeding efforts. The present investigation was undertaken to evaluate 39 genotypes of finger millet during the Kharif season of 2022 under CRBD with 3 replications at the experimental field of Plant Breeding and Genetics, B.N. College of Agriculture, Biswanath Chariali. The objectives of the investigation were to study the genetic variability, character association, and genetic diversity in the accessions for thirteen morpho-physiological traits. The analysis of variance revealed ample genetic variation in the germplasm. Moderate to high values of PCV and GCV were recorded for all the characters except days to 50 per cent flowering, days to maturity, relative water content in leaves, and chlorophyll stability index. High heritability coupled with moderate to high genetic advance as per cent mean was observed for all the traits except chlorophyll stability index and relative water content. Correlation and path analysis revealed that the characters viz., 1000 grain weight, biological yield per plant, and total chlorophyll content had a positive direct association effect along with a significant positive correlation with grain yield. Based on per se performance the genotypes viz., CFMV 2(i), CFMV 1(i), VL 391, and VL 408 were identified as promising with respect to grain yield per plant along with several other yield attributing traits. Based on the relative magnitude of D2 , the genotypes were grouped into five distinct non-overlapping clusters. The maximum intra-cluster distance was observed within cluster I (32.29) while clusters V and III exhibited the highest inter-cluster distance. Amongst all the characters, days to maturity had the highest contribution towards divergence. Based on

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the per se performance and inter-cluster distances for different traits genotypes viz., PR 202 (i), VL 408, CFMV1 (i), VL 391, OEB 610, WN 566 and KOPN 1055 of Cluster I and TNEc 1335 of Cluster V are expected to produce desirable segregants for grain yield, earliness and other important yield attributing traits following hybridization. Similarly, IIMR FM-7028 of clusterIII and TNEc1335 of cluster V could also be selected for crossing programmes for earliness and desirable grain yield. Thus, an efficient hybridization programme may be formulated which could pave the way for obtaining basic genetic materials for realizing desired genetic improvement in finger millet.

Selection Index and Marker Polymorphism Analysis in Black gram [*Vigna mungo* (L.) Hepper]

Manisha Pani

Black gram (Vigna mungo L. Hepper) is an important diploid (2n = 2X = 22), short duration, self-pollinated grain legume, known for its high nutritional quality and suitability to any cropping system. India currently represents the largest producer and consumer of black gram in the world, accounting for more than 70% of the global production. Variability and diversity analysis in unexplored germplasm is needed for developing improved varieties in black gram. In the study, 50 genotypes of black gram along with 2 check varieties were evaluated in a randomized block design with 2 replications in ICR experimental farm, AAU, Jorhat, Assam during Kharif 2022, to study the pattern of genetic variation along with the creation of selection indices for component characters of seed yield and studying SSR polymorphism pattern. Analysis of variance showed highly significant differences for all the 13 quantitative characters studied among the genotypes. High heritability coupled with high genetic advance as percent of mean was exhibited by plant height, primary branches per plant, number of clusters per plant, number of pods per plant, biological yield per plant and seed yield per plant. Seed yield per plant showed significant positive correlations with biological yield per plant, harvest index, pods per plant, 100 seed weight, plant height, clusters per plant and primary branches per plant. Path analysis revealed that biological yield per plant had the highest positive and direct effect on seed yield per plant followed by harvest index. The selection index based on the thirteen characters combination gave the highest expected genetic gain and relative efficiency overstraight selection for only seed yield per plant. The genetic score revealed that IC-472006 ranked first followed by IC-519914, IC-530449, IC-519933 and IC-530646.Out of 21 SSR markers,12 markers were polymorphic with an average PIC value of 0.478. A dendrogram based on Jaccard's coefficient of similarity grouped the 50 genotypes into 2 main clusters A and B. Genotypes IC-530620 and IC-530485 were found to be most similar and genotypes IC-530458 and IC-530503 were most diverse based on similarity coefficient. Further in-depth investigation for the superior genotypes identified in the study should be done.

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Genetic variability analysis in F3 population derived through intraspecific hybridization in oilseed Brassica

Masuma Farhana Ullah

Brassica juncea is an allotetraploid with the genomes AA and BB from Brassica rapa and Brassica nigra, respectively. It belongs to the Brassicaceae/Cruciferae family. It is world's third most important source of edible oil after soybean and oil palm. Indian mustard has the genetic potential for higher yield and is the predominant oilseed Brassica in India. But due to its longer crop duration, the harvesting time coincides with the pre-monsoon showers resulting in crop loss. Therefore, the development of short-duration high-yielding Indian mustard varieties that can be incorporated into the rice-based cropping sequence of Assam will play a crucial, role in increasing the average yield of rapeseed-mustard in Assam. The genetic diversity found in the available germplasm of a particular crop is wholly responsible for the success of any breeding strategy. The current study revealed significant variation for all the 17 yield attributing characters. All the characters under study have demonstrated high broad sense heritability. Plant height, number of primary branches, number of secondary branches, number of seeds per siliqua, 1000 seed weight, number of siliqua on main shoot, seed yield per plant, seed yield per hectare, biological yield per plant, harvest index, lesion size, number of lesions on infected leaves number of infected leaves per plant and number of infected plants per plot demonstrated high heritability coupled with high genetic advance. Correlation coefficients and path coefficients together provide more reliable information that may be used to effectively create crop improvement strategies. Results of the correlation studies demonstrated that seed yield per hectare had a strong positive correlation with days to maturity, biological yield per plant, and seed yield per plant. Path analysis of the current study revealed that the character, and number of infected plants per plot followed by seed yield per plant had the maximum direct effect on seed yield per hectare. Alternaria blight caused by Alternaria brassicae (Berk) Sacc. is one of the important diseases of rapeseed-mustard affecting the quality and quantity of seed. In the 25 populations that were assessed for disease incidence in field, five

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genotypes, PM-22, PHR-2 X PM-21, PM-21 X PM-22, PM-21 X Pusa Karishma and PM-27 were shown to have a moderate level of disease resistance. The Artificial inoculation of test genotypes is necessary to produce a more uniform disease occurrence for precise screening. Out of the 10 genotypes that were assessed for disease incidence through artificial inoculation the genotype PM22, exhibited moderate resistance. Molecular markers are effective, precise, and reliable than other types of markers for genetic study of plants in distinguishing closely related species and cultivars. In the current study, 15 SSR markers were evaluated, and 12 of them were shown to be polymorphic. Therefore, the experimental findings revealed that the analysis of variance components will assist in the selection of the parents to develop better recombinants for use in future breeding projects to develop early maturing mustard genotypes that are appropriate for Assam's agroclimatic condition and have a maximum impact on traits that affect yield. The genotypes that exhibited resistance to Alternaria blight can be used for additional in-depth investigation regarding the host-resistance mechanism to develop resistant mustard varieties to Alternaria blight.

Study of genetic diversity of few drought tolerant rice varieties using morphological and molecular marker

Mridusmita Kalita

Rice (*Oryza sativa* L.) is one of the most important cereal crops. Increasing rice production is constrained by various stress and drought is one of the major limiting factors. For future food security assessments of genetic resources are necessary. North east India is the home of many indigenous rice varieties that are traditionally cultivated and maintained by farmers. Indigenous varieties contain a high level of genetic diversity and can serve as potential genetic resources for improving yield, and resistance to various biotic and abiotic stress conditions. The genetic architecture of diverse germplasm can be precisely estimated by assessing the structure of the population using molecular markers. Simple sequence repeat (SSR) markers are highly informative, codominant and reproducible. The first objective of this study was to assess the genetic diversity of a few indigenous rice germplasm using SSR markers. Out of the total of 28 SSR markers screened, 16 were polymorphic across twenty-seven genotypes with PIC values ranging from 0.076 to 0.499. The genetic diversity of rice germplasm under study was estimated by the Jaccard similarity coefficient. The phylogenetic tree, using unweighted neighbor-joining (UPGMA) drawn from the analysis divides 27 genotypes into 3 clusters. In the second objective, 9 genotypes were further characterized by exposure to drought stress compared to the control condition. Plants were grown in PVC pipes and subjected to drought by withdrawing water at 45 days after showing (DAS) for 25 days. After that plants were uprooted and a comparative study was done for a few morphophysiological parameters i.e. root length, root biomass, root-shoot ratio, root length density, chlorophyll content etc. It was observed that genotype Dehangi followed by N22 and Shahabhagi showed the best performance for all parameters under drought stress. This information will help in the selection of varieties with better root characteristics for drought tolerance in future breeding programs.

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Evaluation of some rice varieties under normal sown and delayed transplanting situation in sali with low level of fertilizer input

Olympica Das

Rainfed lowland rice cultivation holds significant importance, but it faces various challenges due to its heterogeneous ecosystem and unpredictable rainfall patterns, especially for farmers in flood-affected regions. Severe floods can lead to complete damage of seedlings in the main fields. However, some seedlings may survive in the seedbeds, offering an opportunity for farmers to replant their fields once the floodwaters recede, using overaged seedlings (60-70 days old). Therefore, the present investigation was carried out during the Sali season (July) of 2022 at the ICR Farm, Assam Agricultural University, Jorhat. The study followed a 3-replicated Randomized Block Design (RBD). The main objective of the trial was to assess the performance of various genotypes under normal sowing and delayed transplanting situations with 70day old seedlings. Considerable variation was observed among the grain yield and its associated component traits. The analysis of mean sum of squares for 18 quantitative characters indicated significant differences attributed to various sources of variation, particularly for grain yield and its component traits. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were found high for chaffs per panicle, grains per panicle, number of panicles per hill, grain yield per hill (g/hill), spikelets per panicle, grain yield (kg/ha), straw yield (kg/ha) and biological yield (kg/ha). The present study evaluated traits such as chaffs per panicle, grains per panicle, spikelets per panicle, biological yield (kg/ha), straw yield (kg/ha), grain yield (kg/ha), grain yield per hill (g), and number of panicles per hill to exhibit high heritability, genotypic coefficients of variation, and genetic advance as a percentage of the mean. These findings suggest that selecting these traits could effectively lead to improvements under normal sown and delayed transplanting conditions with 70days old seedlings. Among the genotypes evaluated in this study, Gandhari stood out as the top yielder, showcasing a remarkable yield of 4201.5 kg/ha. This exceptional performance can be attributed to its significantly higher values for

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grains per panicle (172), spikelet fertility (89%), grain yield (18.7 g/hill), straw weight (6420.8 kg/ha), biological yield (10622.4 kg/ha) compared to Gitesh, grains per panicle (161.4), spikelet fertility (76.9%), grain yield (12.3 g/hill), straw yield (4691.7 kg/ha) and biological yield (7383.8 kg/ha) respectively. Furthermore, Gandhari showed moderate performance for the remaining evaluated characters. The analysis revealed a significant positive correlation of grain yield (kg/ha) with grain yield per hill (g/hill), biological yield (kg/ha), and straw yield (kg/ha) at both the genotypic and phenotypic levels. Other noteworthy genotypes, such as JR-16(3752.2 kg/ha) and JR-21(3670 kg/ha), also had higher yields compared to the check variety Gitesh (2691.6 kg/ha) and exhibited commendable performance in other traits. These genotypes showed promise for recommendation under normal sown and delayed transplanting situations, provided the investigation is extended for another 2-3 years followed by on-farm trials. Additionally, they could serve as potential parental material in hybridization programs aimed at developing suitable rice varieties for normal sowing and delayed transplanting situations specifically targeting flood-affected farmers of Assam in Sali season.

Evaluation and diversity analysis of chilli genotypes (*Capsicum* spp.)

Palki Priya Khargharia

In the present investigation, 31 genotypes of chilli were evaluated in a Randomized Block Design at Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat-13 during Rabi, 2022-23. The investigation was oriented to assess the genetic variability parameters, character association, cause-effect relationships and clustering of genotypes based on the existing variation. Analysis of variance revealed presence of significant variation among all the genotypes for the concerned traits under study. Based on mean performance, the genotypes Chilli Sel-1, Krishna Selection, Kashi Abha, Mem chilli, Kharika Selection, Local Collection-5 and 2021/CHIVAR-4 were found to be superior. GCV and PCV were high for the characters total chlorophyll content, ascorbic acid content, fruit length, fruit diameter, pericarp thickness and average fruit weight indicating high variation among the genotypes. Total chlorophyll content, ascorbic acid content, fruit length, fruit diameter, pericarp thickness, plant height and average fruit weight disclosed high heritability coupled with high genetic advance which implies role of additive gene action. Correlation studies revealed that fruit yield per plant was significantly and positively correlated with relative leaf water content, fruit length and average fruit weight. Genotypic path analysis showed that days to first red ripe fruit harvest followed by relative water content and average fruit weight exhibited positive direct effect on yield. Pertaining to this, selection for these characters should be functional for improvement in yield. Mahalanobis D2 statistics divided the thirty one genotypes into eight clusters among which cluster I had maximum numbers of genotypes i.e. 10. The maximum intra-cluster distance was recorded in cluster VI signifying wide range of variation among the genotypes of that cluster.. The superior genotypes Local collection-5 and Kashi Abha were included in cluster II and Cluster V respectively which had highest inter-cluster distance. Hence hybridization of genotype Local collection-5 with Kashi Abha can result in improved varieties with high heterosis. This study has revealed scope for further detailed research works to improve the chilli genotypes with regards to the major characters.

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Morpho-Physiological Evaluation and DNA Fingerprinting of Drought QTL Introgressed Rice Genotypes

Pragyan Adhikari

Rice (*Oryza sativa* L.) holds a significant position as one of the world's most crucial cereal crops, serving as a staple food for a vast majority of the global population. In India, it plays a vital role, contributing around 45 percent to the total cereal production and serving as the primary food source for over 60 percent of the population. Developing countries, particularly in Asia, Africa, and Latin America, contribute more than 90% to the world's total rice production. However, around 40% of the world's rice is produced under rainfed environment, making it vulnerable to the adverse effects of low rainfall. Drought stands out as a major abiotic stress factor that leads to reduced yields. Rice faces even greater challenges due to its semi-aquatic nature and high-water requirement. Keeping the significance of drought stress in mind, an effort to introgress drought QTLs into some of the popular rice varieties of Assam was made at AAU – Assam Rice Research Institute, Titabar. In the present study, morpho-physiological evaluation of 17 drought QTL introgressed lines along with 4 checks (IR64 drought, Sahbhagi Dhan, Luit and Lachit) was carried out in a field experiment laid out in Randomised Block Design with three replications under irrigated and drought stress conditions. 10 traits; 7 morphological viz., leaf rolling, days to 50% flowering, ear bearing tillers, panicle length, spikelets per panicle, spikelet fertility and grain yield per plant and 3 physiological traits viz., chlorophyll content, relative leaf water content, excised leaf water loss were studied. Significant variation was observed among the genotypes for all the 10 traits evaluated under drought stress conditions, while under irrigated conditions, significant variation was observed for all traits except relative leaf water content and spikelet fertility. Highest GCV and PCV values were observed for spikelets per panicle (19.46 and 20.12 respectively) under irrigated conditions and leaf rolling (70.30 and 74.17 respectively) under drought stress conditions. High heritability coupled with high genetic advance as percentage of mean were exhibited by 3 traits, viz., chlorophyll content, ear bearing tillers and spikelets per panicle under both

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irrigated and drought stress conditions, while leaf rolling and grain yield per plant displayed high heritability coupled with high genetic advance as percentage of mean under drought stress conditions. Genotyping was done using the linked SSR markers to confirm the presence of the QTLs and the study revealed that 4 lines out of the 17 lines evaluated contained all three introgressed QTLs (qDTY 1.1, qDTY 2.2 and qDTY 4.1). DNA fingerprinting was also carried out for the lines under study using 50 SSR panel markers selected from Gramene, out of which 11 were found to be polymorphic. The PIC content of the markers varied from 0.0023 (RM152) to 0.7460 (RM154). A dendrogram constructed from the dissimilarity index grouped the population into 3 clusters. Based on the evaluation, the four bestperforming lines Luit x IR64 Drought (4.13-1), Kolong x IR64 Drought (4.4-2), Kolong x IR64 Drought (12.1-4) and Kopilee x IR64 Drought (2.1-2) were identified which may be sent for multilocation trials and subsequently be released and notified. These lines hold promise in assisting farmers to better manage and mitigate the impact of drought stress.

Diversity study of Greengram [*Vigna radiata* (L.) Wilczek] with morphological and SSR markers

Santosh Sonowa

Greengram [Vigna radiata (L.) Wilczek] belongs to the family 'Fabaceae' and subfamily 'papilionaceae' is an important grain legume crop in the world. It is the third important pulse crop after chickpea and pigeon pea in India. Although, India is the leading producer of green gram globally but its production and productivity levels are very low to meet the nutrient status of people due to many reasons including lack of superior varieties or hybrids. Evaluation and characterization for genetic variability and identification of diverse genotypes is the first and foremost step in any crop improvement programme. Genetic parameters like GV, PV, GCV, PCV, hbs and GA were estimated in 30 genotypes of greengram collected from NBPGR. A high extent of variability was found for quantitative characters like plant height, number of cluster per plant, pods per plant, seeds per pod & harvest index. Estimates of GCV & PCV were high for characters viz., seed yield per plant, pods per cluster, pods per plant and harvest index. High heritability coupled with high genetic advance as per cent of mean was observed for characters viz., harvest index, yield per plant, pods per plant, cluster per plant, pod per cluster, seed per pod, 100 seed weight, number of primary branches and plant height indicating the role of additive gene action and highlighting the importance of those traits as efficient selection criteria. High extent of variability was found also for qualitative traits like terminal leaf shape, seed colour, seed shape etc. among the genotypes studied. Diversity study using quantitative characters depicted 6 clusters out of which 3 are solitary. Among all the characters studied, 100 seed weight exhibited maximum contribution towards divergence. Cluster II and cluster VI exhibited maximum inter-cluster distance. Hence, it can be suggested that hybridization among the genotypes of these two clusters might give better heterotic combination. Again on the basis of qualitative traits studied, genotypes were grouped into 3 main clusters and 4 solitary clusters applying Jaccard's similarity coefficient. Accordingly, maximum divergence was observed between the genotype IC-148403 and IC-282094 suggesting their utility in crossing to get better segregant. Out of 30 genotypes, 15 were subjected to SSR (already reported) based polymorphism analysis. Out of the total 22 SSR

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screened, 10 were polymorphic across fifteen genotypes. The maximum PIC was revealed by primer GMES4400, cp06039 and cp8304 (0.375 each) while minimum PIC among polymorphic markers was shown by primer DMBSSR038 (0.2772). The average value of PIC was found to 0.35744. Accordingly, the genetic diversity pattern of these 15 greengram germplasm under study was estimated by the Jaccard similarity coefficient. The dendrogram using unweighted neighbour-joining (UPGMA) drawn from the analysis divided 15 genotypes into 3 clusters. Maximum divergence was observed between the genotype IC-76544 and IC-39548 indicating the usefulness of these genotypes in hybridization programme. More number of polymorphic SSR primers will be required for further investigation to get a clear picture of diversity pattern at molecular level. Genotypes viz., IC-76544 and IC-121232 were grouped in the same cluster for quantitative, qualitative as well as SSR studies. Although the diversity at both morphological and genomic level was studied, there is need of further statistical analysis to measure the degree of relationship between the dissimilarity matrixes generated from qualitative, quantitative and SSR marker data.

A Comparative Study of Vegetable and Grain-type Soybean (*Glycine max* L. (Merrill.)

Vivechana Kurrey

Soybean (*Glycine max* (L.) Merrill) is one of the most important leguminous oilseed crops and known for its useful nutrients like protein (32-43%) oil content (14-16%), carbohydrate content (23-38 mg/g), and many other useful minerals including vitamin A, B and D and also rich in lysine. Global awareness of the use and benefits of vegetable soybean has been increased through the efforts of the Asian vegetable research and development center (AVRDC). The present investigation was carried out at ICR Farm, AAU Jorhat during 2022-23, using 28 genotypes consisting of both vegetable and grain-type. It was laid out in RBD with two replications. Analysis of variance for various traits revealed significant differences among all the genotypes for traits studied. GCV and PCV were high for primary branches per plant, total chlorophyll content and seed yield per plant indicating high variation among the genotypes. High broad sense heritability coupled with high genetic advance showed for primary branches per plant, total chlorophyll content, protein content, carbohydrate content and seed yield per plant implies predominant role of additive gene action. The Correlation study revealed that seed yield per plant had strong positive correlations with plant height, days to maturity and total chlorophyll content. Further, the Path coefficient analysis demonstrated that the character days to maturity, followed by plant height and pods per plant showed maximum direct effect on seed yield per plant. The result of field evaluation revelled that pod blight, anthracnose caused by Colletotrichum truncatum. Rhizoctonia aerial blight and hypocotyl rot caused by Rhizoctonia solani. Fusarium wilt and root rot caused by Fusarium oxysporum were found as major diseases that affected the soybean genotypes. A precise screening was done by utilising artificial inoculation technique in vegetable soybean genotypes, the result evident that no genotype was found immune or completely resistant. The only genotype AVSB 2009 among vegetable-type showed moderately resistant against all the diseases studied on the basis of field and artificial inoculation. Among all the genotypes PS 1670 (grain-type) is the highest yielder with moderate resistance against major disease on the basis of field screening. Key words: Vegetable soybean, Heritability, GCV, PCV, Correlation. Path analysis, Diseases.

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Influence of seed fortification on germination and early seedling vigour of chilli

Arkita Borkatoty

India is one of the largest producers of chilli peppers with production of 1.98 million tonnes and contributes 43% of total spice export quantity of the country. Chilli belongs to the capsicum genus and encompass various species like *Capsicum annuum, Capsicum chinense , Capsicum frutescens , Capsicum baccatum, Capsicum pubescens* .There are thousands of chilli varieties worldwide varying in their characters. The main barrier to chilli production is prolonged and uneven germination. There are several methods that can be used to address the poor germination of chillies, and one of them is priming. Seed priming is the technique of carefully hydrating seeds to a point where pregermination metabolic activity can continue but radicle emergence is prevented. An investigation was conducted in the laboratory of Seed Science and Technology Programme, Department of Plant Breeding and Genetics, Assam Agricultural University, Jorhat, Assam during the year 2022-2023.The pre-sowing seed treatments comprised of T1- untreated control,T2-hydropriming for 24 hours,T3-KNO3 priming @1% for 12hrs, T4- KNO3 priming @1% for 24hrs, T5-KNO3 priming @1.5% for 12hrs, T6-KNO3 priming @1.5% for 24hrs , T7-KNO3 priming @2% for 12hrs, T8-KNO3 priming @2% for 24hrs . All the priming treatments had significant effect on germination, and seed vigour characters .The seed germination parameters viz. germination percentage, days to germinate, germination index ,mean germination time, seedling length, seed vigour indexI, seed vigour index-II, seedling dry weight responded well in T3 in king chilli and capsicum variety Pongal-2and T5 in chilli variety Tez. .Seed cubes were prepared using a combination of soil, sand, saw-dust, coco-peat, vermicompost and cowdung (1:0.5:1:0.5:1:0.25) with 230-250ml of water per kg of medium and then shade dried for 36 hours. In the seed fortification procedure, primed seeds in the seed cubes were found best among all the other treatments for germination and seed vigour characters. It was observed that primed seeds in the cubes performed more efficiently in increasing the germination parameters than the unprimed seeds in the cubes.

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Major Adviser: Dr. Sharmila Dutta Deka

Effect of Solar Bubble dryer on seed quality of Paddy

Eunice Suoneiyang Serto

Paddy (*Oryza sativa* L.), is the staple food of over 3 billion people and is the most widely cultivated food crop. Although rice holds great importance as a crop, significant amount of rice ends up going to waste as a result of challenges in post-harvest management. Post-harvest loss reduction has the potential to increase the national food security. Drying and storage are two key post-harvest processes to improve yield in rice production. Storing of freshly harvested seeds without properly drying to safe level of moisture may affect the quality of seeds. Assam is identified for its poor storability and lack of proper storage facility makes it difficult for its storage up to the next season resulting in deterioration of seed quality parameters. In the present investigation, freshly harvested seeds of three varieties (Ranjit sub1, Numali and Mahsuri) were taken from the ICR farm of Assam Agricultural University, Jorhat. Dryer performance of Solar bubble dryer (SBD) was evaluated and compared with the sun drying method. Higher air and grain temperature were recorded in SBD as compared to the sun drying method. Grain temperature inside SBD did not exceed the critical limit 43°C which ensured quality and prevented damage of the paddy seeds. In the same duration of time, SBD showed advantage over sun drying in achieving faster reduction of moisture content (%) for all the three varieties. After drying, seeds were stored in different packaging materials viz., T1 (seeds dried in SBD + stored in HDPE bag), T2 (seeds dried in SBD + stored in poly-lined jute bag), T3 (seeds dried in SBD + stored in IRRI super bag) and T4-control (seeds sun dried + stored in PP bag). Seed quality parameters were recorded at 30 days interval for 6 months (180 DAS). Analysis of variance showed significant variation among treatments and storage periods for all the seed quality parameters. Irrespective of the varieties, T1 (seeds dried in SBD + stored in IRRI super bag) gave the best result with respect to all seed quality parameters after 180 DAS, i.e. seed germination (87.6%), seed viability (97.1%), seedling length (16.81 cm), SVI-I (1679.63) , seedling dry weight (131.31mg), SVI-II (11536.3), seed moisture content (11.49 %) and seed infestation (8.56 %). Lowest result was observed in seeds T4 - control (seeds sundried + stored in PP bag) with respect to seed germination

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(80.1%), seed viability (89.3%), seedling length (16.26 cm), SVI-I (1301.28), seedling dry weight (126.54 mg) and SVI-II (9371.9). However, in case of seed infestation, T2 (seeds dried in SBD + stored in poly-lined jute bag) was recorded the lowest with 17.67%. Therefore the findings revealed that seeds dried in SBD and stored in IRRI super bag can be an option for lesser seed deterioration of paddy seeds.

Efficacy of bioagents on storability of maize seeds (*Zea mays* L.)

Kishore Kumar Kurmi

Maize (*Zea mays* L.) is one of the most important cereal crops in the world, ranking third next to rice and wheat. Its production plays a significant role in ensuring food security and is used both for direct consumption as well as for second cycle produce in piggery and poultry farming. The estimated losses is as high as 59.48% in maize grains after storing them for 90 days in the traditional storage structures. Inadequate post-harvest pest management practices leads to huge amount of losses during storage and also limits it's storage life to a great extent. The present investigation helped to find out whether the bio control strategies are effective against stored grain pest and can improve the storage quality of seed w.r.t their physiological parameters. The pooled analysis of variance revealed highly significant variation for all quality parameters of maize seeds for treatments and period of storage up to 270 days while significant results were obtained for infestation w.r.t. time of storage up to 270 days. ANOVA for the biochemical characters after 270 days of storage showed significant results for the treatments studied. Highest mean performances were recorded in seeds treated with black pepper powder in plastic air tight container for germination percentage, viability, seed vigour index and alpha amylase activity, whereas highest lipid peroxidation value was recorded in seeds treated with pongamia oil in HDPE bag. Seed infestation was comparatively lower in seeds treated with neem oil in both the packaging material and lowest moisture content was recorded in seeds treated with black pepper powder. Therefore, the experimental findings revealed that storing seeds with black pepper powder in plastic air tight container produce superior results for quality traits of maize seeds and storing seeds with neem oil in plastic air tight container gives better protection to stored seeds against infestation and can be prescribed for large scale trials.

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Department: Seed Science and Technology (PBG)

Major Adviser: Dr. Akashi Sarma

Seed fortification with zinc and its effect on seed quality and nutritional quality of rice

Nisha Kumari

Rice (*Oryza sativa* L.) a member of family Poaceae is a cereal foodstuff which forms an important part of the diet of many people worldwide. It is a staple food for more than 60% of the worldwide population, making it the second-most consumed cereal grain. Rice cultivation in our country is done mostly in the humid tropical and subtropical climate which is characterized by high temperature and relative humidity; hence storage may lead to rapid deterioration of seeds. Usually crops seeds are stored from harvest till next growing season and storage duration may vary from months to a year or more. However, the vigour and viability of seeds rapidly decline during storage, and the use of low vigour seeds frequently results in poor field performance, weak seedling growth, and, ultimately, low yield. Assam Agriculture condition with high rainfall and high humidity is not ideal for medium and long-term seed storage. Sometimes it is challenging for seed growers to save the seeds with Indian Minimum Seed Standard for even one growing season. Invigoration of aged seeds after storage is important to enhance the seed quality. For the present investigation, seeds of rice variety Gitesh were taken having two lot, lot 1 (one year old seed) and lot-2 (freshly harvested seed). These two lots were primed for 12 hours with water, ZnSO4(100,200,400,800 mg/liter) and ZnO (100,200,400,800 mg/liter) followed by shade drying for 12 hours and it was evaluated to see the effect of seed treatment with zinc on seed quality and nutritional quality of rice. Seed primed treated with treatment T4 (100 mg/liter ZnSO4) was found to be the best treatment for increasing the germination and field parameters viz., germination first count, germination final count, germination index, root length shoot length seedling dry weight, SVI-I, fresh and dry weight of plant, panicle length, number of grains/panicle and yield/Plant. However, treatment T7 recorded highest (800 mg/litre, ZnSO4) field emergence % and chlorophyll content. Zinc is the most important and limiting micronutrient for rice growth and yield. Reports suggested that seed yield and nutritional attributes can be manipulated with seed treatment with zinc. In the present investigation treatment T9(200 mg/litre, ZnO) recorded highest zinc and total soluble protein content. Significant improvement in germination % was observed with

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zinc treatment in both the new and old seed lot. However, lot-1(i.e., old seed) where germination % was below IMSC, but increased to certification standard with Zn treatment. Seed yield/plant was found to have positively and highly significantly correlated with all the germination attributes.

Effect of priming on quality of true potato seed

Prasurjya Das

Potato is the world's most important tuber vegetable, with a vital yet often underappreciated role in the global food system. True potato seeds are small, round, and dark in color, and they are produced by the sexual reproduction of potatoes. A major constraint in potato production is the lack of good quality of seeds. Quality seed is one of the most important elements in successful potato cultivation. Unlike traditional potato propagation methods that use tubers, True potato seed (TPS) offers several advantages such as disease-free starting material, easier transportation, and increased genetic diversity. However, they have low acceptability due to low uniformity in heterogenous seedling populations and low vigour. Seed priming is a pre-sowing treatment that aims to improve seed performance and accelerate germination. TPS priming is a technique used to enhance the germination and early growth of true potato seeds. In the present study, the parameters Germination percentage(G%), seed vigour index(SVI), Germination index(GI), seedling dry weight(SDW), vigour at 30DAT(V@30DAT), plant height(PH), Number of tuber plant(NTPP), Tuber yield per plant(TYPP), Tuber dry matter(TDM) and Incidence of major diease(IOD) high significant variation at P=0.05 was observed among 10 treatments. Among the treatments the highest germination percentage, seed vigour index and germination index is shown in the seeds primed with gibberellic acid followed by melatonin and T. harzianum. Seeds primed with Melatonin recorded maximum vigour at 30DAT. Among the treatments highest number of tuber per plant, tuber yield per plant and tuber dry matter is shown by the seeds primed with poly ethylene glycol (PEG). Therefore the experimental findings revealed that priming with Gibberellic acid and polyethylene glycol enhances the seedling and tuber characters producing superior result relatively compared to other results and can be promoted for further large scale trials.

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Major Adviser: Dr. Bhaswati Sarmah

Characterization of Pre-harvest Sprouting Tolerant Lines of Wheat

Sumon Dutta

One of the first and most significant cereal crops to be produced worldwide is wheat (*Triticum aestivum* L). It is the primary cereal crop and the principal source of nourishment for millions of Indians, second only to rice. Wheat is traded more globally than all other crops combined. With a global production of 749 million tonnes in 2016, wheat surpassed maize as the second-most produced crop. The crop is grown on 30 million hectares of land overall in India, producing 93 million tonnes at a productivity of 2.98 tonnes per hectare. In Assam, wheat is sown in November and harvested in March or April, which frequently falls within the pre-monsoon rainy season and negatively affects seed production. Pre-harvest sprouting can significantly reduce the nutritional value and processing quality of seeds in addition to decreasing wheat production. Breeding for pre-harvest sprouting tolerancein wheat is under progress at the University and a few lines have been developed. Characterisation of these lines following DUS test guidelines for various morphological characters and confirmation of pre-harvest sprouting tolerance is required for recommendation of the lines for cultivation in pre-harvest sprouting prone areas with aberrant rainfall pattern. In the present study, evaluation of five pre-harvest sprouting tolerant lines (PHST 1-1, PHST-1-5, PHST-4-3, PHST-7-3, PHST-7-3-1) along with two check varieties (DBW-39 and HD-2967) for DUS characteristics as per Guidelines for the Conduct of Test for DUS (PlantVarietyJournalofIndia.Vol.1(1),2007) was carried out in a field experiment laid out in Randomised Block Design with three replications. The study also involved evaluation of the lines pre-harvest sprouting and incidence of diseases in field conditions. Significant variation was observed among the genotypes for characters such as plant growth habit, ear: time of emergence, flag leaf: waxiness of sheath, ear: waxiness, plant length, ear: length, awn: length, grain:colouration with phenol, 1000-seed weight and yield. The check varieties DBW-39 and HD-2967 and a pre-harvest sprouting tolerant line PHST 1-1 has shown in-ear sprouting. Among these three genotypes, the highest in-ear sprouting was observed in HD-2967. No major wheat

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diseases were observed during the study. However, all the genotypes were affected by Sooty mold/ Black head mold as the crop was kept in the field for prolong period to expose the crop to pre-monsoon shower for the purpose of observation of inear sprouting.

Evaluation of Zinc based compounds for antibacterial activity and disease suppression ability of citrus canker disease in Assam lemon (*Citrus limon*)

Ananya Purkayastha

Citrus is one of the major fruit crops in the world with a global production of 144 million tonnes. India is an important producer of citrus and ranks third in terms of area with 1028 thousand hectares with a production of 13404 thousand tonnes. However, a number of biotic and abiotic constraints has made its production challenging, among which citrus canker is a major threat. Citrus canker is caused by Xanthomonas citri pv. citri (Xcc) and is one of the biggest obstacles in cultivation of Assam lemon (Nayam et al., 2017). The symptoms comprise of round spots that later turn brown, corky and sunken in the center coupled with water-soaked margins surrounding the yellow chlorotic halos which affects the vitality of citrus trees and cause premature fruit drop reducing their marketability and impacting their export and domestic trade. Conventional bactericides and antibiotics commonly used against canker possess various disadvantages. Also widely used antibiotics like tetracycline and streptomycin, are recently banned from use in agriculture because of their risk of developing multi-drug resistant superbugs. Hence, there is an urgent need to explore novel and safe antibacterial agents to suppress canker disease in citrus. The present study aims to investigate the antibacterial efficacy of zinc and phenolic compounds against this bacterial pathogen due to their innate antimicrobial and physiological role in plants. For the study Xanthomonas citri pv. citri was isolated and identified based on cultural, morphological and molecular characterization as well as pathogenicity test in Assam lemon plants. Also, previously characterised and identified Ralstonia solanacearum was also used in the study to assay the antibacterial activity of the compounds. In vitro assay of four zincbased and two phenolic compounds were assayed at different concentration (100-1000ppm) to check their antibacterial efficacy against X. citri pv. citri and R. solanacearum through macro broth dilution and micro broth dilution assay to determine their minimum inhibitory concentration (MIC). Zinc oxide, thymol

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and zinc sulphate showed the best result among all the compounds with MIC of 200 ppm,100 ppm and 800 ppm, respectively. The three best performing compounds from the in vitro assay was selected to test their in vivo efficacy in 3 months old Assam lemon plants inoculated with X. citri pv. citri. Disease severity and its reduction was investigated for the three selected compounds and compared with the untreated control plants for 60 days. Zinc oxide showed the best efficacy among all the treatments with the most reduction in disease incidence (49.80%) followed by thymol (38.58%). Pathogen colonization was estimated 65 days post inoculation and highest pathogen load was found in untreated infected plants, followed by plants treated with zinc sulphate and least in thymol and zinc oxide. The phenol content was also recorded to be highest in plants treated with zinc oxide. Hence, zinc oxide and thymol could be a viable alternative for the management of bacterial canker disease in citrus.

Metabolic profiling of tomato defence against *Ralstonia solanacearum* and imparting resistance through rootstock grafting

Ankita Saha

Tomato (*Solanum lycopersicum* L.) is one of the most important horticultural crops of the world. Its production is severely affected by bacterial wilt disease caused by Ralstonia solanacearum. This pathogenic bacterium causes wilt disease in more than 200 plant species by invading the xylem vasculature and causing death. The pathogen R. solanacearum is a 'species complex' consisting of races, biovars, phylotypes, sequevars, and clones (Fegan and Prior, 2005). Asian strains cluster in the Phylotype I, American strains in Phylotype II (A and B), while African and Australian-Indonesian strains group under Phylotype III and Phylotype IV, respectively. In this study, a multiplex PCR for easyand rapid detection of the phylotypes was performed, which help in easy traceability of the geographical origin of the pathogen in case of any accidental entry between countries through trade of agricultural commodities. Multiplex PCR performed using four isolated strains of R. solanacearum from different districts of Assam has revealed all of them to be of Phylotype I. Moreover, one of the most eco-friendly approaches to control bacterial wilt disease is through host resistance. The tomato cultivar Hawaii 7996 (H7996) is well knownfor its stable resistance against the pathogen R. solanacearum (Grimault et al., 1995). In order to unravel the underlying defence mechanism, liquid chromatography mass spectrometry (LC-MS) combined with multivariate data analysis has been used to identify the metabolites that play a crucial role in the defence mechanism of tomato against bacterial wilt. A number of secondary metabolites with varying fold changes were identified in H7996 that have been found to play pivotal role in the plant defence system. The identified metabolites were under the broad categories of flavonoids, terpenoids, saponins, glycoalkaloids, organic acids, quinone derivatives etc. Moreover, this studyaimed at exploring grafting in tomato using the resistant rootstock H7996 and susceptible cultivar Marmande to check for the efficacy of grafted plants against bacterial wilt. Wilting assay following challenge inoculation of *R. solanacearum* showed a significantly lower progress of the disease in

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resistant rootstock H7996 and Marmande scion grafted plants in comparison to non-grafted Marmande plants. The colonization of R. solanacearum was also recorded in both grafted and non-grafted tomato plants which showed significant reduction of pathogen load in the scion of grafted plants in comparison with non-grafted stem, indicating grafting as a potential and sustainable tool against this dreadful disease.

Exploring tea endophytes for the eco-friendly management of bacterial wilt of tomato

Bandana Singha

Plants and microorganisms have co-evolved for millions of years. Endophytes are the microbial community that colonizes the internal plant tissues without causing any negative effect. These endophytes play a critical role in plant growth, development and their ability to resist several biotic and abiotic stresses. Their presence enhances the overall fitness of the plant. In the present investigation, endophytic diversity of tea tree was studied with an aim to isolate, identify and to test its effectiveness both in vitro and in vivo against Ralstonia solancearum causing bacterial wilt of tomato. 40 bacterial and 20 fungal endophytes were successfully isolated from tea leaves and stem samples collected from various locations in Assam. Two bacterial and two fungal endophytes were selected as promising biocontrol agent based on their antagonistic effect on R. solanacearum in dual culture assay. These endophytes were characterized and identified based on morpho-cultural and molecular characteristics and were identified as Bacillus amyloliquefaciens, Bacillus subtilis, Diaporthe phaseolorum and Cophinforma atrovirens. D. phaseolorum showed highest per cent inhibition i.e., 70.37% in dual culture with R. solanacearum. In in vivo condition plants treated with Bacillus amyloliquefaciens showed significantly lower disease incidence (8.33%) and highest yield (244.7g/plant). Plant growth promoting activities, yield attributing characters, extracellular enzymatic activities were also assayed. Defense related enzymes were also evaluated and all the treatments showed considerable increase in PAL, POD, PPO, total phenols and total flavanoid activities. The results from the present investigation indicates the importance of tea endophytic microflora in suppressing R. solanacearum and hence can be used as an alternative against hazardous chemical pesticides. Furthermore, the antimicrobial activity of these endophytic communities may serve as an invaluable source in the development of novel biopesticides for managing some of the major global phytopathogens.

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Major Adviser: Dr. Pradip Kumar Borah

Biocontrol potentials of *Bacillus* species against white mold of French bean

Chayanika Bora

French bean (*Phaseolus vulgaris*) is one of the most commonly cultivated and commercially important edible vegetable crops in the world. Soil borne fungal diseases are most common among vegetable crops and have major implications for crop yield and productivity. Among that, white mold is one of the most important constraints to French bean in major French bean producing areas of the world which causes serious and unpredictable yield loss as high as 100 per cent (Prudy et al., 1989). The present investigation was undertaken to study the biocontrol potentials of Bacillus species against white mold of French bean caused by Sclerotinia sclerotiorum (Lib.) de Bary. Ten Bacillus spp. were evaluated in vitro for their efficacy in inhibiting the mycelial growth of S. sclerotiorum by dual culture technique. Among them, B. amyloliquefaciens recorded the highest inhibition (64.17%) followed by B. valezensis (52.08%) and B. altitudinis (40.14%). The lowest inhibition (8.06%) was recorded in B. cereas. Based on the in vitro test, B. amyloliquefaciens was further evaluated in pot condition. The treatment comprising of seed, soil and foliar application of B. amyloliquefaciens was found most effective in reducing the white mold disease with highest reduction of disease incidence (85.71%) and severity (86.76%) over control. The maximum plant vigour was recorded in the combined seed, soil and foliar application of B. amyloliquefaciens, which was measured in terms of shoot and root length, and shoot and root weight. Highest yield (91.96g/plant) was recorded in the combined application followed by chemical treatment (Azoxystrobin, 0.1%) with the yield of 77.25 g/pot.

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Department: Plant Pathology

Major Adviser: Dr. Hiranya Kr. Deva Nath

Molecular Characterization of ChiVMV infecting King Chilli (*Capsicum chinense* Jacq.) and Production of ChiVMV CP gene specific dsRNA construct

Devayani Sarmah

King chilli, also known as the Ghost Pepper (*Capsicum chinense* Jacq.), stands out as one of the spiciest chili peppers globally, originating from Northeastern India, specifically Assam, Nagaland, and Manipur. Its extraordinary heat levels and potential applications across various industries have garnered significant interest. However, the king chilli plant's susceptibility to viral diseases, particularly Chilli Veinal Mottle virus (ChiVMV), poses a substantial risk of yield losses, making the detection and management of this virus essential. To investigate its prevalence, 55 king chilli leaf tissue samples were collected from three districts in Assam (Jorhat, Golaghat, Sivsagar) and subsequently subjected to RT-PCR using CP gene specific primers to identify ChiVMV. The results revealed a ChiVMV incidence of 41.81% across different survey sites. During the survey, characteristic symptoms of ChiVMV infection in king chilli, such as leaf mottling, mosaic, vein banding, enations, leaf puckering, and filiform leaves, were observed. The phylogenetic analysis was drawn between the isolated sequence of the study and other ChiVMV isolates around the world in which the ChiVMV isolate (OR291157) showed percent identity of 97.91% with ChiVMV isolated of Yunnan, China (OP575323.1). Managing ChiVMV in the field poses challenges, prompting us to explore alternative methods to tackle the disease. To address the issue, we utilized RNA interference as a control method, with the primary objective of developing a double-stranded RNA construct that confers ChiVMV resistance in king chilli by mimicking the viral RNA intermediate involved in replication, and thus initiating RNAi when externally applied. For this purpose, the CP gene of ChiVMV was initially cloned into the pTZ57R/T vector and transformed into DH5α E. coli cells. Afterward, it was further cloned into the L4440 vector and transformed into DH5α cells, with both clonings confirmed by restriction digestion. Following that, the ChiVMV coat protein gene-specific dsRNA was produced at a large scale using E. coli with T7 RNA

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polymerase. This dsRNA molecule holds great potential to enhance the effectiveness of ChiVMV plant protection programs for king chilli plants, benefiting both nurseries and fields.

Bioprospecting of wild edible mushroom flora of Assam for nutraceutical and pharmaceutical properties

Dipankar Haloi

Mushroom production represents one of the most commercially important steps towards diversification of agriculture based microbial technology for large-scale recycling of agro-wastes in an agricultural country like India. Wild edible mushrooms are a natural resource with a high nutritional value and appreciable content of vitamins B, C, and D as well as a higher content of trace minerals. Along with the immense nutritional supremacy they are also known to contain various bioactive components which are being continuously used as a raw material for developing functional foods by the pharmacists. In this study, an attempt was made to explore the wild mushroom diversity in few districts of Assam with predominant history of wild mushroom flora occurrence. With the help of random roving survey, a total of 63 no. of wild mushroom florae were collected from four (4) districts of Assam (Tinsukia, Dibrugarh, Jorhat and Karbi Anglong) with a predominant history of occurrence of wild mushroom flora. Morphological and anatomical characterization of the collected samples revealed that majority of the wild mushroom flora belonged to families of Auriculariaceae (75%), Schizophyllaceae (75%), Lyophyllaceae (50%), and Polyporaceae (50%). The six (6) species with the highest frequency of occurrence was subsequently validated through molecular analysis. Thereby, those wild mushroom samples were confirmed to be Auricularia delicata, Auricularia auricula-judae, Schizophyllum commune, Termitomyces heimii, Lentinus squarrosulus and Trametes elegans. Based on ethnomycological knowledge and literature, the selected wild mushroom florae were edible. Cultural characterisation of the selected wild edible mushroom florae showed mostly dense, white, or off-white colony colour and cottony growth except Schizophyllum commune which showed velvety growth. Proximate nutritional analysis of these mushrooms revealed varying levels of crude fibre, crude protein, crude fat, carbohydrates, total ash, vitamin-D and moisture contents. Crude fibre content was highest in Schizophyllum commune (31.23%) while Lentinus squarrosulus exhibited the highest crude protein content (10.32%). Termitomyces heimii portrayed the highest

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crude fat content (8.21%) and highest carbohydrate content was recorded in Auricularia delicata (66.14%). Trametes elegans showed the highest total ash content (14.36%) while highest moisture content was observed in Auricularia auricular (86%). Termitomyces heimii exhibited the highest Vitamin D content (1.7 µg/100g). Methanolic extracts of these selected wild mushroom florae were subjected to GC-MS analysis. This chromatographic technique became instrumental in identifying important volatile constituents (9,12-Octadecadienoyl chloride (z, z), nhexadecanoic acid, 9,12-hexadecadienoic acid, methyl ester, etc.) that belonged to varied chemical groups viz., Amino group, Phenolic group, Fatty acid group or Alcoholic groups. These compounds were found to possess numerous bioactive properties (antiviral, anticancer, and antimicrobial effects) as per literature and thus may be of huge utility in pharmaceutical industry. Overall, this study has enabled bioprospecting of available untapped diverse wild mushroom florae in few selected regions of Assam, their nutritional composition, and potential medicinal properties of their bioactive constituents.

Study on incidence and management of anthracnose disease of bottle gourd

Jyotishmoi Dey

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is one of the important cucurbitaceous vegetable crops which belong to the family Cucurbitaceae. It is a popular crop, cultivated almost in all the Indian states with a total production of 2.86 MT covering an area of 1.58 M ha. Assam recorded a total production of about 55.16 MT (NHB, 2021-22). It is nutritionally rich, having a cooling effect with diuretic and cardio-tonic properties, also useful in the prevention of constipation. Like other crops, bottle gourd is sensitive to various biotic (different types of pathogens like fungus, bacteria and viruses) and abiotic stresses that limit their production. Among commonly occurring diseases, the prevalent of anthracnose is common with the highest disease index in Assam. Anthracnose may cause about 90 per cent yield loss of marketable fruits. In the present investigation, survey on disease incidence and symptomatological study was carried out. Based on cultural, morphological (Scanning Electron Microscope, SEM) and molecular studies the causal pathogen was identified as Colletotrichum lagenarium. In vitro efficacy of different botanicals, biocontrol agents and chemicals against C. lagenarium was done. Among the three botanicals (viz., Polyalthia longifolia, Allium sativum and Azadirachta indica) (@10%) against C. lagenarium, using the Poisoned Food Technique revealed A. sativum was effective with the highest mycelial growth inhibition (100%). Similarly, among the three biocontrol agents viz., Trichoderma viride, T. harzianum and Pseudomonas fluorescens against C. lagenarium using dual culture technique, the combination of T. viride and P. fluorescens recorded highest(82.22%) mycelial growth inhibition. Efficacy of five fungicides viz., Propiconazole (0.1%), Thiophanate methyl (0.1%), Carbendazim (0.1%), Copper oxychloride (0.1%) and Mancozeb (0.25%), alone and in combination against C. lagenarium revealed that Thiophanate methyl (0.1%) could restrict the mycelial growth completely (100%). The best treatments obtained under in vitro condition were further evaluated under in vivo conditions in farmer's field. Under in vivo condition, Thiophanate methyl (0.1%) significantly recorded the lowest PDI (12.67%) with highest PDR (84.42%). The treatment combination [Biogreen-L (@5ml/l) + A. sativum (10%) +

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Thiophanate Methyl (0.1%)] was found to be second best with 17.33 and 78.68 per cent PDI and PDR respectively. Although the foliar application of fungicide was observed to be effective in reducing the disease, its application alone should preferably be avoided because chemical control measures are not only uneconomical but also potentially hazardous for ecological and environmental health.

Management of tomato leaf curl disease through intercropping and crop geometry

Kongkona Orah

Tomato yellow leaf curl virus (TYLCV) is the most destructive disease of tomato, and it can be found in tropical and subtropical regions causing severe economic losses. Tomato crop faces crop loss up to 20-90 per cent due to viral infections caused by more than 20 viruses all around the world. Tomato yellow leaf curl virus (TYLCV) synonymous to tomato leaf curl virus (ToLCV), a DNA virus from the genus Begomovirus and the family Geminiviridae, has been reported as one of the most severe viral diseases, may cause up to 100 per cent infection and 90 per cent yield loss. Considering the importance of the disease, an experiment was carried out to study the management of tomato leaf curl disease through intercropping and crop geometry in the experimental field of Department of Plant Pathology, B. N. College of Agriculture (BNCA), Assam Agricultural University (AAU) during 2022-23 with two objectives, viz., Symptomatology and incidence of ToLCV in relation to its vector population and management of ToLCV through crop geometry and inter-cropping. Symptoms of ToLCV observed were curling of leaves, stunted growth of the plant, leaf puckering and reduction of leaf size and yellowing of leaves. Severity of symptoms were moderate in treatment T0 (control) and mild in treatment T8 (wider spacing + marigold) and T1 (wide spacing), while T7 (wider spacing + garlic as intercrop) showed no symptoms. Whiteflies (Bemisias tabaci) were the primary vector observed in the experimental field. Vector incidence was high in treatment T0 (control) and low in T7 (wider spacing + garlic as intercrop), T8 (wider spacing + marigold as intercrop) and T1 (wide spacing). There were considerably low disease incidence throughout the cropping period in the treatments T7 (wider spacing + garlic as intercrop), T8 (wider spacing + marigold as intercrop) and T1 (wide spacing) than the other treatments. No disease incidence (0 per cent) throughout the cropping period was found in case of treatment T7 (wider spacing + garlic as intercrop) followed by 0 to 22.40 per cent in treatment T8 (wider spacing + marigold as intercrop). The per cent reduction of disease over control was highest (100 per cent) in treatment T7 (wider spacing + garlic as intercrop) followed by 75.18 per cent and 72.90 per cent in the treatments T8 (wider spacing + marigold as intercrop) and

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T1 (wide spacing), respectively, while the lowest (14.13 per cent) was observed in the treatment T2 (wider spacing). The whitefly population in all the treatments ranged from 0 to 10.53, having the highest (10.53) no. of whiteflies in the control plot (T0). The lowest whitefly population throughout the cropping period was found in case of treatment T7 (wider spacing + garlic as intercrop) followed by the treatment T8 (wider spacing + marigold as intercrop). The treatment T7 (wider spacing + garlic as intercrop) recorded the highest yield of 90.8 t/ha followed by 73.3t/ha and 64.5 t/ha in the treatments T1 (wide spacing) and T8 (wider spacing + marigold), respectively. The results of benefit: cost ratio revealed that the highest benefit: cost ratio of 4.61:1 was recorded in the treatment T7 (wider spacing + garlic as intercrop) followed by the treatment T1 (wide spacing) and T8 (wider spacing + marigold as intercrop) with benefit: cost ratio of 3.59:1 and 3.20:1, respectively.

Management of Post Harvest Diseases of Banana with Essential Oils

Prateeti Barua

Banana (*Musa* spp.) is a tropical and subtropical crop. Banana has originated in South East Asia. It belongs to the family Musaceae. Fruits are a good source of potassium (358 mg/100g), carbohydrate, and vitamin B. India is the world's largest producer of bananas. It accounts for 13% of the total area and 33% production of fruits. Upto 30-40% losses occur due to post harvest diseases. These post-harvest diseases are anthracnose, crown rot, and finger tip rot of banana. These post-harvest diseases are commonly managed by chemical fungicides whose long term application may result in resistance, residue, environmental and health hazards. Natural plant products (i.e., essential oils) as an eco- friendly alternative are gaining popularity and drawing the attention of researchers globally owing to their biodegradable, economical, and eco-friendly. In the present investigation in vitro and in vivo evaluation of essential oils against the major disease was carried out. Mature green fruits were collected from three markets in Biswanath Chariali and kept in lab condition for symptom development. Two major post-harvest diseases viz., anthracnose and crown rot were observed. The causal organism of anthracnose disease was confirmed to be Colletotrichum musae and causal organism of crown rot was confirmed to be Fusarium spp. and Verticillium spp. based on morphological, cultural, colony characteristics and by following standard reference books. Out of which anthracnose was found to be most damaging. Six essential oils viz., clove, cinnamon, neem, sesame, basil, and peppermint oils were evaluated against C. musae in vitro and in vivo at 0.1%, 0.5%, 1.0%, and 1.5%. Clove and cinnamon oil treated culture plates were found most efficient in inhibiting mycelial growth (100.00%). Followed by basil oil (86.00%) and peppermint oil (76.85%). The best concentration of respective essential oils was used for in vivo treatment. Lowest disease incidence (33.33%) and disease severity (29.98%) were recorded in clove oil treated fruits. After in vivo treatment, the clove and cinnamon oil treated fruit increased the shelf life of bananas by 3 days over control followed by basil (1.0%) and peppermint oil (1.0%) treated fruits with 2 days increment of shelf life over control. Physiological weight loss of fruits treated with cinnamon oil recorded the lowest (9.52%)

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physiological weight loss followed by clove oil (9.92%), respectively. The physicochemical qualities of bananas viz. colour, total soluble solids, titratable acids, peel: pulp ratio, dry matter, pulp: peel ratio, reducing sugar, and total sugar were greatly influenced by the application of essential oils. The fruits treated with clove and cinnamon oil retained better colour in comparison to the control which was closely followed by basil and peppermint oil treated fruits. The effect of essential oils on the results of TSS, TA, TA: TA ratio, and dry matter were found to be statistically nonsignificant. highest pulp: peel (2.57) ratio was observed in clove oil (0.1 %) treated fruits. The highest reducing sugar (8.03 %) and total sugar (8.34 %) were observed in cinnamon oil (0.1 %) treated fruits respectively. Essential oils can be used for managing post-harvest disease management in bananas. Further research can be developed to study the effects of essential oils on biotic phytopathogens and on improved delivery system of essential oils to manage post-harvest diseases.

Induced resistance against the viral disease complex of King Chilli using biotic and synthetic agents

Preetam Baruah

King Chilli is one of the important traditional spice crops with high export value, grown in North Eastern region of India. Studies revealed that viral diseases in this crop are widespread,with prevalence of viral infections as complex viral symptoms. The study on different biotic and synthetic agents for the management of viral complex in open cultivated King Chilli was carried out in experimental farm, Department of Horticulture, AAU. The treatment combinations were POP + Biopesticide (Biogreen) @ 50g/L + Biofertilizer (Azotobacter) @ 80g/L, POP + Jivamrit @ 5%, POP + Salicylic acid @ 0.5mM, POP + Vitex negundo (Posotiya plant) @ 5%, POP + King chilli fruit extract 1ppm, POP and untreated control. Treatments were applied following proper application methods and viral disease incidence was recorded at 0 th, 15th, 30th, 45th, 60th, 75th, 90th, 105th and 120th days after transplanting in the main field based on symptomatology and molecular detection of healthy plants. The mean value of disease percentage indicated that, expression of symptoms was heavier at 120th days after transplanting in all the treatments. The results of this investigation when subjected to descriptive statistical analysis viz. ANOVA, PCA-Biplot, AUDPC, Correlation indicated that most effective treatment was POP + Salicylic acid @ 0.5mM which caused significant reduction in percentage of viral infection (16.67%) followed by POP + Biopesticide (Biogreen) @ 50g/L + Biofertilizer (Azotobacter) @ 80g/L (19.44%). Although none of the treatments were completely effective in management of mixed virus infection, but all the treatments were effective in comparison to un-treated control. Amongst the growth parameters the maximum plant height at 120th days after transplanting was 94.08 cm recorded in treatment with POP + Salicylic acid @ 0.5mM and the highest yield of King Chilli was recorded to be 88.4 q/ha at 120th days after transplanting in the plot where POP + Salicylic acid @0.5mM was applied. Further, the virus infected leaf samples of King Chilli based on visual symptoms were collected from experimental plot, Dept of Horticulture, AAU. CMV, ChiVMV, TSWV and ChiLCV were successfully detected in the infected leaf samples of King Chilli by

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Reverse Transcription PCR (RT-PCR) and PCR using coat protein (CP) gene specific primers with a product length of 290 bp, 1026 bp, 302 bp and 218 bp respectively. The phylogenetic analysis was drawn between the isolated sequences in which viruses share common homology with other isolates of India as well as around the world.

Epidemiology and integrated management of cucumber mosaic virus disease of pumpkin

Shahin Shobnu

Pumpkin (*Cucurbita moschata* Duch.) belongs to the family Cucurbitaceae, is one of the important vegetable crops grown in India and abroad. Production of pumpkin is limited by a number of biotic and abiotic factors, among which cucumber mosaic virus disease caused by Cucumber Mosaic Virus (CMV) has become a major threat in its cultivation. Considering the importance of the disease, experiment was carried out to study the epidemiology and integrated management of cucumber mosaic virus disease of pumpkin in Assam in the experimental field of Department of Plant Pathology, BNCA, AAU during 2022-23 with 2 objectives, viz., (i) To study the effect of dates of sowing on incidence of cucumber mosaic virus disease of pumpkin and its aphid vector. (ii) Integrated Management of cucumber mosaic virus disease of pumpkin. In the six dates of sowing, highest (100%) disease incidence was observed in the crop sown on 18.10.22 (D4), 02.11.22 (D5) and 17.11.22 (D6) and lowest disease incidence (50.00) was recorded in the first date of sowing 3.09.22 (D1). Correlation studies revealed a positive significant relationbetween the disease incidence and aphid vector population in all the six dates of sowing and also with bright sunshine hour and diurnal variation on crop sown on 3.09.22 (D1) and 18.09.22 (D2). Disease incidence had significant negative correlation with maximum temperature, minimum temperature, day temperature and night temperature on the crop sown on 3.09.22(D1),18.09.22(D2),3.10.22(D3) and 18.10.22(D4). The aphid population had negative significant correlation with maximum temperature, day temperature and night temperature during the first four dates of sowing D1, D2, D3 and D4, whereas minimum temperature had a negative significant correlation with aphid population during the first three dates of sowing D1(3.09.22), D2(18.09.22) andD3(3.10.22). The disease incidence could be predicted up to 93-97 per cent accurately with aphid population only in different dates of sowing. Sowing time of pumpkin also affected the yield parameters of the crop. highest fruit yield was obtained in D2(18.09.22). Out of eighteen pumpkin cultivars evaluated against cucumber mosaic virus disease, six were moderately susceptible, eleven were susceptible and one cultivar was observed to be highly resistant against the disease. Among the eleven treatments

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evaluated for management of the disease, treatment T10 consisting of two rows of maize as barrier crop + seed treatment with HCl (2%, 10min) + foliar spray of Imidacloprid 17.8 SL @2.0ml/10L at 30 DAS + spray with bioagent (Beauveria bassiana) @ 1% at 45 DAS + spray with neem oil (3ml/l) at 60 DAS has resulted in least disease incidence (16.67%) and fruit yield of 83.89q/ha. Treatment T10 also resulted in highest benefit: cost ratio of 2.53.

Effect of Trichoderma spp. in response to application of nanoparticles for management of Rhizhoctonia disease of Black Gram

Suprakash Sau

An experiment was conducted to test the compatibility of nanoparticles with three different Trichoderma spp. namely Trichoderma viridae, Trichoderma harzianum, Trichoderma pseudokoningii at five different concentrations 200 ppm,400 ppm,600 ppm, 800 ppm and 1000 ppm. Results revealed that out of three Trichoderma spp, T.harzianum was found to be compatible with ZnO NPs @ 200ppm where we observed maximum mycelail growth inhibition of 10.25% . Web blight caused by Rhizoctonia sp. was isolated from infected black gram plant which was collected from Instructional Cum Research Farm , AAU, Jorhat. Cultural, morphological and molecular identification revealed that the isolated was found to be Rhizoctonia solani. In vitro efficacy of , T. harzianum compatible with ZnO NPs showed mycelia growth inhibition of 73.91%.However highest inhibition percentage of 88.47% was observed in chemical treatment hexzconazole @0.1% In vivo assessment was made to find out the effect of T. harzianum supplemented with ZnO NPs @ 200ppm on disease incidence, severity, plant growth parameters, yield and yield attributing characters. Disease incidence was found to be in the range of (76.37 to 90.25 per cent) and disease severity was observed in the range of 87.53 to 95.12 .Highest plant growth parameters was like shoot length (35.79 Cm), root length (20.90Cm), fresh shoot weight(44.78g), fresh root weight (1.78g) , dry weight of shoot (4.30g) and dry weight of root (0.66g) was observed when soil and foliar application of T. harzianum supplemented with ZnO NPs @ 200ppm was done as compared to control. Highest yield and yield attributing characters like number of branches per plant (15.67), number of pods per plant (25.77), pod length (7.18 cm), yield per plant (9.59q/ha) , and weight of 100 seed (4.38g) observed when soil and foliar application of T. harzianum supplemented with ZnO NPs @ 200ppm was done as compared to control. From present study, it can be concluded that the severity of web blight of black gram can significantly reduced along with increase in yield by the use of bioagent T. harzianum supplemented with ZnO NPs @ 200ppm by soil and foliar application @ 5gm/plant and 5ml/litr.

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Department: Plant Pathology

Major Adviser: Dr. Pranjal Kr. Kaman

Field evaluation of new generation fungicides against Late blight of Potato

Swapnil Borah

Potato (*Solanum tuberosum* L.) is the most commonly cultivated tuber crop and fourth most important food crop in the world, after wheat, rice and maize. Among the various factors limiting the yield of the crop, Late blight of potato caused by oomycetous fungus Phytophthora infestans (Mont.) de Bary, is of major concern all over the world causing yield loss to a range of 20-75 %. For more than a decade, management of late blight has become increasingly demanding because of its aggressive appearance and emergence of resistance in new strains of the pathogen against fungicide. In the present investigation, efforts have been made to evaluate the efficacy of kresoxim methyl, azoxystrobin, propamocarb and dimethomorph against late blight of potato under different spray schedule and to evaluate the phytotoxic effects of these new generation fungicides on potato crop, if any under different spray schedule. Results of the present investigation revealed that, all the spray schedule of fungicides were significantly effective in suppressing late blight over untreated control. Among the different treatment combinations, one prophylactic spray with chlorothalonil @ 0.25 % followed by two sprays of propamocarb @ 0.2 % and one spray of chlorothalonil @ 0.25 % in alternate application at 10 days interval proved to be the best treatment combination economically resulting in a yield of 14.73 t/ha. This treatment not only recorded the highest benefit-cost ratio of 2.74:1 but also provided significantly better control of foliar late blight (84.29 %) and tuber infection (0.59 %) in field condition. However, highest disease reduction (98.20 %) was achieved by application of one prophylactic spray with chlorothalonil @ 0.25 % followed by three sprays of dimethomorph @ 0.2 % and two sprays of chlorothalonil @ 0.25 % in alternate application at 10 days interval. This treatment also recorded the minimum disease incidence (29.33 %) and disease intensity (1.78 %) under field condition. The experiment on evaluating the phytotoxic effect of kresoxim methyl, azoxystrobin, propamocarb and dimethomorph at rates two or even three times higher than the normal recommended dose of the fungicide indicated that these four fungicides had not shown any phytotoxicity on potato crop in terms of necrosis, chlorosis and leaf epinasty.

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Department: Plant Pathology

Major Adviser: Dr. Mitul Kumar Saikia

Bacillus spp. as a potential bioagent against major postharvest pathogens of Khasi Mandarin, Citrus reticulata, Blanco

Trishna Taye

Khasi Mandarin Citrus reticulata Blanco, which belongs to the Rutaceae family holds a significant importance as a horticultural crop and it occupied second most important fruit crops after banana. The present study aims to the identification of major postharvest pathogens of Khasi Mandarin (Citrus reticulata, Blanco) and evaluation of promising Bacillus spp. against major postharvest pathogens and assessment of bioagent-induced qualitative changes in citrus fruits. The isolated pathogen was identified as Penicillium sp. and Aspergillus sp. based on their cultural and morphological characteristics. Four Bacillus spp. were screened with both the pathogen and results showed that all the biocontrol agents were significantly inhibit the mycelial growth of the pathogens. B. subtilis LB22 were showed highest per cent mycelial growth inhibition of Penicillium sp. and Aspergillus sp. with 74.60% and 86.20%, respectively. SEM (Scanning Electron Microscopy) analysis of B. subtilis and pathogens interaction shows disintegration in fungal morphology. GC-MS analysis of B. subtilis LB22 found the presence of nine different antimicrobial compounds such as 2, 4-di-tert-butylphenol, n-hexadecanoic acid, 1H-Indene, 1- hexadecyl-2, 3-dihydro, etc. B subtilis cell suspension and cell free culture filtrate could significantly control the disease occurrence in Khasi Mandarin fruits with a 100% biocontrol efficiency, as compared with control and B. subtilis cell suspension, cell free culture filtrate with co-inoculation of pathogens. Peel and pulp were observed under SEM micrograph where colonization of Bacillus subtilis cells can be seen in the treated peel when compared with the untreated sample. The microphotograph of the pulp shows there is no bacterial colonization both in treated and untreated samples. The fruits treated with B. subtilis cell suspension show TSS of 11.90ºB and Titratable acidity of 0.85% as compared to the control after 15 days of storage which was non-significant. An Organoleptic test was carried out for untreated and treated samples concerning colour, flavour, texture, taste and overall acceptability.

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Department: Plant Pathology

Major Adviser: Dr. Popy Bora

Green Synthesis of Zinc oxide nanoparticles against Bacterial wilt of Tomato caused by "*Ralstonia solanacearum*"

V Shiva Sai Swaroop

Ralstonia solanacearum, a major bacterial pathogen, is known to cause bacterial wilt disease in over 200 plant species (50 families) throughout the world, but is particularly devastating in the Solanaceae family. A recent survey was conducted by 458 bacterial pathologists worldwide to vote on the top ten most important pathogenic bacteria in terms of their scientific and economic importance and amongst them, R. solanacearum obtained second place in the list .The current methods of control include host crop rotation, biological soil disinfestations, and cultural practices. But these measures provide limited ability to prevent its spread .Nanotechnology is a research hot spot in modern science.this technology is capable of providing miscelaneous ways to exploit some beneficial properties of metal oxide nano particles like Anti bacterial property against pathogens and there ability to induce Nano particle Triggered systemic resistance (NTR) in plants against biotic stress by triggering the expression of defence genes in the plant cell .The aim of this work was to evaluate these two properties of nano particles. ZnO NPs were Synthesized from various Biological sources like Curcuma longa, Jatropa curcass, Pipper nigrum, Trichoderma viride, Trichoderma harzianum, Bacillus subtilis against Ralstonia solanacearum. Among which ZnO NPs from curcuma longa have shown best anti bacterial activity and the average size of curcuma longa ZnONPs was found to be 18 .5 nm and curcuma longa ZnONPs have shown 78% inhibition and 100 % inhibition at 90 and 120 ppm respectively in in vitro. Seed priming was done with both the concentrations to check the expression of PR1, PR5 and PAL genes.Final Analysis showed the Up regulated expression of all the genes under biotic stress. The Nano particle treated plants @ 90 ppm and 120 ppm have shown 22% and 30 % disease reduction respectively compared to control which showed 80% disease incidence when challenged with pathogen. These results indicate that ZnO NPs induces Systemic resistance in Tomato plants against wilt pathogen.

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Major Adviser: Dr. Pranjal Kr. Kaman

Exploration of some eco-friendly tools for the management of bacterial wilt of tomato

Vercity Bora

Tomato (*Solanum lycopersicum* L.) is one of the most important horticultural crops belonging to the family solanaceae. In tomato, bacterial wilt caused by Ralstonia solanacearum is one of the most dreadful diseases. This pathogenic bacterium causes wilt disease in more than 200 plant species by invading the xylem vasculature and causing death. Due to various environmental hazards caused by chemocentric management, we need to shift to eco-friendly cultivation. This present study is aimed at exploring some eco-friendly tools for the management of bacterial wilt of tomato. For the study, R. solanacearum was isolated and identified based on cultural, morphological, and molecular characterization as well as pathogenicity test in the susceptible tomato variety Pusa Ruby. In vitro efficacy of nine essential oils, four organic amendments and three organic formulations were tested against R. solanacearum by disc diffusion method to check the efficacy. Among the essential oils, the highest suppression of R. solanacearum was exhibited by T7 (thyme oil: 72.67%) in 0.14% concentrations followed by T2 (clove oil: 69.56%). T2 (oyster spent mushroom compost) had the highest percent inhibition of 64.67% at 35% concentration followed by T1 (karanj cake: 58.00%) in the case of organic amendments. Among the organic formulations, highest per cent inhibition was shown by T1 (panchagavya: 58.22%) followed by T2 (jivamrit: 50.22%) at 10% concentration. In in vivo pot culture assay, highest per cent bacterial wilt reduction was recorded in T3 (thyme oil: 13.33%) followed by T1 (clove oil: 20.00%). Whereas among the organic amendments and organic formulations, highest per cent bacterial wilt reduction was recorded in T2 (oyster spent mushroom compost: 22.22%); T3 (Karanj cake: 22.22%). Among the essential oils, highest yield was observed in in T3 (Thyme oil: 208 g/plant) followed by T1 (Clove oil: 186 g/plant). Whereas among the organic amendments and organic fomulations, highest yield was observed in T2 (Oyster spent mushroom compost: 198 g/plant) followed by T3 (Karanj cake: 173.67 g/plant). Among the essential oils, at 48 hours post application, the plants which were treated with Thyme oil (T3: 145.07 n mol cinnamic acid/min/g tissue, 0.780 u unit/g fresh tissue, 0.895 u unit/g fresh tissue) showed high enzyme concentration

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(PAL, PPO and POD) followed by Clove oil (T1: 134.78 n mol cinnamic acid/min/g tissue, 0.721 u unit/g fresh tissue, 0.769 u unit/g fresh tissue). Whereas among the organic amendments and organic formulations, in case of PAL, at 48 hours post application, the plants which were treated with Karanj cake (T3:142.01 n mol cinnamic acid/min/g tissue) showed high enzyme concentration followed by Oyster spent mushroom compost (T2: 126.94 n mol cinnamic acid/min/g tissue). In case of PPO, at 48 hours post application, the plants which were treated with Panchagavya (T5: 0.592 u unit/g fresh tissue) showed high enzyme concentration followed by Jivamrit (T1: 0.576 u unit/g fresh tissue). In case of POD, at 48 hours post application, the plants which were treated with Oyster spent mushroom compost (T2: 0.667 u unit/g fresh tissue) showed high enzyme concentration followed by Panchagavya (T5: 0.660 u unit/g fresh tissue). Further in case of application of essential oil, there was no significant changes in the nutrient status of soil. But application of organic amendments and organic formulations, significantly increased nitrogen, phosphorus and potassium content in the soil. In case of organic amendments and organic formulations, Oyster spent mushroom compost (T2: 359 kg/ha) significantly increased nitrogen content in soil followed by Rice straw biochar (T4: 299 kg/ha). In the case of phosphorus, the highest increase in phosphorus content was shown by soil treated with Panchagavya (T5: 11.13 kg/ha) followed by Oyster spent mushroom compost (T2: 10.48 kg/ha). In the case of potassium, the soil treated with Jivamrit (T1: 198.44 kg/ha) had the highest potassium content followed by Karanj cake (T3: 198.28 kg/ha).

Formulation of quality compost using sericultural wastes

Bidisha Kashyap

The study on the "Formulation of quality compost using sericultural wastes" was performed at Instructional- Cum-Research (ICR) Farm, Assam Agricultural University (AAU), Jorhat during 2022-23 with the aim to formulate organics with high NPK content from locally available silkworm rearing wastes. In this study, composting using crop residue (banana pseudo-stem) along with silkworm rearing wastes (mulberry and eri) at different combinations were attempted. The treatment combinations were – T1: Crop waste+ Cow dung (3:2), T2: Crop waste + Mulberry silkworm rearing waste (3:2), T3: Crop waste + Eri silkworm rearing waste (3:2), T4: Cow dung + Mulberry silkworm rearing waste (3:2), T5: Cow dung + Eri silkworm rearing waste (3:2), T6: Crop waste + Mulberry silkworm rearing waste + Earthworm (3:2), T7: Crop waste + Eri silkworm rearing waste + Earthworm (3:2), T8: Cow dung + Mulberry silkworm rearing waste + Earthworm (3:2), T9: Cow dung + Eri silkworm rearing waste + Earthworm (3:2), T10: Crop waste + Mulberry silkworm rearing waste + Cow dung+ Earthworm (3:1:1), T11: Crop waste + Eri silkworm rearing waste + Cow dung + Earthworm (3:1:1). The experiment was laid out in Randomized Block design with 11 treatment combinations, replicating 3 times. Results revealed distinct differences in compost qualities prepared from silkworm rearing wastes. Temperature variation during composting period of all composts followed a typical pattern being maximum (42-54ºC) at 30 days of composting and decreased gradually up to 120 days. The pH, electrical conductivity and cation exchange capacity were increased with increasing the time of composting until maturity. At the end of the composting, the highest water holding capacity was found in T7 (69%) and lowest was found in T1 (53%). Different carbon (C) fractions viz., water soluble C, labile, non-labile C, total organic carbon, total inorganic carbon in all the composts from different crop residues decreased during composting up to maturity. The total C content in the composts also decreased with the advancement of composting period until compost maturity (120 days) in each substrate. There were distinct differences in concentration of N, P and K in the composts generated from banana pseudostem and silkworm rearing wastes. The NH4 – -N

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contents were found to decrease in all the composts prepared with various organics, whereas NO3 – -N contents were increased with the composting periods. Total N content in all the treatments was also increased with composting time. The highest total N content (1.49%) was observed in T6. In available phosphorous and total phosphorous there were significant difference between the treatments and the highest was found in T6 (121.33 mg/kg and 2.05% respectively) and lowest was found in T1 (97 mg/kg and 0.59% respectively). Available potassium and total potassium were also found to be significant. At the end of composting the highest was found in T6 (1.30 mg/kg and 4.13% respectively) and lowest was found in T1 i.e., 116 mg/kg and 3.07% respectively. Earthworm can significantly enhance the secondary nutrient content and micronutrients in the finished product as compared to the composts without earthworm. C:N ratio and nitrification index decrease with increasing days of maturity. The C:N ratio in the finished compost varied from 9.73 to 13.18. Significant variation is also observed in compost recovery and yield from the lowest 48% under treatment T6 to the highest 60% under T4. The highest germination index was found in T6 (107.66 %) and lowest was found in T5 (72.92 %). Overall, the relative order of performance of manures in terms of compost prepared from the mixture of crop waste + mulberry silkworm rearing waste + earthworm (T6) due to their NPK contents, other nitrogen fraction, root-shoot ratio and germination index were found to be higher in T6. However, the above inferences are based on one year investigation and thus, further studies are required for recommendations of the findings from this study.

A Study on Population Dynamics of Insect Pests and their Natural Enemies in castor (*Ricinus communis* L)

Bidyut Bikash Dutta

A Study on Population Dynamics of Insect Pests and their Natural Enemies in castor (*Ricinus communis* L) was carried out during 2022-2023 at Assam Agricultural University, Jorhat and Muga and Eri Germplasm Conservation Center, Chenijaan, CMER&TI, Lahdoigarh, Jorhat and. During investigation six insects pests were recorded infesting castor in different castor growing areas of Jorhat district. Jassid (Empoasca flavescens), semilooper (Achaea janata), tobacco caterpillar (Spodoptera litura), tussock hairy caterpillar (Olene mendosa), capsule borer (Conogethes punctiferalis), castor butterfly (Ariandne merione) are the six species among which Empoasca flavescens was found more dominant with 53.64% of abundance, followed by Spodoptera litura 12.29%,Conogethes punctiferalis16.15%, Achaea janata 5.93%, Olene mendosa 5.96% and Ariandne merione 6.00%.Two coccinellid predators were also found namely Coccinella transversalis and Micraspis discolor and one species of Mantodea predator was found associated with insect pests population. Praying mantid was the most abundant among the natural enemies during 2022-2023 with 43.67% abundance followed by Coccinella transversalis 21.89% and Micraspis discolor 34.42%. The regression analysis revealed that the combined influence of abiotic and biotic variables accounted for 65-90 percent fluctuation with the insect pests population during the crop seasons. During 2022-2023, among these three predators the two coccinellid predators showed a significant positive correlation with the maximum and minimum temperature and rainfall but the bright sunshine hour showed negative correlation with the Coccinella transversalis and positive correlation with Micraspis discolor. The multiple regression analysis was used to determine the effect of weather factor and the insects pests population on the predators population that accounted for 87-99 percent reproduction and abundance of Coccinellid and Mantodea predators.

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Major Adviser: Dr. Mukul Kumar Deka

Diversity and seasonal incidence of sucking pest on som (*Persea bombycina* (King ex Hook. fil.) Kosterm) and their management

Jil Boro

The study on "Diversity and seasonal incidence of sucking insect pests infesting som (*Persea bombycina* (King ex Hook. fil.) Kosterm) and their management" was carried out during 2021-22 at Assam Agricultural University, Jorhat. A total of four species of sucking insect pests belonging to 2 orders and 4 families were recorded during the study period. They were Schizoneuraphis himalayensis (Ghosh & Raychaudhuri), Empoasca sp, Chionaspis sp. and Selenothrips rubrocinctus (Giard). Chionaspis sp. and S. rubrocinctus were recorded for the first time in muga ecosystem. S. himalayenis was active from May to 2nd week of August, 2022, and from 12th March 2023 to May, 2023, with its peak population on 21st of May, 2023. During 2022, Empoasca sp. was observed from middle of June to early September while, during 2023 it was observed from late April to May, with its peak population on 31st of July, 2022. Chionaspis sp. population was recorded from late May to 3nd week of November, 2022, again it was observed from 2nd week of May, 2023 onwards, with its peak population on 23rd of October, 2022. S. rubrocinctus was active from middle of September, 2022 to early January, 2023, with its peak population on 30th of October. Among the recorded sucking insect pests, the highest leaf infestation among the four recorded insect pests was caused by S. himalayensis (52.40%) during May, followed by Chionaspis sp. and S. rubrocinctus during October, and Empoasca sp. during July. S. himalayensis population had significant positive correlation with maximum temperature, minimum temperature, total rainfall, number of rainy days and wind speed, while morning relative humidity had a significant negative correlation on som plant. Empoasca sp. population on som plant showed significant positive correlation with maximum temperature, minimum temperature and wind speed, while morning relative humidity showed a significant negative correlation. Chionaspis sp. population on som plant had significant positive correlation with maximum temperature and minimum temperature, while morning relative humidity showed a significant negative correlation. S. rubrocinctus population

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Major Adviser: Dr. Monimala Saikia

showed significant positive correlation with maximum temperature, while morning relative humidity, evening relative humidity total rainfall and number of rainy day showed a significant negative correlation on som plant during the study period. The combined effect of all the weather parameters influenced 38% variation on S. himalayensis population, whereas the cumulative effect of all the weather parameters on population of Empoasca sp. Chionaspis sp. and S. rubrocinctus were 26%, 50% and 66%, respectively. Among the recorded insects S. himalayensis was found to be the most abundant (63.27%) while, the least abundant (8.77%) was Empoasca sp. DNA analysis of all the collected aphid samples produced a 5′ COI amplified region of approximately 700 base pairs. The sample collected from Kokrajhar showed 96.23% similarity with sequence of Macrosiphum sp., while sample collected from Lakhimpur district showed 92.31% similarity with the reported sequence of Szhizaphis graminum whereas, samples collected from Jorhat and Karbi Anglong district showed 91.25% similarity with the reported sequence of Diuraphis noxius. The present study revealed that the LC50 values of the aqueous extract of P. thyrsiformis, C. odorata, A. marmelos and A. indica were 1.04%, 1.07%, 0.98% and 0.57%, respectively after 72 HAT. The order of toxicity with respect to the LC50 values after 72 hours of treatment was A. indica > A. marmelos > P. thyrsiformis > C. odorata.

Efficacy of *Nesolynx thymu* (Girault) for management of Uzi fly in Muga silkworm

Rubi Sut

An experiment was carried out to study the efficacy of Nesolynx thymus (Girault), a bio-control agent for the management of a very serious endo-larval parasitoid of muga silkworm, Blepharipa zebina (Walker) at experimental field and experimental rearing room, Department of Sericulture in collaboration with Department of Entomology, Assam Agricultural University, Jorhat-13, during 2022-2023. The study regarding biology revealed that the life cycle of Blepharipa zebina (Walker) is completed in 30 days on average for male and 33 days for female fly which consist an average of 2.40 days of incubation period, 6.20 days larval period, 12.40 days pupal period and adult longevity was 10.80 days in case of male and 12.00 days in case of female. The severity of infestation by Blepharipa zebina was as high as 38.57% - 61.42% depending on the season of rearing i.e. winter (Nov-Dec) and early spring (FebMar) during the experimental period. Preferred site for oviposition by Blepharipa zebina on muga silkworm body was found to be the lateral side (50.83%) followed by ventral (25.42%) and dorsal (23.97%) side. The adult emergence was found to be 74.00% in laboratory condition and highest emergence was recorded in soil (80%) followed by empty petri dish (68%) and sand (40%). The sex ratio was found to be 2.84:1 female to male ratio and average fecundity was found to be 219.00 eggs per female during the experimental period. Another laboratory experiment was carried out to observe the parasitization of Blepharipa zebina pupa by their hyperparasitoid Nesolynx thymus (Girault) in relation to the pupal age and density and also to observe the host searching behavior of Nesolynx thymus (Girault). The findings revealed that Nesolynx thymus (Girault) exhibit random host searching behavior in laboratory condition and are density dependent parasitoid. Nesolynx thymus (Girault) mostly prefers 2 day old pupa for parasitization in laboratory condition with parasitisation percentage of 84.00%.

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Major Adviser: Dr. Roshmi Borah Dutta

Development of bio-intensive integrated management practice against uzi fly of mulberry silkworm (*Bombyx mori* Louis)

Toko Naan

Uzi fly, Exorista sorbillans is a serious larval endoparasite of mulberry silkworm, Bombyx mori causing huge crop losses. An experiment was conducted during the year 2022-23 at laboratory condition to evaluate the effect of different biointensive treatments for suppression of Exorista sorbillans Weidemann in mulberry silkworm using different plant oils (neem, karanj and castor oil), physical barriers (nylon net) and bio-control agent (Nesolynx thymus Girault) against uzi fly at experimental rearing room and experimental laboratory of Department of Sericulture and rearing room of College of Sericulture, Assam Agricultural University, Jorhat, India. Three different concentrations of 0.2%, 0.4% and 0.8% were considered for plant oils. The parameters viz., numbers of egg laid by Exorista sorbillans, egg hatchability, maggot mortality, maggot recovery, pupal formation, adult emergence, adult longevity of Exorista sorbillans, ratio of healthy and infested cocoon of Bombyx mori and morphological deformities of pupa and adult of Exorista sorbillans were studied. Also, the effect of plant oils on silkworm larvae mortality, larval weight and larval duration were studied. The experimental findings revealed that out of the different treatments the physical barrier (individual tray covered with nylon net) outstand in control of Exorista sorbillans with 92.67 % healthy cocoons obtained, followed by neem oil (79.33) and karanj oil (71.00) at 0.8 percent concentration. Nesolynx thymus being at parity with control in most of the parameters except in the adult emergence, with lowest adult emergence of uzi fly (14.00%).The eggs laid by uzi fly (77.33, 50.00 and 40.33 numbers), hatchability of uzi fly eggs (66.33, 40.67 and 46.00 %), maggot recovery (52.67, 32.00 and 34.00 %), pupation (47.67, 27.33 and 30.33), adult emergence (54.33, 41.67 and 41.00 %), adult longevity (10.33, 6.67 and 6.00 days) and fecundity (54.67, 48.00 and 32.33 %), maggot mortality (47.67, 59.33 and 65.33 %) was reduced when neem oil was sprayed at three different concentrations followed by karanj oil. The plant oils sprayed to the uzi fly maggot caused morphological changes in pupa and adult. Constricted pupa and

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malformed adult were resulted. The infestation of Exorista sorbillans was maximum in the month of JuneJuly, 2022 when overall rainfall was high (282.80 mm) during rearing of (76.00 %) and the minimum infestation of Exorista sorbillans was recorded in the month of Februarymarch, 2023 when the rainfall was lowest (63.30mm) during rearing of Borpat silkworm.

Assessment of Soil Properties and Water Quality around Municipal Solid Waste Disposal Site of Guwahati Metropolitan City of Assam

Aiush Pratim Saikia

The present study was carried out during 2021-2023 to assessed the on-site and off-site soil and water pollution caused due to the Municipal Solid Waste (MSW) disposal site in Boragaon, Guwahati, Assam. The disposal site is situated in the vicinity of Deepor Beel, a Ramsar site located in Guwahati, India. A total of thirty-two soil samples were collected at specified distances viz. 0 m, 100 m, 300 m and 500 m away from the MSW dumping site using radial sampling method and a total of twelve water samples; three surface water samples and nine groundwater samples were collected. The soil samples were analysed for its physico-chemical characteristics and heavy metal concentration. The water samples were analysed for its chemical properties and heavy metal concentration. Pollution indices were also calculated in order to indicate its contamination load posed by these metals. The analysis of pH revealed that the soils were strongly acidic to neutral in reaction ranging from 4.18 to 7.28. The textural classification revealed that the soils in the study area were sandy clay loam to clay in texture. The bulk density and particle density were in the range 1.24 to 1.61 Mg m-3 and 2.21 to 2.87 Mg m-3 respectively. The soil organic carbon content was high ranging from 5.60 to 29.00 g kg-1 respectively. Hydraulic conductivity of the study area was low to moderately low ranging from 1.15 to 5.81 mm hr-1 and significant variations was observed with porosity, organic matter content and sand content of the soil samples. The porosity of the soils ranged from 36.41 to 55.18 per cent. The field capacity and permanent wilting point ranged from 17.42 to 43.44 per cent and 6.62 to 20.72 per cent. They showed strong variations with the different properties of the soil samples. Infiltration rate (cm hr-1) was seen to be moderately low in the study area, the highest infiltration rate was observed in 100 m away towards West side of the dumping ground. The mineralizable nutrient content (NPK) was low to medium in the study area. Nitrate nitrogen content were in the range 18.21 to 49.85 kg ha-1 and significant correlation was seen with the different soil properties of the study area. The total concentrations of Zn,

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Mn, Cu, Cd, Ni, As and Hg in the study area were high in majority of the soil samples as compared to the permissible limits prescribed by World Health Organization (1996). The concentration of the heavy metals ranged from 218.68 to 521.07 mg kg-1 for Zn, 169.41 to 513.57 mg kg-1 for Mn, 1.26 to 2.43 per cent for Fe, 100.48 to 281.92 mg kg-1 for Cu, 7.04 to 49.16 mg kg-1 for Cd, 19.72 to 133.92 mg kg-1 for Ni, 20.19 to 89.95 mg kg-1 for As and 145.82 to 539.70 mg kg-1 for Ni respectively. Multi-variate regression revealed significant effect of soil properties on the concentration of heavy metals in the soil samples. The R2 values ranged from 0.68 (As) to 0.94 (Hg). Single Factor Pollution Load Index (Pi), Integrated Pollution Load Index (IPi) and Geo-Accumulation Index (Igeo) were employed to assess the overall level of soil heavy metal pollution in the study area. Cd, Zn, Mn, Cu and As showed high values in the indices, thus making this dumpsite strongly contaminated with these metals. The pH of Surface water samples was strongly acidic to medium acidic (5.20 to 5.76) and the groundwater samples were medium acidic to slightly acidic (5.27 to 6.73) in nature. EC ranged from 0.76 to 0.86 dS m-1 in surface water samples and 0.09 to 0.76 dS m-1 in groundwater respectively. $NO3^{-}$-N concentration was seen to be higher in surface water compared to groundwater samples. Majority of surface water samples had higher concentration of heavy metals than groundwater samples. For water samples the heavy metals ranged from 0.38 to 6.24 mg L-1 for Zn, 1.41 to 9.69 mg L-1 for Mn, 4.25 to 65.85 mg L-1 for Fe, 1.02 to 4.68 mg L-1 for Cu, 0.48 to 3.01 mg L-1 for Cd, 35 to 328 µg L-1 for As, 7 to 152 µg L-1 for Hg and 0.08 to 1.40 mg L-1 for Ni respectively.

Agro-hydro-physical assessment of soils of riverine areas in Dibrugarh district of Assam

Aditya Bezbaruah

The state of Assam occupies an area of 74,438 sq. km area out of which 3,608 sq. km area is occupied by riverine areas or Char areas. These char areas have a huge potentiality for agriculture, especially for rabi crops. But at the same time these areas are also highly prone to soil and nutrient loss. Keeping this view a study was conducted in the riverine areas (char areas) of Dibrugarh district of Assam to assess the soil and nutrient loss and land suitability for crops and irrigation. Based on Survey of India toposheets (1:50,000) coupled with geocoded FCC of Resourcesat Satellite data, the entire district was divided into 18 different chars covering an area of 145.66 sq km. Altogether 133 numbers of georeferenced surface and core samples were collected from the entire areas. The soil samples were analysed for various physico-chemical, hydrological and erosional properties following standard procedures. GIS based thematic maps as well as land suitability and irrigability maps were prepared for better crop planning and management practices. The study area was dominant in coarser particles with sandy loam being the dominant soil texture of the area. Particle size analysis revealed that the total sand content varied from 1.45% to 82.81%, while the silt and clay content ranged from 4.04%-58.46% and 3.65% to 48.75%, respectively. It was observed that 91.61% of the study area contained sand in the range of 55-70%, while 92.67% of the study area contained silt in the range of 15-30% and 96.45% of the study area contained clay in the range of 10-20%. The bulk density of the soil ranged from 1.20 Mg/m3 to 1.78 Mg/m3 with a mean value of 1.47 Mg/m3. The porosity of soils in the study area varied from 30.35% to 49.91%, while the water holding capacity were in between 8.65% to 43.24%. The field capacity of the soils ranged from 9.63% to 40.32% with a mean value of 14.99%. The permanent wilting point of the soils ranged from 4.12% to 12.61%, while the available water content of the soil ranged from 2.83% to 28.59% with a mean value of 7.55%. The liquid limit for the soils of the study area was found to be in between the value of 13.29% to 45.32%. The pH of the soils of the study area was quite higher and it ranged from 5.2 to 7.81. Out of the total geographical area, 96.95% area showed a pH range of 6.5-7.5, while 1.31% of the studied soils showed a

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pH range of 7.55-8.0. Out of the total geographical area, 93.13% area had low organic matter and only 0.42% of the area had higher organic matter content. The total nitrogen, total phosphorus, total potassium ranged from 0.001% to 0.48%, 0.014% to 0.155% and 0.540% to 2.88%, respectively. The CEC of the study area was found to be in the range of 3.01 C mol(P+) kg-1 to 10.02 C mol(P+) kg-1 with a mean value of 4.82 C mol(P+) kg-1. The per cent base saturation of the study area was high in the study area. The erodibility indices revealed that majority of the study area was erodible in nature. The percentage of microaggregates was higher than that of macroaggregates. The mean weight diameter of the soils ranged from 0.09 to 2.98, while the geometric mean diameter ranged from 0.01 to 0.42. Stability coefficient showed a range from 0.03 to 0.32 with an average value of 0.11. Clay ratio ranged from 1.05 to 16.51, while modified clay ratio ranged from 1.02 to 14.75. The Critical Level of Organic matter ranged from 0.003 to 0.069. The Dispersion ratio, Erosion ratio and Erosion Index ranged from 0.10 to 0.34, 0.01 to 0.28, and 0.02 to 0.34, respectively. The soil loss in the study area varied from 3.45t/ha/yr (slight) to 101.88 t/ha/yr (extremely severe) with a mean value of 35.16 t/ha/yr (severe). The spatial distribution map of soil loss revealed that out of the total geographical area, 94.57% of the area suffered from severe to very severe soil loss, while 0.32% of the area suffered from extremely severe soil loss. This can be justified by the positive correlation of soil loss with total sand and negative correlation with clay and organic matter content of the area. The investigated Char area also showed a fertile soil loss of 5,38,532.74 t/yr. In terms of nitrogen, phosphorus and potassium, the total loss from the region was found to be 6,253.32 t /yr, 69172.12 t /yr and 7,48,739.45 t/yr, respectively while the organic carbon loss was found to be 1,98,078.75 t/yr. The assessment of soil site suitability index revealed that the major portion of the studied soils were marginally suitable to moderately suitable for rabi crops. Out of the total geographical area, 99.73% area for maize, 99.18% area for cabbage, 93.73% area for millets and 97.11% area for groundnut was moderately suitable. Moreover, 73.35% of the area for sesame, 99.07% area for rapeseed-mustard, 92.97% area for onion, 98.25% area for tomato, 73.07% area for carrot, 99.56% area for potato and 95.25% area for watermelon was found to be marginally suitable. In contrary for pea, only 25.69% of the area was marginally suitable and 74.14% of the area was found to be unsuitable for pea cultivation. Lack of organic matter, higher soil pH, mostly caused hinderance to crop cultivation in the area. The assessment of land irrigability in the study area revealed that the range of irrigability was in between highly suitable to moderately suitable. Out of the total geographical area, 98.77% area was moderately suitable and 1.23% of the area was highly suitable for irrigation. Use of organic matter, biochar, vermicompost, green manuring crops and soil conservation measures will ensure increased crop production as well as preventation of soil and nutrient loss from the area.

Profile Distribution of Micronutrients in Soils Under Different Rice Ecosystems of Assam

Ajay

The profile distribution pattern of micronutrients in typical rice growing soils is important for understanding the inherent capacity of soils to supply these nutrients to plants as well as their downward movement in soils. With this background a study was carried out to study the profile distribution of micronutrients in different rice ecosystems of Assam and to evaluate the relationship between micronutrient distribution and soil properties. To accomplish the objectives representative profiles were collected from four rice ecosystems viz. rice-fallow (P1), rice-rice (P2), rice-jute (P3) and ricevegetables (P4). Along with profile samples twenty five numbers of composite surface soil samples were also collected from each rice ecosystem to determine the current availability of Fe, Mn, Cu, Zn and B in soils. The soils were dark greyish brown to vary pale brown in colour, loamy sand to clay loam texture, fine to medium, weak to moderate sub-angular block structure, strongly acidic to neutral (5.37 to 6.93) in soil reaction, low CEC values (6.7-12.7 cmol(p+) kg-1) with a base saturation range of 38.8- 66.6%. The Ca2+ was the most dominant exchangeable cation in soils over Mg2+, Na+ , and K+ . Based on the morphological, physical and chemical properties, soils of the profile P1 and P4 were classified as Oxyaquic Dystrudepts, P2 as Aquic Udifluvents and P3 as Aquic Dystrudepts. The analysis of surface samples reveled that soils were adequate in DTPA extractable Fe, Mn and Cu but deficient to marginally sufficient in Zn and B particularly in rice-rice, rice-jute and rice-vegetable system. The DTPA extractable Fe, Mn, Cu and Zn of the soils ranged from 32.2-149.0, 14.4-94.1, 5.7-15.9, 0.51-2.72 mg kg-1 respectively. The highest PWM (Profile Weighted Mean) of Fe and in surface soils (0-25 cm) was observed in P2 and lowest in P1. The highest PWM, surface and subsurface content of DTPA Mn, Cu and HWB was recorded in P4 while DTPA Zn was highest in P3. The highest amount of HWS B was recorded in P4 (0.93 mg kg-1) and the lowest was observed in P2 (0.43 mg kg-1). The total Fe, Mn, Cu and Zn of the soils varied from 4.92 to 7.02 %, 144.7 to 422.7, 31.8 to 91.6, and 84.7 to 152.5 mg kg-1 respectively. The PWM of Total Fe, Mn, Cu and Zn ranged from 5.06-6.11%, 298.0 to 381.0, 56.7 to 79.5 and 92.4 to 129.4 mg kg-1 respectively. The DTPA extractable

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nutrients and HWB showed a decreasing trend with depth of soil while a reverse trend was seen in total micronutrient. The relationship between DTPA and Total micronutrient was found to be very weak indicating a slow replenishment process. The content of Total micronutrients in surface (0-25 cm) and subsurface soils (25-100 cm) did not varied considerably among the different rice ecosystems. It implies the homogeneity in the source of soil forming materials. The bivariate and multivariate analysis revealed that irrespective of rice ecosystems, the total micronutrient content was mostly influenced by clay and silt fractions of the soils while soil organic carbon found to regulate the distribution pattern of DTPA fractions and hot water-soluble boron. The major soil forming processes involved in profile distribution of micronutrients were enrichment, oxidation & reduction, eluviation, illuviation and leaching. The investigation indicated that irrespective of land use, the profile distribution pattern of all the trace elements was influenced mainly by the soil organic carbon and soil texture of the soils. The original composition of the parent material could be regarded as a major factor affecting the content of micronutrient cations in these soils. The findings of the present study suggested that maintenance of an appropriate level of soil organic carbon is the key factor in trace element availability particularly for Zn and B in rice-rice and rice-jute system.

Ecosystem services of Arbuscular Mycorrhizal Fungi in *Citrus reticulate*

Ankita Kumari

Khasi mandarin (*Citrus reticulata* Blanco) is native to north east (NE) India, which is favoured by the subtropical to sub-temperate climate and evenly distributed rainfall in the region throughout the year. In recent times, the citrus crop has witnessed a downward trend in terms of yield and productivity, which has been attributed to various biotic and abiotic stresses prevalent in the region. Though strategies of chemical fertilization and integrated nutrient management has been in place, the citrus orchards are declining gradually. The citrus crop benefits greatly from the function that beneficial soil bacteria, such as arbuscular mycorrhizal fungi (AMF), perform in the citrus rhizospheric zone. AMF promotes soil tolerance to adversity, enhances mineral nutrient uptake, enhances water status, improves soil structure through secreting glomalin related soil protein (GRSP), etc. Thus, the research work was designed to extract AMF spores from citrus rhizosphere of four different commercial citrus growing areas across NE India, viz., Boko and Rani from Kamrup district, Assam; Tarajan area from Tinsukia district, Assam and Mebo from Pasighat district, Arunachal Pradesh, mass multiply in different host crops like maize and onion and estimate GRSP and key defense related enzymes. Soil chemical analysis across all the sites revealed low to medium range of available nitrogen (N), available phosphorous (P2O5), available potassium(K2O), and medium to high range of organic carbon (OC), while pH was recorded in acidic range across all the sites. The highest available N was recorded at Mebo (215.82 kgha-1), while highest available P2O5 was recorded in Rani (29.26 kgha-1) and both available K2O (145.89 kgha-1) and OC (1.3%) was recorded highest in Mebo. The lowest pH was recorded 4.55 in Tarajan. The mean value of exchangeable calcium [2.77cmol(p+) kg-1] was highest in Tarajan, while exchangeable magnesium was highest [1.43 cmol(p+) kg-1] in Mebo. Among the soil biological properties, microbial biomass carbon (MBC) was recorded to be highest in Rani (379.83 µg g-1) followed by Mebo (372.76 µgg-1). Phosphomonoesterase activity was highest 42.49 (µg p-nitrophenol g-1 h -1) in Tarajan, while highest fluorescein diacetate (18.35 µg g-1 hr-1) and dehydrogenase activity (163.44 µg TPF g-1 24 h-1) was recorded in Mebo.

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Morphological characterization of the extracted spores revealed the presence of two types of AMF spores viz., Glomus and Gigaspora. Mean spore abundance was recorded to be 296.67(±75.08) in Boko, 276.62 (±86.21) in Rani, 352.90 (±54.21) in Tarajan, and 399.50 (±21.29) in Mebo. The mean easily extractable glomalin, a fraction of GRSP was recorded to be highest (1.76 mg g-1) in Boko, followed by Mebo (1.41mg g-1). The second fraction of GRSP, viz., total glomalin was recorded to be highest in Boko (10.50 mg g-1), followed by (9.89 mg g-1) Mebo. The percent root colonisation was observed to more than 50% across all the study sites, with highest in Mebo (57.65%), which may be attributed to pristine nature of the orchards. Paired t- test result revealed significant differences across study sites in terms of spore abundance, percent root colonisation, GRSP. Significant correlation was observed between MBC and percent root colonisation (0.199**) and spore abundance and root colonisation (0.267**). After morphological characterization, spores were mass multiplied in maize and onion. After 30 days of inoculation (DAI) of spores in both maize and onion, increase in the mean values of spore abundance and percent root colonisation as compared to the control was observed. In maize, defense enzymes, peroxidase and polyphenol oxidase were recorded to be 0.80 change in OD g-1 min-1 fresh tissue weight and 0.04 change in OD g -1 min-1 fresh tissue weight, respectively after 30 DAI. Similarly, in the host crop, onion, peroxidase and polyphenol oxidase activity were recorded to be 0.27 change in OD g-1 min-1 fresh tissue weight and 0.02 change in OD g-1 min-1 fresh tissue weight, respectively. The catalase activity in maize and onion was recorded to be 0.65 H_2O_2 µg g-1 min -1 and 0.34 H_2O_2 µg g-1 min -1 , respectively. The spores extracted from the mass multiplied crops were further inoculated in two months old C. reticulata seedlings to check the infectivity. Thus, the study indicated occurrence of AMF in the citrus rhizosphere of NE India and its involvement in ecosystem services like secretion of GRSP for improvement of soil structure, release of defense related enzymes, etc.

Evaluation of fertility status of Coconut (*Cocos nucifera* L.) growing soils in Kamrup district of Assam

Arup Kumar Sarma

Soil fertility is one management approach that has a big impact on coconut (*Cocos nucifera* L) productivity. Knowing the status of soil fertility is crucial to comprehending nut productivity in a given area. The purpose of this study was to evaluate the state of soil quality deterioration or aggravation due to coconut plantations. The study reveals variations in sand, silt, and clay content in neighboring and surrounding soils, with varying percentages in *Satdola*, *Majir* Gaon, and *Garilik*. The mean percentages of sand under coconut soils ranged from 36.50 in *Satdola* to 43.53 percent in *Garilik* village. The distribution of sand content was slightly higher in adjacent and under-plantation soils, while silt and clay content slightly rose down soil depths. The lowest soil BD (g cm^{-3}) in *Satdola* was 1.40, with a calculated range of 0.12, and the highest BD was 1.80 in *Majir* Gaon. The pH values of plantation soils varied significantly, with the highest values in *Borka* (5.93) and the lowest in *Satdola* (4.26). As soil depth increased,the pH of surrounding and plantation soils, with a noticeable rise between 60 and 90 cm. It was found that the mean EC (dS m^{-1}) of nearby soils varied from 0.058 in Kahikuchi, where the lowest recorded value was 0.02 to a maximum of 0.40 in *Garilik*. The mean soil CEC (c mole $p^{+}kg^{-1}$) in coconut plantations ranged from 4.12 in *Majir* Gaon to 7.06 in *Borka*, with minimum and maximum ranges in *Maliata* and *Satdola*, respectively. The organic carbon content (%) in coconut plantations varied from 0.08 to 1.35, with *Majir* Gaon having the highest range (1.27) and *Borka* having the smallest (0.70) range. Organic carbon concentrations significantly decreased with soil depth, regardless of neighboring soils or coconut plantations. The available soil nitrogen (kg ha^{-1}) in coconut plantations ranged from 113.60 in *Garilik* to 157.70 in HRS, Kahikuchi. The minimum and maximum ranges were 92.00 and 205.00, respectively. Soil depth increased the available nitrogen, but not significantly in-depth categories between 30 and 60 cm and 60 and 90 cm. The highest mean P2O5 content (kg ha^{-1}) in coconut plantations was found at HRS Kahikuchi (16.58), followed by *Majir* gaon (14.88), *Borka* (14.73), *Garilik* (15.93), *Satdola* (15.40), and *Maliata*

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(15.08). P_2O_5 content increased with soil depths, regardless of the coconut crop and surrounding soils. The mean available K_2O (kg ha^{-1}) for coconut plants varied from 131.10 in *Borka* to 154.08 in *Garilik*, with the highest range in *Garilik* and the lowest in *Borka*. As soil depths increased, K_2O availability decreased. Kahikuchi had the highest mean S (kg ha^{-1}) under coconut plantations, followed by *Majir* gaon, *Borka*, *Satdola*, *Garilik*, and *Maliata*. Adjacent soils showed similar patterns, with available S content dropping with depth. The mean available Ca (c mole $p^{+}kg^{-1}$) concentration in the HRS was lowest in Kahikuchi (1.15) and highest in *Majir* Gaon (1.35), with comparable amounts in neighboring soils. Available Ca content increased significantly with soil depths. The study revealed that *Majir* Gaon has the highest magnesium content (c mole $p^{+}kg^{-1}$) and Zn (mg kg^{-1}) in coconut plantations, while *Maliata*has the lowest. Available soil B (mg kg^{-1}) in *Maliata* ranged from 0.308 to 0.506, with the lowest value being 0.20 in *Satdola* and the highest value being 0.64 in Kahikuchi, supporting coconut palms. The mean Zn and B decreased dramatically with soil depth. The study found extremely low Nutrient Index (NI) values for available nitrogen and phosphorus in the soil in coconut plantations and nearby fallow. Low to marginal NI for available potassium was found in soils supporting coconut plants and neighboring soils. DTPA-Zn values varied from low to adequate for both soils and nearby fallow. Nearby soils had higher NI for P_2O_5, K_2O, and B. The total NI of available nitrogen, phosphorus, potassium, and boron was extremely low. The SQI score of the coconut plantation, despite a positive rating, revealed low fertility due to its score below the threshold value.

Study on Soil Health and Carbon Fractions under Intensive Cropping Systems

Bhaswati Bora

The research reports on the effect of intensive cropping systems on soil properties in the acid Inceptisol of north-east India are not adequately available. Therefore, a study was carried out during 2021-22 at Instructional-cum-Research Farm, Assam Agricultural University (AAU), Jorhat to investigate the impact of different cropping sequences on the physico-chemical and biological properties of soil. The present study forms a part of the experimental trial on "Identification of cropping systems module for different farming systems" that has been going on since 2018-19 under the All India Coordinated Research Project on Integrated Farming Systems at AAU, Jorhat. The experiment was laid out in a Randomized Block Design replicating 3 times with 10 treatment combinations viz.,T1: Winter rice-Autumn rice, T2: Winter rice-Toria, T3: Winter rice-Pea-Cowpea, T4: Green manure-Toria-Blackgram, T5: Winter rice-Rajmah-Cowpea, T6: Winter rice-Toria-Blackgram, T7: Teosinte-Oat-Cowpea, T8: Maize-Oat-Rice bean, T9: Ridge gourd-Broccoli-Lady's finger and T10:Bittergourd-Tomato-French bean sequence. Results revealed that the effect of intensive cropping system on soil bulk density and water holding capacity were non-significant. However, aggregate size and infiltration rate were significantly affected by the various cropping sequences. The highest mean weight diameter and infiltration rate were recorded under T10 and T4 respectively. Significant variations were also observed in soil pH, cation exchange capacity (CEC) and electrical conductivity (EC) after the end of the cropping sequences. The highest soil pH and CEC were recorded in T4, whereas EC was found to be the highest in case of T3. Significantly highest organic carbon content in soil was recorded in T4 followed by T9. Ammoniacal and nitrate N content in soil varied from 28.33 to 38.30 and 15.90 to 22.53 kg ha-1, respectively. Significant variationsin available N, P2O5 and K2O status in soil were recorded at the end of the cropping sequences due to long-term cultivation of various cropping sequences. The highest soil available N and P2O5 were recorded in T4, whereas the lowest was in T1. Available K in soil was found to be the highest in T9 followed by T4 . Exchangeable calcium and magnesium content in soil ranged from 0.91 to 1.20 and 0.47

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to 0.65 c mol (p+) kg-1, respectively. The available sulphur ranged from 11.70 to 17.13 kg ha-1 and the highest was recorded in T9 (Ridge gourd-Broccoli-Lady's finger) followed by T4. DTPA micronutrients (Fe, Mn, Zn and Cu) in soil were significantly affected by the various cropping sequences and treatment T4 and T5 recorded highest values. Data on dehydrogenase, phosphomonesterase and urease activities varied from 95.5 to 141.1µg TTF g-1 soil 24 h-1, 117.3 to 145.5 µg p-nitrophenol g-1 soil h-1 and 1.50 to 2.70 µg NH4-N g-1 soil h-1, respectively. Microbial biomass C, water soluble C, very labile and labile C fractions were recorded highest in T4 with Green manure-Toria-Black gram sequence. The treatment under Ridge gourd-Broccoli-Ladys finger sequence (T9) showed the highest content of less labile and non-labile C fractions in soil. The total organic C and total C content in soil were found to be the highest in T4, whereas the highest total inorganic C was recorded in case of T5. Data on soil organic C stock under intensive cropping systems varied significantly from the lowest 45.27 Mg ha-1 under T7 to the highest 56.84 Mg ha-1 under T4. The effect of various cropping sequences on NPK uptake by the cropping sequences showed significant variations, and the data on rice equivalent yield was also varied significantly from the lowest 24.89 to the highest 656.45 q ha-1. The highest benefit: cost ratios (4.33 and 3.70) were recorded in case of the cropping sequences meant for income enhancement i.e. in T9 and T10, respectively. Correlation studies showed positive correlations of physico- chemical properties (except bulk density) with available nutrient status and C fractions in soil. Overall, the present study revealed that the inclusion of green manure and legume crops in the cropping sequences sustains soil productivity and hence triple cropping is possible without having negative impact in the soil system under long-term.

Phosphorus Adsorption and Desorption Characteristics in Acid Soil under Intensive Cropping Systems

Boishali Dutta

The present study was carried out during 2022-2023 to investigate phosphorus adsorption and desorption characteristics in acid soil under intensive cropping systems in the on-going experimental trial on "Identification of cropping systems module for different farming systems" since 2018-2019 under All India Coordinated Research Project on Integrated Farming Systems at Instructional-cum-Research farm AAU, Jorhat. The experiment was laid out in randomized block design consisting of three replications of ten different treatments viz., T1: Winter Rice- Autumn Rice, T2: Winter rice-Toria, T3: Winter rice-Pea-Cowpea, T4: Green manure-Toria-Black gram, T5: Winter rice-RajmahCowpea, T6: Winter rice-Toria-Black gram, T7: Teosinte-Oat-Cowpea, T8: Maize-Oat-Rice bean, T9: Ridge gourd-Broccoli-Lady's finger, T10: Bitter gourd-Tomato-French bean. Phosphate adsorption and desorption studies were conducted on surface soil samples (0-15 cm) and the adsorption data were fitted into Langmuir and Freundlich equations. The soils were acidic in reaction (pH 5.15 -5.37) with significant variations in soil organic carbon, available NPK, free Fe and Al oxides, CEC and exchangeable Ca2+ and Mg2+ . The inorganic P fractions of soils under cropping systems followed the trend of Fe-P>Al-P>CaP>Sa-P. All these fractions were positively correlated with total-P (624.43-766.23 mg kg-1) indicating dynamic equilibrium amongst them. The organic P ranged from 94.92-135.92 mg kg-1 and was positively correlated with soil organic carbon. Phosphorus adsorption study revealed an increase in the absolute amount of adsorbed P (x/m) and decrease in per cent of added P adsorbed (Xad) and distribution coefficient (Kd) with increasing P levels (Co) in all the studied soils. Phosphorus adsorption was highest in T2 consisting of winter rice-toria cropping system (18.0-1240.5 µg P ml-1) and was lowest in T4 containing green manure-toria-black gram (16.7- 609.8 µg P ml-1). Freundlich adsorption isotherm showed a better fit of adsorption data with higher levels of significance (R2≥ 0.98) than Langmuir adsorption isotherms. The Langmuir adsorption maxima (b) and Freundlich K showed highest values in treatment T2 and the lowest values in treatment T4. Similar

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but reverse trend was observed in desorption study in the above treatments with special reference to treatment T4 where P desorption was highest. The desorption data were well fitted to Freundlich equation (R2=0.99). It was observed that, only small portion of adsorbed P was desorbed suggesting partial reversibly in P adsorption. The respective values of phosphate adsorption and desorption were highest and lowest in nearby virgin soil than all the cropping systems. Changes in soil properties under the influence of different management aspects in cropping sequences were responsible for such observations. The Phosphorus Supply Parameter (SP) at various initial concentrations gradually increased with increasing exogenous P. Strong positive and negative correlation of SP at a given level of added P with soil pH and free iron and aluminium oxides, respectively, implied their influences on P availability. Thus, the present study revealed that, inclusion of green manure and legume crops in the cropping sequence lowered P adsorption and increased P desorption resulting in higher P supply to crops and hence intensive (triple) cropping tended to eliminate negative impacts on P adsorption in soil systems under long term cultivation.

Phosphate dynamics in Maize (*Zea mays*) as influenced by zeolite enabled nano phosphatic fertilizer

Dipika Das

A pot culture experiment was carried out to study the "Phosphate dynamics in Maize (*Zea mays*) as influenced by zeolite enabled nano phosphatic fertilizer" during 2022-23. The aim of the experiment was to study the phosphate dynamics in maize and the release pattern of phosphorus for a period of 75 days at 15 days interval taking five treatments including treatments with Zeolite based nano-P fertilizers which was already synthesized and characterized. The treatments with nano fertilizers were 100% RDP through nano P fertilizer and reduced doses of 60% and 80% RDP through nano P fertilizer. These treatments were compared with an absolute control and a treatment where recommended dose of P was applied through chemical fertilizer taking the recommended dose of maize as the rate of phosphorus application. Three different types of soil collected from various locations of Jorhat, Titabar and Majuli representing different textural classes viz. silty clay loam, clay loam and sandy clay loam were taken for the study. Treatment receiving 100% RDP through nanofertilizer showed minimum concentration of available P from 0 days upto 15 days and thereafter it gradually increased reaching its maximum value in 60 days of interval period. Similar trend were observed for other treatments receiving nano P with reduced doses. Such trend was same for the two soils with textures sandy clay loam and silty clay loam whereas clay loam soil showed a gradual increase in available P throughout the cropping period reaching its peak at 75 days and thereafter declined. Highest concentration of P at 60 days interval was found in treatment receiving 100% RDP through nanofertilizer which was statistically higher than treatment receiving RDP through SSP. Significant difference in P release was found between 100% nano P and treatment receiving 60% of RDP through nano fertilizer in all the three type of soil. No significant difference in P release was found between treatments receiving 60% and 80% RDP through nano P. Significant difference in phosphorus content and uptake in grain and straw was found between absolute control, RDP through SSP and RDP through nano P fertilizer. However no significance difference was found between the treatments receiving 100% RDP through

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nano and the reduced doses of 60 % and 80% RDP through nano P. This trend followed in all the three types of soil. Correlation coefficients among soil available phosphorus concentration at 15 days with corresponding plant phosphorus concentration at 15 days was found to be non significant. However the same was found to be highly significant during the other days of interval.The first order kinetic constant was found to increase from T2 to T5 which might be due to less fixation of P by soil components. In case of second order kinetics, the decrease in rate constant value means increase in the release of P, which is dependent upon both soil solution and soil matrix. The parabolic diffusion equation was best fit for describing the P release as compared to the other two kinetic models.

Effect of Lime and Zinc on Strawberry Yield and Quality in Rice-Fallow Soil

Malin Teronpi

A field experiment was carried out to study the "Effect of lime and zinc on strawberry yield and quality in rice fallow soil" at ICR Farm, Jorhat, during 2022-23. The aim of the experiment was to evaluate the effect of lime and zinc and its application method on yield and quality of strawberry in rice fallow soil. The experiment was done with 2 treatments in the main plot consisting of lime @ 500 kg ha-1 and unlimed, in the sub plots 5 treatments were applied as: T1- Control, T2- N:P:K @ 10:7:7 g / sq. m, T3- RDF + Zn @1.0 kg/ha, T4- RDF + Zn @2.0 kg/ha and T5- RDF + Zn 0.1% foliar spray at 30, 45, 60 and 75 DAP following split plot design with four replications. Application of lime showed significant increase in soil pH, available phosphorous, exchangeable Ca2+ and Mg2+ content. Changes in soil pH, available K, exchangeable Ca2+ and Mg2+ was found to be non-significant among the nutrient treatments, but phosphorous content was highly significant in application of RDF at 30 DAP and then gradually decreased with increase in number of days. Liming did not significantly affect Available N, available K and DTPA Zn content of soil. Among nutrient management practices, significantly higher available N and DTPA Zn was found in application of RDF + Zn @2.0 kg/ha. Available K was nonsignificant among the treatments. Application of lime significantly decreased all the forms of soil acidity and changes in different forms of soil acidity were non-significant among the treatments in the sub-plot. Plant growth parameters like plant height was non significantly influenced by application of lime but application of RDF + Zn 0.1% foliar spray showed the highest plant height at 75 DAP. Liming significantly increased the number of leaves from 45 DAP and application of RDF + Zn 0.1% foliar spray showed the maximum number of leaves at 75 DAP. Application of lime and nutrient management did not influence the leaf relative water content. The days to first flowering and the number of flowers per plant was highly influenced by application of lime. Application of RDF + Zn 0.1% foliar spray showed the minimum number of days required for first flowering and maximum number of flowers per plant. Plant yield parameters like number of fruits per plant, fruit weight and yield and B : C ratio was greatly influenced by application of lime. Among nutrient

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management, maximum number of fruits per plant, fruit weight, yield and B:C ratio was observed in application of RDF + Zn 0.1% foliar spray. Application of lime and RDF + Zn 0.1% foliar spray significantly enhanced total Zn content of strawberry fruit. After harvesting of strawberry, the soil pH and available P were found to be highly significant by liming whereas available nitrogen and DTPA Zn of soil was found highest in the application of RDF + Zn @ 2 kg/ha as basal and available P was highest in the application of RDF. Strawberry quality parameters like TSS, titratable acidity, ascorbic acid, reducing sugar, non-reducing sugar and total sugar was highly significant in the main plot. Maximum TSS, minimum titratable acidity, maximum ascorbic acid, Reducing sugar, Nonreducing sugar and Total sugar was observed in the application of RDF + Zn 0.1% foliar spray. A sensory evaluation was also conducted and found that flavour, sweetness and appearance of fruit were significantly increased by application of lime. Among nutrient treatments, application of RDF + Zn 0.1% foliar spray reported the significantly higher value in skin colour, pulp colour, flavour, sweetness and appearance.

Influence of organomineral fertilizer on soil acidity, phosphorus availability and potato yield after winter rice

Rini Borah

A field experiment was conducted in ICR farm, AAU, Jorhat during November 2022 to February 2023 to assess the acidity and phosphorus availability in soil and yield of potato (Variety- Kufri Lalima) as influenced by organo-mineral fertilizer after winter rice. The experiment was conducted in a randomized block design (RBD) comprising individual plot size of 3 m X 3 m with three replications and seven treatments. The treatments included unfertilized plot, recommended doses (RD) of N:P2O5:K2O fertilizer @ 60:100:100 kg ha-1 (RDF) with farmyard manure (FYM) @ 5 t ha-1 , RDF with FYM @ 2 t ha-1 , RDF with vermicompost prepared substituting 30% of FYM by poultry litter (PLV) @ 2 t ha-1 , RDN and 40% RD- PK with PLV @ 2 t ha-1 , RDN and 60% RD- PK with PLV @ 2 t ha-1 , RDN and 80% RD- PK with PLV @ 2 t ha-1 . The PLV treatments were applied in two equal splits at planting and at 30 DAP as instant mixture with mineral fertilizers. The exchange acidity of soil was not influenced by nutrient management practices at 15, 30 and 45 days after planting of potato (DAP). RDF with PLV 2 t ha-1 significantly lowered the soil exchange acidity at 60 and 75 DAP over the unfertilized plot. The exchangeable H+ decreased at 45 and 60 DAP but exchangeable Al3+ was not affected by the treatments. The soil pH increased due to application of organo-mineral fertilizer at 15 and 45 DAP and decreased at 30, 60 and 75 DAP. The available phosphorus of fertilized soil was higher than initial value throughout the growth stages of potato. Application of RDF with FYM 5 t ha-1 or with PLV 2 t ha-1 significantly increased available P in soil at 15 and 30 DAP over RDF with FYM 2 t ha-1 and RDN + 40% RD-PK + PLV 2 t ha-1 instant mixture. The available phosphorus in soil increased at 30 DAP and decreased thereafter up to 75 DAP. The water extractable phosphorus showed similar trend as to available P at 15 and 30 DAP among the treatments. The water extractable P was relatively higher at 15 DAP and 45 DAP compared to other sampling dates, irrespective of the treatments. The available N and K content of soil increased with application of RDF with FYM 5 t ha-1 or with PLV 2 t ha-1 at stolon formation and tuber development stages. The plant growth, quality,

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yield attributing characters and yield of potato increased significantly with application of RDF with FYM 5 t ha-1 or with PLV 2 t ha-1 . The nutrient content of tuber and haulm was not affected by the treatments. The total nutrient uptake by potato increased with application of organo- mineral fertilizer over the unfertilized plot. The soil pH, organic carbon, available P and K contents in soil after harvest of potato were significantly higher with fertilizer application compared to the unfertilized plot. The highest net benefit in terms of B:C ratio was observed with application of RDF with FYM 5 t ha-1 (1.72).

Characterization and Fertility Capability Classification of soils under different landforms of Dhemaji district, Assam

Tikendrajit Saikia

The present investigation was undertaken in Dhemaji district of Assam in order to study the physical and chemical properties of soils and to evaluate the fertility capability classification of soils under different landforms. Three different landforms viz., piedmont plain (P1 & P2), alluvial plain (P3, P4, P5 & P6), flood plain (P7 & P8) were selected and horizon wise profile samples were collected from these three landforms. The study area experienced a mean annual rainfall of 3009.19 mm and mean annual temperature of 23.16°C. The soil temperature and moisture regime were hyperthermic and udic, respectively. The colour of the studied soil samples in all three landforms ranges from grey to brownish yellow with a dominant hue of 10 YR except in C1 horizon of P1 under piedmont plain where the hue was 7.5 YR. The value ranged from 3 to 6 and chroma 1 to 6. A textural variation ranging from sandy loam to loam in surface horizons and loamy sand to clay loam in sub surface was observed. Sand, silt and clay contents in these soils varied from 32.35 to 85.00, 9.00 to 50.60 and 4.40 to 34.02 per cent, respectively. Higher clay content was recorded in alluvial plain soils (34.02 per cent). Organic carbon content in the soil varied from 0.06 to 0.98 per cent, showing decreasing trend with depth with some exceptions in alluvial plain and flood plain soils. Soil pH varied from 4.81 to 6.44. Higher pH was recorded for flood plain soils on profile weighted mean basis. The cation exchange capacity (CEC) varied from 2.01 to 14.26 cmol (p+) kg-1 soil. On the basis of profile weighted mean, highest CEC value was recorded in piedmont plain soils. Among the basic cations, Ca2+ was the dominant cation. Per cent base saturation ranged from 18.07 to 62.52. The CBD extractable Al (Ald) and Fe (Fed) varied from 0.45 to 1.30 and 0.33 to 0.86 per cent, respectively. Soils were classified as Aquic Udorthents (P1, P7 and P8), Typic Udorthents (P5), Aquic Udifluvents (P6), Typic Dystrudepts (P2 and P3) and Typic Endoaquepts (P4). The amount of available N, P2O5 and K2O ranged from 12.54 (low) to 238.34 (low) kg ha-1 , 2.56 (low) to 74.38 (high) kg ha-1 and 21.45 (low) to 193.24

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(medium) kg ha-1 , respectively. In general these nutrients tended to decrease with depth with few exceptions. DTPA- extractable Fe, Mn, Cu status was found to be high in all the soils and Zn was low to high. Hot water soluble B status was found to be low to high in all the soils. The soils of P1 (piedmont plain), P6 (alluvial plain), P7 and P8 (flood plain) were found to be loamy (L) in type and sandy (S) in sub strata type. Rest of the pedons viz., P2 (piedmont plain), P3, P4 and P5 (alluvial plain) were loamy (L) in both type and sub strata type. Finally after considering all the modifiers the fertility capability units were designated as 'LSakm(1-3)', 'LLakm(1-3)', 'LLaek(0-1)', 'LLak(0-1)', 'LLhk(0-1)', 'LSak(0-1)', 'LShkm(0-1)'and 'LSakm(0-1)' for P1, P2, P3, P4, P5,P6, P7 and P8, respectively.

Impact of rubber tree shade on microclimate and some physiological processes of tea

Laxmipriya Saikia

Tea (*Camellia sinensis* (L.) O. Kuntze) is one of the most popular beverages, which is being consumed by over two thirds of the world's population due to its refreshing, nutritional and medicinal properties. Shade is an integral part of tea plantation. Owing to the geography of Assam, shade is an essential component for this region. Though tea cultivation is considered as a mono cropping system, it is the only plantation crop integrated with other crops of economic importance such as pepper, coffee, arecanut, etc. to maximize productivity in tea plantations. Rubber (Hevea brasilensis Muell Arg.) is an economically important crop. It may be used as an alternative to commercial shade trees. In this experiment the impact of rubber tree shade on some physiological processes and yield of tea was studied. The experiment was laid out and studied in the Section no. 13 of the Experimental Garden for Plantation Crops, Department of Tea Husbandry and Technology, Assam Agricultural University, Jorhat during2022. The experiment was conducted under two cropping situations i.e., one involves tea grown as monocrop (conventional shade) and other involves tea – rubber based cropping system (rubber as shade). Rubber tree in addition to providing shade would also act as a cash crop and thus might act as a source of additional income. The effect on photosynthetic related parameters along with the physical condition of the microclimate such as light transmission, Photosynthetically Active Radiation were observed. The effect of rubber leaf canopy on the tea bushes were compared with that of traditional shade tree. From the study, it may be concluded that there is a significant variation in the physiological and physical parameters in tea bushes under rubber shade over conventional shade. The results showed that the growth parameters of tea recorded the highest value under Albizzia chinensis shade and the lowest value was recorded under rubber tree shade. The study generated a considerable amount of important information on the effect of Albizzia chinensis shade and rubber shade on growth of tea leaves, and chemical and physical parameters. Overall results clearly showed that conventional (T1) shade favours more growth in terms of yield, leaf area and weight of leavesas compared to rubber tree shade (T2, T3 and T4). Better performance was

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noticed under conventional shade which is due to the availability of necessary photosynthetically active radiation and light intensity that maintains the leaf temperature of the plants.

Growth & Yield of Tea and Soil Nutrient Availability as Influenced by Tea – Rubber Cropping System

Rishika Borah

Tea is generally grown as a monoculture. However to augment farm income of small tea growers the concept of tea based cropping system where other crops are raised within a tea plantation is being tried. Two cropping systems- one with tea under conventional shade and the other with tea under intercrop situation were studied. The experiment was carried out in Experimental Garden for Plantation Crops, Department of Tea Husbandry and Technology, Assam Agricultural University, Jorhat during 2022. Effect of rubber on growth and yield of tea in tea based cropping system was studied along with the nutrient availability in the soil. Tea under conventional shade tree Albizzia chinensis gave highest yield when compared to tea under rubber plant's shade as the uptake of nutrients was more. The light penetrating through the dense canopy of rubber is very low, which is a direct factor for lowered yield under rubber shade. Even the thickness of the tea stem, plucking point density, shoot weight, bush spread of tea was found to be highest in the tea- Albizzia chinensis plot. The nutrient uptake by the tea shoot was higher in the control plot due to proper penetration of light and adequate nutrients in the soil. Rubber tree showsincrement in girth which is an important parameter for the rubber yield. For the growth and development of the rubber tree, canopy is also an important factor as it regulates the exchange of carbon. Tea under rubber shade was more prone to moisture stress due to higher rate of transpiration. The soil carbon content was found to higher in the tea-rubber intercropped plot due to faster rate of decomposition of leaf litters in a well shaded condition. The available NPK content was found to be higher in the intercropped plot due to releasing of nutrients by the tree to meet crop demands. The rubber plant had no adverse effect on the soil status but due to the dense canopy spread of the rubber interplanted with narrow spacing the light transmission is quite low which eventually effects the yield and growth of the tea plants.

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Major Adviser: Dr. G.K Saikia

Master of Science (Community Science)

- **Extension and Communication Management**
- **Family Resource Management**
- **Food Science and Nutrition**
- **Human Development and Family Studies**
- **Textile and Apparel Designing**

Ergonomic evaluation of task performed by workers in Manual Brick Kiln

Nikhil Baruah

The present study was conducted in Jorhat district of Assam. The study intended to find out the work-related health problems prevalent among the workers engaged in brick kiln activities. The ergonomic risk factors causing health problems were also examined in the study. The measures to minimize work related health problems among the brick kiln workers were also discussed. Three subdivisions of Jorhat namely Jorhat, Mariani and Titabor were selected performing for the study based upon the brick kiln industry. A total of 306 workers from the selected brick processing industries were selected from the total population of the brick industry on the 95% level of confidence. Findings revealed that among the surveyed workers, 59 per cent were male and 41 per cent were female workers and mostly 81 per cent were married. Most of the workers were under the age group of 41-50 years. Most (53) of the workers in the age group of 51-60 years were involved in the brick industry from 4 to 6 years followed by 46 numbers in the age group of 61- 70. Only 11 of the workers were engaged from 7 to 9 years in the age group of 61-70. Loading of bricks to bake was found to be highly involved activity (Rank I). This was followed by arranging brick to dry (Rank II) and stacking brick (Rank III). The workers engaged in brick kiln industry worked for 10 to 12 hours daily. On an average of 2 hours of the break was found to be taken by the respondents for their lunch and rest period in all the brick processing units as surveyed. In the present study of ergonomic risk factors in brick kiln industries was studied in terms of postural analyses, types of muscular efforts, perceived exertion, REBA score etc. Findings of the study revealed that highest RPE score (Rating of Perceived Exertion) i.e., 4.25 was observed while performing molding brick which was followed by loading brick to fire with the mean RPE score of 4.23. While performing these activities the workers sit and stand in a continuous awkward posture. Arranging bricks to dry recorded the lowest RPE score of 2.47. From the data it was observed that during performance of all the activities the workers felt highest discomfort in thighs, lower back in standing type of activity followed by neck, wrist and shoulder in sitting and squatting postures. Majority 97.71% reported knee pain followed by 94.12% suffered

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low back pain and shoulder pain 93.79%. Around 66 per cent of the workers felt the pain always whereas, 28 percent of the workers had the pain sometimes, followed by 6 per cent of workers who never had pain during activities. It was observed that 38 percent of the workers suffered from less acute incidences of body pains whereas 45 percent of the workers had negligible incidences which was followed by acute incidences i.e., 17 percent. From the analysis of collected data, it was observed that as age, years of involvement increase prevalence of work-related musculoskeletal disorder among the worker was higher. To improve the musculoskeletal health of kiln workers, workers should be trained in occupational safety and ergonomic principles. They should be encouraged to use personal protection aids like the lumbar belt to reduce lower back issues, the duration of rest should be split into short breaks, workers should be motivated to change their postures periodically with various stretching practices to relieve excessive muscular stress, tasks should be rotated between males and females, among age groups and BMI categories periodically as these factors are associated with musculoskeletal issues. Trolleys should be used not only in brick carrying but also in mould carrying. Moulding box and other hand tools should be redesigned ergonomically, and the use of already redesigned hand tools (i.e., spade, trowel, etc.) must be promoted.

Evaluation of functional properties of seeds from Moringa oleifera available in Assam

Farhanaz Sultana Hoque

The present study entitled "Evaluation of functional properties of seeds from Moringa Oleifera available in Assam" was undertaken with an aim to evaluate the functional properties of the Moringa oleiufera seeds.The objectives of the study were ,analysis of phytochemical and antioxidant properties of Moringa oleifera seeds, formulation of Moringa oleifera seeds flour incorporated product, nutritional evaluation of the developed product and analysis of hypoglycemic efficacy of the developed product. In the present study, a total no. of 45 different formulations of product (chapatti) were developed with incorporation of raw and debittered Moringa oleifera seeds flour. The debittering treatments were boiling, roasting as well as soaking (for 12, 24, 36 and 48 hrs.) and boiling, and soaking (for 12, 24, 36 and 48 hrs.) and roasting. Results obtained from the analysis of phytochemical and antioxidant properties of the raw and treated Moringa oleifera seeds available in Assam in terms of total phenolic contents (mg/100g) of Moringa oleifera seeds for T0, TB, TSBa, TSBb, TSBc, TSBd, TR, TSRa, TSRb, TSRc, TSRd were found to be 29.55±0.01 mg/100g, 23.87±0.01 mg/100 g, 19.28±0.007 mg/100g, 18.96±0.02 mg/100g, 17.87±0.02 mg/100g, 16.26±0.02 mg/10g, 24.57±0.01 mg/100g, 19.55±0.04 mg/100g, 19.95±0.58 mg/100g, 19.99±0.017 mg/100g, 20.00±0.02 mg/100 g respectively. Total flavanoid contents (mg/100g) of Moringa oleifera seeds for T0, TB, TSBa, TSBb, TSBc, TSBd, TR, TSRa, TSRb, TSRc, TSRd, were found to be 5.82±0.04 mg/100g, 9.07±0.01 mg/100g, 6.03±0.02 mg/100g, 5.76±0.02 mg/100g, 5.73±0.01 mg/100g, 5.66±0.02 mg/100g, 5.74±0.01 mg/100g, 5.65±0.04 mg/100g, 5.62±0.03 mg/100g, 5.60±0.02mg/100g respectively whereas tannin content (mg/100g) of the raw and treated Moringa oleifera seeds for T0, TB, TSBa, TSBb, TSBc, TSBd, TR, TSRa, TSRb, TSRc, TSRd; were 6.11±0.08 mg/100g, 3.24±0.01 mg/100g, 2.52±0.02 mg/100 g, 2.82±0.01 mg/ 100 g, 2.77±0.04 mg/100g, 2.92±0.01 mg/100 g, 3.02±0.02 mg/ 100 g, 2.89±0.05 mg/ 100g, 2.82±0.01 mg/ 100 g, 2.80±0.01 mg/100g, 2.69±0.01 mg/ 100g, respectively. The phytic acid contents of the raw and treated Moringa oleifera seeds ranged from 7.51±0.02 mg/ 100 to 9.82±0.03 mg/100g. The phytate contents (mg/100g) of the raw and treated Moringa oleifera seeds were observed as 8.05 ± 0.03 mg/100g, 7.75 ± 0.03 mg/100g,

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7.51±0.02 mg/100 g, 7.54±0.01 mg/ 100 g, 7.57±0.01 mg/100g, 7.62±0.03 mg/100 g, 9.82±0.03 mg/ 100 g, 7.74±0.03 mg/ 100g, 7.77±0.01 mg/ 100 g, 7.84±0.02 mg/100g, 7.90±0.02 mg/ 100g, in T0, TB, TSBa, TSBb, TSBc; TSBd, TR, TSRa, TSRb, TSRc, TSRd; respectively. Antioxidant activity was ovserved highest in boiled Moringa oleifera seeds which showed 71.18±0.06%. All the formulations of raw and treated Moringa oleifera seeds flour incorporated chapatti with the level of 5 to 20 per cent were subjected to sensory evaluation by 10 semi trained panelists using 9 point hedonic scale. From the sensory evaluation chapatti incorporated with 20 per cent soaked (12 hrs) and boiled Moringa oleifera seeds flour i.e. CSBa4 and chapatti incorporated with 15 percent soaked (12 hrs) and roasted Moringa oleifera seeds flour i.e. CSRa3 were highly accepted in terms of all the sensory attributes and selected for further analysis. Results revealed in terms of moisture, crude fibre, crude fat, crude protein, total carbohydrate, total energy content and total mineral content for CSBa4 and CSRa3 were : 32.82±0.68 g/100g and 24.21±0.38 g/100g; 3.25±0.03 g/100g and 3.75±0.04 g/100g; 3.58±0.02 g/100g and 4.25±0.03 g/100g; 8.57±0.02 g/100g and 7.23±0.04 g/100g; 30.00±0.02 and 35.00±0.01; 214.09±0.04 kcal/100g and 220.43±0.03 kcal/100g; 1.80±0.03 g/100g and 1.89±0.01 g/100g respectively. Mineral contents of the developed product in terms of iron, calcium, potassium and zinc were found to be 4.07±0.04 mg/100g and 6.73±0.10 mg/100g; 40.16±0.42 mg/100g and 38.42±0.52 mg/100g; 158.6±1.00 mg/100g and 117.4±0.01 mg/100g; 1.10±0.02 mg/100g and 1.11±0.03 mg/100g respectively. In vivo studies were performed to study the impact of supplementation of the developed product in Wister rats. The product obtained score of 45.65 in the glycemic index scale and it can be considered as low glycemic index food. It also significantly reduced the blood glucose level of alloxan induced diabetic rats in 21 days supplementation period with @100 mg/kg b.w, @300 mg/kg. b.w. and @900 mg/ b.w. in dose dependent manner. The mean decrease in blood glucose levels were found to be 25 mg/dl followed by 21 mg/dl and 19 mg/dl in group D3, group D2 and group D1 respectively. From the findings of the study it can concluded that Moringa oleifera seeds possesed a decent nutritional composition and it can be incorporated in value added product development after subjecting to debittering treatments. The developed product can also be commercialized and popularized among different populations as a source of nutri dense food as this has low glycemic index property (45.65) and antihyperglycemic effect. It can be recommended to patients having type 2 diabetes mellitus with some modifications, as well as for people with other non communicable diseases.

Development of convenient food mix from germinated indigenous red rice

Julena Saikia

The present investigation was undertaken with an aim of developing a convenient food mix from a germinated indigenous red rice of Assam along with underlying objective of standardising the germination process for higher GABA (Gamma-aminobutyric acid) content and developing a GABA containing convenience food mix. Red ahu paddy were treated with different with steeping (8, 12, 24, 36 hours) and germination time (24, 36, 48,72 hours). The treatment -T12, with 24h steeping and 72 h of germination, showed highest germination percentage (94 %) and lowest dormancy percentage (6%). The water uptake ratio ranged from 1.37 ± 0.02 (T0) to 1.85 ± 0.04 % (T12), grain elongation during cooking ranged from 1.37 ± 0.24 (T0) to 1.72 ± 0.03 mm (T15), solids in cooking water ranged from 0.36 ± 0.05 (T0) to 0.87 ± 0.00 g (T12), optimum cooking time ranged from 50.00 ± 2.00 (T0) to 33.66 ± 1.15 (T16), amylose content ranged from 21.28 ± 0.11(T0) to 24.54 ± 0.26 % (T16) and GABA content ranged from 0.48 (T0) to 20.60 mg/100g (T12). After evaluating the physiochemical and biochemical properties, T12 (24 hours steeping & 72 hours germination time) was selected as the optimum germination condition for product development. Two convenient food mixes coded as GRCMS (Germinated Rice based Convenient Mix with Spices) and GRCM (Germinated Rice based Convenient Mix) were formulated incorporating powdered germinated red ahu rice (T12) as major ingredient. Variable ingredients were mushroom (Pleurotus ostreatus), Lotus seed (Euryale ferox), sesame seeds (Sesamum indicum L.), onion (Allium cepa), garlic (Allium sativum) and black pepper (Piper nigrum) in different ratios. Eight treatments of each convenient food mix were formulated and after conducting acceptability trials for each product, GRCMS2 (Germinated rice: Oyster mushroom: lotus seed: sesame seed: garlic: onion; 70:15:10:2:1:1:1) and GRCM2 (Germinated rice: Oyster mushroom: lotus seed : sesame seed; 70:15:10:5) for food mix were selected. The physico-chemical properties of the selected formulations GRCMS2 and GRCM were compared with the control sample which was the germinated autoclaved cooked pre-processed germinated (T12) red ahu rice. Physical properties of the products were assessed, and bulk density

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was found to be in the range of 0.38 (GRCM2) to 0.50 g/ml (Control) and rehydration ration in the range from 3.4 (Control) to 3.6 (GRCMS2). Nutritional properties of the convenient food mixes were determined (per 100 g basis) in which moisture content ranged from 80.00± 0.20 (Control) to 9.89± 0.19% (GRCM2), crude protein from 10± 0.043 (Control) to 21.00± 1.76 g (GRCMS2), crude fat from 1.33± 1.11 (Control) to 2.66± 0.57 g (GRCM2), Carbohydrate from 72.33± 0.76 (Control) to 74.06± 0.76 g (GRCMS2), total ash from 1.26± 0.26 (Control) to 1.80 ± 0.08 g (GRCMS2), crude fibre from 0.45± 0.06 (Control) to 0.64± 0.03 g (GRCM2) and phytic acid was found to be varying from 2.77± 0.57 (GRCMS2) to 2.78± 0.56 mg (Control). GABA content of the developed product varied from 10.20±0.36 mg/100g (Control) to 12.50±0.51mg/100g (GRCMS2). Across the storage period (0-56 days) the microbial profile of the developed product in HDPE and aluminium laminated pouch were determined by taking total microbial count and it was found to be within the permissible limit of 5cfu/g (FSSAI,2017). Moisture and free fatty acid contents were also found to be within the standard permissible limits (FSSAI, 2020). The developed products were found to be stable across the storage period of 56 days during this study. From our study it was found that the utilisation of the indigenous red ahu rice for developing a ready to eat convenient food mix showed promising result in case of GABA content, physio chemical, bio-chemical properties and showed satisfactory overall acceptability of the developed product.

Consumption pattern of Ultra Processed Foods (UPFs) among the Rural and Urban populations of Jorhat District of Assam

Syeda Jadida Akhtar

The present study "Consumption pattern of Ultra Processed Foods (UPF) among rural and urban population of Jorhat district of Assam" was undertaken to assess the consumption pattern of Ultra Processed Foods (UPFs) and related factors among target populations along with the Knowledge on Ultra Processed Foods among urban and rural populations. Nutrition education intervention was also carried out to know the impact of nutrition education on UPFs among the target population. To fulfill the objectives 270 household were randomly selected, out of which, 120 household were from urban areas and 150 households were from rural areas. The respondents were of 15- 60 years of age. Data on different parameters like socio demographic profile was recorded using a self structured questionnaire. Consumption pattern of ultra processed food was accessed using Food Frequency Questionnaire (FFQ) method. Level of knowledge on UPF was assessed by Bloom's (2021) knowledge score cut off. Comparison between Urban and Rural consumption pattern of UPF was assessed by Food Frequency Questionnaire Method which was self structured and pre tested. Socio demographic data revealed that the target population of the study was 44.44 per cent in urban and 55.6 percent from rural areas, 47.50 percent of the respondents were male and 52.50 percent were female in urban areas and 52.50 percent were male members and 47.50 percent were female in rural areas. Majority of the respondents were seen from the young adults age group (20-35 years). i.e. 61.66 percent of the population in urban areas and 66 percent in rural areas,71.66 percent of the surveyed population was Hindu in urban areas and 83.33 percent in rural areas, majority of the target population belong to nuclear family (78.33 percent in urban and 75.33 percent in rural) whereas 21.67 percent and 24.67 percent were from joint family in urban and rural areas respectively. Regarding education level highest qualification was undergraduate, (51.66 percent) in urban areas and 31.33 percent in rural areas,40.84 percent of the families belong to upper middle i.e. earning between 15,000-20,000 which is seen highest among the urban

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Department: Food Science and Nutrition

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areas while 62 percent of the families belong to lower middle i.e. earning between 10,000-15,000 is seen highest among rural areas.With reference to the food habit, majority (93.7 percent) were non vegetertain. Consumption pattern of UPF was analysized based on 7categories - Carbonated drinks/ sweetened beverages foods, packaged confectionary products, fast food, Processed meat products, Breakfast cereals, Packaged snacks, Frozen and Packaged meals. The consumption of UPFs is seen highest among the age group 20-35 years of age. Association between socio demographic characteristics of the target population with the consumption pattern of UPF in urban areas revealed as gender(p value -0.26ns) in urban and (p value -0.21ns) in rural areas , age(p value -0.21ns) in urban areas and (p value - 0.16ns) in rural areas, education (p=0.0*) in urban and (p= 0.32ns) in rural areas, occupation (p= 0.30ns) in urban and p= 0.37ns ,in rural areas, income (p=0.97ns) in urban and p =003* in rural areas. Knowledge level regarding UPF in urban areas revealed that 35 % have low level of knowledge and 20 % have very low level of knowledge. In rural areas 38 % have low level of knowledge and 33.25 % have very low knowledge level regarding UPF. Association between the consumption pattern and the knowledge level of the respondents are p= 0.017 in urban and rural areas which indicates there is positive significant association. Difference between the consumption pattern of UPF in rural and urban is found to be (t=4.08,

A Study on Prevalence of Social Anxiety among Students

B. Laldinpuii

Due to the COVID-19 pandemic, the worldwide education system has been severely affected, following the shutdown of schools, colleges and universities since March 2020. In order to prevent the spread of the virus, traditional classrooms shifted to online classrooms which profoundly impacted teachers' and students' close interaction, making a paradigm shift in the teaching-learning process. For students, the disparity is more evident, owing to the diverse socio-economic backgrounds and geographical locations that they come from. Some students, especially from the urban areas, are comfortable with the online classes because they have access to online learning opportunities, support and resources at their homes. However, the ones from the lower socio-economic background and rural areas are at a huge disadvantage, asthey do not have accessto proper online resources and adequate infrastructural support. Against such a backdrop, it is relevant to analyse the perception of students and the challenges of online classes during this ongoing COVID-19 outbreak. With this background the present study entitled, "Students' perception towards online school" was undertaken during the calendar year 2019-2022. By using stratified multistage sampling procedure, sample of 384 students from eight schools of the Tinsukia Urban and Hapjan blocks of Tinsukia district were drawn randomly from classes 1-10, both from government and private schools. A self-constructed questionnaire was prepared to elicit information from students regarding background information, perception regarding online school and challenges faced by students. The collected data were coded and analysed using IBM SPSS. By performing linear regression analysis, it was found that the contributing predictors of students' perception towards online school were interaction and participation, teacher conducting classes, perceived usefulness, academic performance and mode of class. It was found that although students found online classes useful for its flexibility and convenience but majority of the students preferred offline class over online class. It was also revealed that majority of the students found problems like internet connectivity, stress and anxiety, data limit and backache during online class. It

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Department: Human Development and Family Students

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was also depicted that there exists significant difference in problems of urban and rural students in technological barriers, accessibility and in mental health issues. Key words: Online school, Traditional learning method, Perception, Students.

Self-Directed Blended Learning and Students Academic Achievement

Kritika Karmakar

Covid-19 pandemic had a marked impact on the educational system all over the world. The pandemic has exposed the students to remote learning environment and has accelerated the adoption and prominence of online education among them. It was seen that in the post-pandemic situation students started to incorporate online learning in their daily routine after the returning back from schools, which is termed as self-directed blended learning. Self-directed blended learning is an educational approach where learners take an active role in their learning process by combination of the offline and online mode. In this approach, learners have the flexibility to engage with educational content online from the comfort of their home in addition to conventional classroom learning. But this approach may have both benefits and challenges. By using stratified sampling method four Kendriya Vidyalaya schools were chosen from Balipara block of Sonitpur district, Assam. After identifying the prevalence of self-directed blended learning among students with the help of a self-constructed checklist, a sample of 224 students were selected from the highly prevalent group by the Cochran's formula. A self-constructed questionnaire was distributed to those selected students in order to elicit information regarding their demographic characteristics, the factors influencing them to adopt the self-directed blended learning approach and the challenges of this approach. Academic records of the selected students were obtained from respective school authorities in order to assess the impact of self-directed blended learning on students' academic achievement. The collected data were coded and analyzed using IBM SPSS software. With the help of a multiple regression analysis, it was found that factors of physical, social and intellectual dimension had a significant influence on students' adoption of self-directed blended learning approach, with intellectual dimension being the strongest influencing factor. By calculation of composite mean it was found that among all the four chosen dimensions of challenges, physical challenge holds the highest position and with the help of correlation analysis, it was identified that self-directed blended learning has a positive impact on students' academic achievement.

Abstract of M.Sc. thesis

Department: Human Development and Family Students

Major Adviser: Dr. Rupjyoti Bhattacharjee

Development of sustainable textile using eco-friendly natural dye extracted from Mango (*Mangifera indica*) leaves

Moirangthem Jeena Devi

Sustainable textiles are materials that are derived from eco-friendly resources such as natural fibers, recycled materials, non-toxic dyes, printing materials and environmentally friendly manufacturing processes which make economically fair products for society. Since synthetic dyes are harmful, people are now shifting towards natural dyes instead which can create unique aesthetic qualities. Natural mordants contain tannin, catechin and other compounds which can be used in the colouration of textile materials. Today's emphasis on natural dyes and eco-printings is a result of the growing concern for ecological sustainability and pollution-related issues that synthetic equivalents have caused around the world. Given the significance of utilizing natural dyes and surface enrichment on the coloured fabric, the targeted study was conducted on the "Development of sustainable textile using eco-friendly natural dye extracted from Mango (Mangifera indica) leaves" with the following objectives: Optimization of dyeing condition of mango leaf dye on eri silk fabric.• Surface ornamentation of dyed fabric using eco-printing method.• Assessment of properties of dyed and printed fabric.• In the present study, mango (Mangifera indica) leaves were selected as a natural dye and myrobalan was selected as a natural mordant and alum as a metallic mordant to use in dyeing eri silk fabric. The effect of mordant on dyeing was compared with the metallic mordanted and non-mordanted dyed fabric. Selected dye and mordant were collected from the Assam Agricultural University campus and eri silk was collected from the market of Guwahati, Assam for the study. Dyeing conditions, such as medium of extraction, extraction time, dyeing concentration, mordant concentrations, mordanting time and mordanting methods were optimized based on the objectives. Before dyeing, pre-treatment process such as degumming was carried out for the eri silk fabric. During the experimental processes, some dyeing conditions were kept constant such as material ratio (1:50) for extraction at 100°C. The dye absorption (%) was determined from the optical density value of the dye solution recorded before and after dyeing. Eco-printing of the dyed fabric was done after the dyeing process.

Abstract of M.Sc. thesis

Department: Textiles and Apparel Designing

Major Adviser: Dr. Sunita Boruah

Utilization of AgroIndustrial Waste *Punica granatum* Rind for Dyeing of Cotton Fabric

Priyanka Borah

Huge quantities of residues are produced every year by agricultural-based industries.Without a proper disposal procedure; these wastes have the potential to harm the environment, affecting both human and animal life in the ecosystem. The ever-increasing amounts of such industrial wastes are a big threat to the environment. Nature, unlike any other source, has a wonderful visual device for sensing the seven shades of the colour spectrum. Hence, it is considered as the most abundant source of colours. Use of natural dyes has increased several folds in the past few years due to the eco-friendly approach of the people. Natural dyes have been the vital source of colouration by craft dyers and printers since time immemorial. Natural dyes are substantive and require a mordant to fix to the fabric, prevent the colour from either fading with exposure to light or washing out.The present investigation entitled "Utilization of AgroIndustrial Waste Punica granatum Rind for Dyeing of Cotton Fabric" was conducted during the year 2021-23. In this study dyeing of cotton fabric was done using Punica granatum Rind with the following objectives: 1. Optimization of dyeing conditions from Agro-Industrial waste Punica granatum rind dye on cotton fabric. 2. Analysis of properties of dyed fabrics. For the study, Agro- Industrial Waste Punica granatum Rind, mordants such as alum, myrobalan and banana pseudo stem were selected for the study. The cotton fabric was selected to carry out the dyeing. For extraction of Punica granatum Rind dye, 0.6% optimized alkaline medium with highest optical density 1.55 was taken for extraction of dye at 100ºC for 75 minutes. The dyeing of cotton fabric was done using 3% dye at 70ºC for 60 minutes. The different shades of colours like beige and brown colourwere obtained after dyeing of cotton fabric with Punica granatum rind dye using three different mordants such as myrobalan, alum and banana pseudo stem. Colourfastness tests namely, colourfastness to sunlight, colourfastness to washing, colourfastness to crocking and colourfastness to pressing were assessed for dyed cotton fabrics and they demonstrated very fair to good ratings, and there was little to no staining of the colour. FTIR analysis indicated the peaks shows different functional groups like -OH, C=C, N-H and C-H, double bonds or aromatic compounds, saturated

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Department: Textiles and Apparel Designing

Major Adviser: Dr. Rickey Rani Boruah

aliphatic compound, aromatic ring, phenol, alcohol, ether, amine and carbonyl compounds in all the mordanted, non mordanted and control cotton fabric. The morphological, structural characteristics of control and dyed cotton fabrics were assessed using SEM and the differences in morphology were clearly visible. The colour strength (K/S) value of dyed cotton fabric was calculated and found that alum mordanted dyed fabric had the greatest K/S value (3.06). Hence alum mordanted fabric showed darker colour. The non mordanted and different mordanted cotton fabrics were found to be increased in terms of fabric count (nos.), fabric thickness (mm), fabric stiffness (cm), fabric wicking height (cm) and moisture regain (%) than control cotton fabric. The tenacity and elongation, crease recovery (angle) of dyed fabrics were decreased due to breakdown of intermolecular forces during dyeing and other processes. Ultra-violet protection properties were increases in dyed cotton fabric. The highest Ultra-violet protection property was observed by alum mordanted cotton fabric followed by myrobalan, banana pseudo stem, non mordanted and control cotton fabric. After 5th and 10th wash, the ultra violet protection properties was found to be decreased in dyed fabric.The investigator developed three different products from the dyed cotton fabric namely, Kaftan top, Parallel pant and shirt andthe assessing of the prepared products were done by using research schedule.

Biomass extraction from Cocosnucifera husk- An agro-organic waste for coloration of silk fabric

Purnima Das

In present years, natural dyes have gained popularity as a safer alternative to dangerous synthetic colors. Eco-friendly, environment-safe natural dyeing techniques and products are today's entail for textiles. Natural coloring substances are now growing trends for their use all over the world because of health hazards and toxicity problems created by synthetic dyes. Considering the growing importance of natural dyes all over the world, the present investigation entitled "Biomass extraction from Cocos nucifera husk- An agro-organic waste for coloration of silk fabric" was undertaken to assess the following objectives: 1. Extraction and optimization of dyeing conditions of coconut husk dye on mulberry silk fabric. 2. Surface enhancement of dyed fabric using eco-printing method. 3. Evaluation of properties of dyed and printed fabrics. To carry out the study, coconut (Cocos nucifera) husks dye was used as a natural dye to develop variety of natural colors on mulberry silk fabric using alum and gallnut as mordants. For extraction of dye, an aqueous medium was employed with an optimum wavelength of 570 nm which showed the highest (1.62%) absorbency value. Pre-treatment method such as degumming was carried out for the mulberry silk fabric to enhance the lustre, color and texture of the dyed silk fabric. Based on the objectives different dyeing parameters were optimized such as extraction medium, extraction time, dye concentration, dyeing time, mordant concentration, mordanting time and mordanting methods. The optimum dye extraction time was 60 min. Dyeing process was carried out keeping the material to liquor ratio 1:30 at a constant temperature of 70ºC for 45 min. The optical density values of the dye solution before and after dyeing were carried out to find out absorption percentage (%). The mordant concentration, mordanting time and mordanting methods were also optimized to get better shades. Brown, light brown and medium to deep brown colors were obtained from dyed, alum mordanted and gallnut mordanted silk fabric, respectively. The physical and colorfastness properties of the fabrics were evaluated.

Abstract of M.Sc. thesis

Department: Textiles and Apparel Designing

Major Adviser: Dr. Binita Baishya Kalita

Optimization of Tamarindus indica L. Dye for Surface Enrichment of Silk Fabric

Shilpi Buragohain

The art of dyeing and printing has played a vital role in adding beauty to textile. Increased awareness regarding environmental issues has vastly encouraged the idea of using eco-dyes and eco-printing for textiles offers numerous benefits, as their preparation and application involved minimal or no harsh chemical reaction that are good for nature and also have positive effects on the wearer's health. In the field of textiles, the present era can truly be called the era of eco-dyeing and printing. Value addition of the silk fabric through eco-dyeing and printing will lead to more consumer acceptance in the National on International markets thereby, more profitability. Dyeing and printing also add natural value to mulberry silk, making it more attractive and allowing for the creation of diversified products. In light of these benefits, the researcher conducted a study on "Optimization of Tamarindus indica L. Dye for Surface Enrichment of Silk Fabric", with the following objectives: • Optimization of dyeing condition of Tamarind seed dye on mulberry silk fabric • Surface enrichment of dyed fabric using eco-printing method • Analysis of properties of dyed and printed fabrics To carry out the study, mulberry silk fabric with two different mordants (Alum and Aloe vera) was selected. Seeds of tamarind (Tamarindus indica L.) were selected after pre-testing as a natural dye source. For the study, selected natural dye and mulberry silk fabrics were collected from the local market of Jorhat district, and mordants were collected from the campus of the Assam Agricultural University, Jorhat. Identification of samples was done by assigning names to each a C (Control sample), CT (Without mordanted), CTA1 (Alum mordanted), CTA2 (Aloe vera mordanted), DMEA1 (Dyed fabric with Manjistha Eco-print using Alum as mordant), and DMEA2 (Dyed fabric with Marigold Eco-print using Alum as mordant). Different dyeing conditions such as extraction medium, extraction time, dye material concentration, dyeing time, mordant concentration, mordanting time and mordanting methods such as (pre, simultaneous and post) were optimized. A pretreatment method such as degumming was carried out for mulberry silk fabric. The optimum dye extracting time was 60 minutes. The extraction was used to dye mulberry silk fabric and the optimum conditions were 1% dye at 60°C

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Major Adviser: Dr. Sunita Boruah

for 60 minutes. The surface of the dyed silk fabric was enriched using eco-printing techniques. Pre-testing was done followed by four techniques i.e., Bundle dye technique, Plain background technique, Tannin target iron blanket technique and Plain target dye blanket technique. Among them, the Plain target dye blanket technique was selected for the study as it shows a better printing effect than others. SEM analysis was done to determine the surface morphology of the control and dyed silk fabric and the differences in morphology and elements between them were clearly visible. FTIR analysis was used to identify the functional groups and various bonds that were present in the fabric and visible in different spectra. The crystallinity region of the fabrics was identified using XRD analysis and an alteration in the crystallinity structures of dyed silk fabrics compared to the control was discovered. The Ultraviolet Protection Factor (UPF) of the control, non-mordanted, and different dyed silk fabrics were evaluated and found that the Ultraviolet protection property was increased in dyed silk fabrics. The samples were evaluated visually and with the help of Greyscale for determining the colourfastness properties such as Colourfastness to Sunlight, Colourfastness to Washing, Colourfastness to Crocking or Rubbing (Dry and Wet), Colourfastness to Pressing (Dry and Wet), Colourfastness to Perspiration (Acidic and Alkaline), which exhibited fair to good ratings with noticeable stained to negligible stained. It was clear from the present investigation that colourfastness properties of natural mordanted samples showed good fastness properties to sunlight, washing, crocking, and pressing as compared to metallic mordant samples. The control, dyed and printed silk fabric were undergone for a series of physical experiments. The dyed, mordanted and printed silk fabrics were found to be increased in terms of fabric count (Ne), fabric thickness (mm), weight (GSM), tensile strength (N), moisture regain (%), wicking height (cm) and crease recovery (angle) than control silk fabric. The elongation (%) and stiffness (cm) were found to be decreased in dyed, mordanted and printed silk fabric as compared to the control one. Hence, it could be concluded from the study that natural dye with natural mordant and eco-print obtained an excellent effect on mulberry silk fabric and it can be used for the textile industry and ecofriendly textile manufacturing.

Master of Science (Veterinary)

- **Animal Biotechnology**
- **Animal Genetics and Breeding**
- **Animal Nutrition**
- **Animal Reproduction, Gynaecology and Obstetrics**
- **Anatomy and Histology**
- **Biochemistry**
- **Clinical Medicine, Ethics and Jurisprudence**
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- **Livestock Production and Management**
- **Livestock Products Technology**
- **Poultry Science**

Isolation and Molecular Characterization of Bacteriophage for Phage Therapy of Necrotic Enteritis in Poultry

Anindita Sarma

One of the obstacles to the expansion of India's poultry sector is the prevalence of several bacterial illnesses among birds. There has been a sharp increase in mortality amongst poultry birds as well as financial losses for the poultry industry as a result of the growth in multi-drug resistant bacteria and the prevalence of necrotic enteritis in poultry farms. For the treatment of necrotic enteritis in poultry, phage therapy against *Clostridium perfringens* is a promising alternative. The goal of the current study is to isolate and characterize *C. perfringens* lytic bacteriophage from caecal samples of poultry. Out of 90 samples initially 24 phage isolates could be harvested however during the process of storage 7 isolates could be stably maintained at 4°C in SM buffer. For long term storage of the C. *perfringens* lytic phages 4°C in SM buffer was found to be the best. The isolates were found to be stable from temperature 37 to 60˚C and pH from 4.0 to 9.0. The identity of the isolates could not be confirmed with the help of PCR targeting the endolysin gene, so a representative isolate was subjected to whole genome sequencing (WGS). The results of showed that the phage isolate contains dsDNA of about 145 kb as the genetic material belongs to the order *Caudovirales* containing 39.42% of GC content and 27 ORFs. The sequenced isolate was found to be closely related to other bacteriophages of *Clostridium* spp. The three-dimensional structure of the phage endolysin was modelled using Swiss model.

Abstract of M.V.Sc. thesis

Department: Animal Biotechnology

Major Adviser: Dr. Luit M. Barkalita

Development of Multiplex PCR Assays for Simultaneous Detection of *Babesia, Ehrlichia* AND *Anaplsama* in Canine

Antoni Das

Canine, particularly dogs are commonly infected with *Babesia, Ehrlichia* and *Anaplasma* leading to poor health conditions. Many a time co-infection of these three pathogens in different combination is encountered causing complex health issues which require proper diagnosis and safe treatment. Molecular diagnosis of canine babesiosis, ehrlichiosis and anaplasmosis with PCR and Real-Time PCR is more accurate and reliable as compared to conventional diagnostic tools. Moreover, assays like PCR and qPCR have the capacity to detect multiple pathogens in a single reaction which saves time, cost and labor. Therefore, the present study aims to develop and validate multiplex conventional PCR and TaqMan Probe-based quantitative Real-Time multiplex PCR assays for simultaneous detection of *Babesia* spp., *Ehrlichia canis* and *Anaplasma platys* in canine blood samples. Accordingly, two multiplex PCR assays, i.e., an end-point and a Real- Time qPCR have been optimized for simultaneous detection of *Babesia* spp., *Ehrlichia canis* and *Anaplasma platys* in blood samples of canine (dog). The end-point multiplex

PCR was standardized to amplify 208 bp *18S rRNA* gene, 410 bp *16S rRNA* and 678 bp *16S rRNA* gene of *Babesia* spp*., Ehrlichia canis* and *Anaplasma platys,* respectively in one reaction tube. The end-point multiplex PCR was found to be sensitive enough to detect 1x103, 4x104, 2x104 copies of standard plasmids carrying *18S rRNA* gene of *Babesia* spp., *16S rRNA* gene of *Ehrlichia canis* and *Anaplasma platys.* The multiplex was clinically specific in detecting *Babesia* spp., *Ehrlichia canis* and *Anaplasma platys* as it did not show any cross-amplification or non-specific amplification of other related haemoparasites such as *H. canis, T. evansi, T. orientalis* and *A. marginale.* The reproducibility of the multiplex PCR was also found to be consistent when it was repeated three times in triplicate reaction. The strength of agreement between the singleplex and the multiplex PCR assays for detection of *Babesia* spp. was very good (κ=0.86) and it was good for *Ehrlichia canis* (κ=0.75) and *Anaplasma platys* (κ=0.69).

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Department: Animal Biotechnology

Major Adviser: Dr. Lukumoni Buragohain

Similarly, the multiplex qPCR was optimized with primers and TaqMan probes for simultaneous detection of *18S rRNA* gene of *Babesia* spp., *dsb* gene of *Ehrlichia canis* and *gltA* gene of *Anaplasma platys*. The *18S rRNA, dsb* and *gltA* genes of *Babesia* spp., *Ehrlichia canis* and *Anaplasma platys,* respectively were cloned into pJET1.2/Blunt vector and standard curve was prepared for single and multiplex qPCR. The efficiency (E) of multiplex qPCR for *Babesia* spp*., Ehrlichia canis* and *Anaplasma platy* were 97.3%, 98.5% and 98.8%, respectively. The evaluation of analytical sensitivity revealed that the multiplex qPCR could detect upto 40, 5 and 7 copies of the standard plasmids carrying respective genes of *Babesia* spp., *Ehrlichia canis* and *Anaplasma platys,* respectively which is equivalent to singleplex qPCR except for *Babesia* spp. which was 10-fold lower. Like end-point multiplex PCR, the Real-Time multiplex PCR was showed specific amplification of the targeted genes of these three pathogens and did not show any crossamplification with genomic DNA of other related haemoparasites. The intra-assay coefficient of variation of the multiplex qPCR ranged from 0.36% to 1.86% whereas the coefficient of variation for inter-assay was between 0.96-4.33% which revealed that the multiplex qPCR was reproducible. The strength of agreement of multiplex qPCR with respect to singleplex qPCR was good for detection of *Babesia* spp. (κ=0.67) and *Anaplasma platys* (κ=0.74), and for *Ehrlichia canis* it was very good (κ=0.84).

On validation with 155 suspected clinical blood samples of dog, both the multiplex PCR and multiplex qPCR assays have the capacity to detect both single and co-infection of *Babesia* spp., *Ehrlichia canis* and *Anaplasma platys* in different combinations such as Babesia/Ehrlichia, Babesia/Anaplasma, Ehrlichia/Anapalsma or all the three pathogens in a single tube reaction. Hence, the multiplex PCR and qPCR assays have the potential to be used in diagnosis of canine babesiosis, ehrlichiosis and anaplasmosis as well as in detecting co-infection of *Babesia* spp., *Ehrlichia canis* and/or *Anaplasma platys*; however, the multiplex assays should be validated in future with large numbers of clinical samples as well as the results should be compared with other similar standard kit (s).

Molecular Characterization of Clinical Isolates of Canine Distemper Virus

Shivam

Canine distemper is one of the most deadly infectious diseases caused by canine distemper virus (CDV) in many species of carnivores. Besides intensive vaccination, clinical CD disease has been frequently reported in some vaccinated dogs worldwide. The current study aimed at detection, isolation and molecular characterization of the local CDV isolates. Clinical samples collected from 60 CD suspected dogs were examined by using RT-PCR assay which confirmed 33.33% (20/60) cases as CDV positive. RT-PCR could detect CDV in 17.07% (07/41) of vaccinated dogs showing clinical disease raising concern regarding the incomplete protection by the current vaccines. Five field CDV isolates could be successfully obtained by successive serial passages of the RT-PCR positive clinical samples in the PHA activated PBMC (lymphocyte) cultures. Partial H gene (1169 bp) and Complete F gene (2153 bp) could be successfully PCR amplified and sequenced from all the five CDV Guwahati isolates. Sequence analysis based on CDV H gene/protein clearly showed that both the Guwahati isolates WT-ABT-51 and WT-ABT-52, although derived from a same geographical location (Guwahati), they shared relatively less sequence similarities at nucleotide (96.8 %) and amino acid (92.9 %) levels indicating a high rate of genetic mutation among the circulating CDVs. Phylogenetic analysis of the Guwahati CDV isolates with that of Genbank available reference strains and current vaccines revealed that the Indian CDV strains (including Guwahati strains) from domestic dogs as well as Indian wild life formed two distinct and separate clusters away from the other reference (18 genetic lineages) and vaccine strains. However, F gene based phylogenetic analysis clearly indicated that though the CDV strains circulating in the domestic and sylvatic cycles are evolving independently there might be some common ancestors at some evolutionary time point.

Keywords: CDV, RT-PCR, Vaccines, Virus Isolation, Dog PBMCs, percent identity, Phylogenetic analysis.

Abstract of M.V.Sc. thesis

Department: Animal Biotechnology

Major Adviser: Dr. Dipak Deka

Studies on Milk Production Traits and Prolactin Gene Polymorphism in Sahiwal Cattle

L Wilson Varay

The Sahiwal cattle, a zebu breed, is renowned for its prolific milk production and adaptability across various regions globally. Originating from the Sahiwal area in the Montgomery district of Punjab, Pakistan, this study aimed to assess the breed's performance in the subtropical conditions of North East India, particularly Assam. Conducted at the Department of Animal Genetics and Breeding (AGB), in collaboration with the Livestock Farm Complex (LFC), College of Veterinary Science, Khanapara, Guwahati-781022, the research aimed to determine the effects of lactation orders, seasons of calving, and milking time on various milk production and constituent traits of Sahiwal cows. Additionally, the study sought to identify the polymorphism of the prolactin (*PRL*) gene and examine its association with the studied traits.

The Least-Squares Analysis of Variance Technique by Harvey (1975) was employed to study the effects of genetic and non-genetic factors on milk production and constituent traits. Duncan's Multiple Range Test (DMRT) as modified by Kramer (1957) was used for pair-wise comparisons among the means. The results indicated least-squares means (LSM) with standard errors (SE) for milk production and constituent traits. Lactation orders significantly affected only peak milk yield, while seasons of milking had no significant effect on peak yield. Moreover, no significant effects were observed for lactation orders and seasons of milking on other milk production traits, such as average milk yield, lactation milk yield, days to attain peak yield, and persistency of milk yield.

Least squares analysis of variance revealed that seasons of milking had a significant effect on fat%, SNF%, and density (kg/m3), with no effect on protein%. However, milking time (M1=morning and M2=evening) had a highly significant effect ($P<0.01$) on all milk constituent traits, including fat%, SNF%, protein%, and density (kg/m3) of milk.

Polymerase chain reaction techniques (PCR-RFLP) were employed to amplify DNA fragments specific to the prolactin (*PRL*) gene of Sahiwal cows. The study analyzed the association of the *PRL* gene with milk production traits. The genotypic

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Department: Animal Genetics and Breeding

Major Adviser: Dr. Purabi Kaushik

frequencies (AA, AB, BB) and allelic frequencies (A, B) were determined, with AA genotypes associated with higher milk yield. The observed genetic frequencies deviated from Hardy-Weinberg expectations, as indicated by the Chi-Square test value (4.3022).

Cardiovascular Renal Disorder and its Therapeutic Management in Dog

Paresh Taye

The present study entitled "CARDIOVASCULAR RENAL DISORDER AND ITS THERAPEUTIC MANAGEMENT IN DOG'' was conducted in the Veterinary Clinical Complex (VCC), College of Veterinary Science, Khanapara for a period of 10 months from October, 2022 to July, 2023 with the objectives to study the prevalence, haemato-biochemical alterations and therapeutic efficacy of CvRDH (stable) in dogs. The study revealed the overall prevalence of CvRDH (stable) to be 0.08% with highest prevalence in Labrador retriever breed (0.22%), predominantly male dogs (0.31%) in the age group of >6-9 years (0.043%). The clinical signs recorded were exercise intolerance, tachycardia, crackles, murmur, dyspnoea, coughing, ascites, syncope, inappetence and weakness. The most common electrocardiographic findings in affected dogs included sinus tachycardia, followed by sinus arrhythmia, low voltage QRS complex, 2nd degree heart block Mobitz type I, atrial fibrillation and 1st degree heart block. Radiographic findings in affected dogs revealed cardiomegaly, pleural effusion, upward tracheal deviation and pericardial effusion. The ultrasonography of abdomen showed presence of ascites, hepatomegaly, early chronic kidney, early renal degeneration and cystitis. A total of 12 affected dogs were divided randomly in two groups (group A and group B), with 6 dogs in each group and another 6 apparently healthy dogs were placed in group C as control. While dogs in group A were treated with torsemide+ spironolactone, dogs in group B were treated with furosemide+spironolactone and both groups included common cardiac and renal supportives. The haemato-biochemical estimation revealed significant increase in BUN and creatinine in both the treatment groups, compared to control group, whereas changes in haemoglobin and PCV were non significant. The examination of urine specific gravity revealed isosthenuria and changes in urine pH was also non significant. Echocardiography showed significant increase in End point to septal separation, ejection fraction and LA/AO ratio and decrease in fractional shortening. The comparison within groups showed improvement of serum creatinine and LA/AO ratio by day 30 in group A, in comparison to group B which improved by day 60. The two regimens were found to be equally effective in the management of dogs

Abstract of M.V.Sc. thesis

Department: Veterinary Clinical Medicine, Ethics And Jurisprudence

Major Adviser: Dr. Pallabi Thakuria

with CvRDH (stable), yet, torsemide being a potent diuretic, had quicker action in the reduction of clinical signs and radiographic signs. Due to more bioavailability and superior diuretic effect than furosemide, torsemide can be used as the first choice of diuretic in CvRDH (stable) rather than as a second option to other diuretics, albeit with regular monitoring.

Comparative Efficacy of Homeopathic and Conventional Medicine in the Management of Chronic Kidney Disease in Dog

Peyi Mosing

The present study entitled "**COMPARATIVE EFFICACY OF HOMEOPATHIC AND CONVENTIONAL MEDICIE IN THE MANAGEMENT OF CHRONIC KIDNEY DISEASE IN DOGS** ''was conducted in the Veterinary Clinical Complex (VCC), College of Veterinary Science, Khanapara for a period of 9 months from October, 2022 to June, 2023 , aimed to study the prevalence, haemato-biochemical and nephrosonographic changes and comparative therapeutic efficacy of homeopathic and conventional medicine in chronic kidney disease in dog. The study found a CKD prevalence of 1.25%, highest in Labrador Retriever (0.64%) and aged >6 to 10 years (0.72%). The most prominent clinical signs exhibited by CKD affected dogs were inappetance, oral manifestation , vomiting ,polyuria , polydipsia , diarrhoea , pale mucous membrane, dehydration, lethargy, weight loss, fever and hematuria. Haemato-biochemical assessment highlighted elevation of WBC count, Serum creatinine, BUN, phosphorus, potassium, and reduced albumin and chloride levels in CKD-affected dogs. Urine analysis indicated abnormal color and increased proteinuria with significantly higher Urine protein and creatinine ratio.Nephrosonogram revealed kidney abnormalities like increased echogenicity of renal cortex, thickened renal cortices, partial or complete loss of cortico-medullary differentiation and wavy capsule. The homeopathic medicines (Serum anguillae 6X and Urea pura 30 CH) was found equally effective as conventional medicine (Rkleen, Renodyl) for managing CKD stages II and III, with added economic benefits and no adverse effects. However, end-stage (CKD-IV) dogs showed unresponsiveness to intensive medicinal therapy, including homeopathy and conventional medicine.

Abstract of M.V.Sc. thesis

Department: Veterinary Clinical Medicine, Ethics And Jurisprudence

Major Adviser: Dr. Bhaben Ch. Baishya

Characterization of Multi Drug Resistant Bacteria From Bovine Mastitis and Evaluation of Their Susceptibility to Herbal Extracts

Sreeramdas Srikanth

Antimicrobial resistance (AMR) poses a critical global health threat due to the escalating prevalence of resistant bacterial strains fueled by widespread antibiotic use. Interactions between livestock and human bacteriota raise concerns about ARG transmission by Horizontal gene transfer (HGT) through environmental pathways and animal product consumption. Plant derived compounds offer diverse antimicrobial properties and traditional medicinal applications, holding potential to enhance existing antibiotics and address multidrug-resistant pathogens, contributing to global efforts to counteract antimicrobial resistance.

The present study was taken up to isolate and characterize multidrug resistant (MDR) bacteria from mastitic milk and other sources from dairy farms in and around Guwahati city of Assam. The study also evaluated the antimicrobial efficacy of 6 different plant extracts on the multidrug resistant isolates.

A total of 398 milk samples were collected and screened for mastitis, out of which 119 (29.89%) samples were from 21 (5.2%) clinically and 98 (24.62%) subclinically affected dairy cows. A total of 101 bacterial isolates could be recovered from the mastitic milk samples. Theprevalence of bacterial isolates in mastitic milk was *Escherichia coli* (40.59%) followed by *Enterococcus faecium* (20.79%), *Staphylococcus aureus* (20.79%) and *Klebsiella pneumoniae* (17.82%). Besides milk samples, other samples from dairy farms *viz*., handswabs of cattle handlers, swabs from cowsheds and sewage samples (24 of each) were also collected. The prevalence of bacterial isolates (n=21) from handswabs of cattle handlers showed the distribution as *E. coli* (61.90%), *K. pneumoniae* (14.29%), *E. faecium* (14.29%) and *S. aureus* (9.52%). Similarly, in the swabs from cowsheds, the prevalence of bacterial isolates (n=36) was *E. coli* (66.67%), *E. faecium* (16.67%), *K. pneumoniae* (13.89%) and *S. aureus* (2.78%). In the sewage of dairy farms, the prevalence of bacterial isolates (n=44) was recorded as *E. coli* (54.55%), *E. faecium* (25%), *K. pneumoniae* (11.36%) and *S. aureus* (9.09%).

Abstract of M.V.Sc. thesis

Department: Veterinary Microbiology

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Antimicrobial resistance spectrum of the *E. coli* isolates showed highest resistance to ampicillin, tetracycline and least resistance to chloramphenicol, carbapenems, whereas *K. pneumoniae* showed highest resistance to enrofloxacin, ampicillin and least resistance to carbapenems, chloramphenicol. The *S. aureus* showed highest resistance to neomycin, tetracycline, streptomycin and least resistant to amoxiclav while antibiogram of *Enterococcus* spp showed highest resistance to tetracycline, ampicillin and erythromycin and least resistant to fosfomycin, chloramphenicol and cotrimoxazole.

Out of 202 bacterial isolates, 75 (37.13%) isolates were found to be MDR of which, 47 (46.08%) were *E.* coli, 16 (51.61%) *K. pneumoniae*, 8 (28.57%) *S. aureus* and 4 (9.75%) *Enterococcus faecium*. The number of antimicrobials to which different isolates showed resistance were 4-17 for *E. coli*, 4-15 for *K. pneumoniae*, 4-9 for *S. aureus* and 8-9 for *E. faecium.*

Extended spectrum beta lactamase (ESBL) production was phenotypically detected in 13 *E. coli* and 10 *K. pneumoniae* isolates using Double Disc Synergy Test (DDST) and Epsilometer test (E-test). Carbapenemase production was identified in 2 *E. coli* isolates using Modified Hodge Test (MHT) and Modified carbapenem inactivation method (mCIM), subsequently confirmed as Metallo beta lactamases (MBL) producers through EDTA carbapenem inactivation method (eCIM). Phenotypic detection of methicillin resistance was observed in 1 *S. aureus* and 4 *E. faecium* isolates by growth on HiChromeTM MeReSa agar. The resistance genes detected in these isolates were *bla*CTX-M, *bla*TEM, *bla*SHV for ESBL producing *E. coli* and *K. pneumoniae*; *bla*NDM, *bla*IMP for carbapenemase resistance in *E. coli* and *mecA* genes in *S. aureus* and *E. faecium.*

In mastitic milk samples, there were 9 (21.95%) ESBL *E. coli,* 9 (50%) ESBL *K. pneumoniae,* 1 (4.76%) methicillin resistant *S. aureus* (MRSA) and 4 (19.05%) methicillin resistant *E. faecium* isolates. In other samples of dairy farms,4 (6.56%) ESBL *E. coli* and 1 (7.69%) ESBL *K. pneumoniae* could be isolated.

The antimicrobial efficacy study was carried out with extracts of *Syzygium aromaticum, Curcuma longa, Allium sativum, Ocimum sanctum, Leucas aspera* and *Azadirachta indica* against multi MDR strains *E. coli, K. pneumoniae, Staphylococcus aureus* and *E. faecium*. Antimicrobial efficacy of the isolates was tested by both well and disc diffusion method. The Methanolic extracts of *Syzygium aromaticum, Curcuma longa* and *Leucas aspera* produced zone of inhibition (ZOI) ranging from 8.75±0.48 mm to 14.43±0.72 mm against MDR strains of *E. coli, K. pneumoniae* and *S. aureus*. In case of aqueous extracts only neem was found to produce a ZOI of 9-11 mm against MDR *E. coli*. Further, 7 admixtures were prepared by mixing 2, 3 and 4 of plant extracts in equal proportions. All admixtures were found to retain and exhibit antimicrobial activity with a ZOI of 8±0.41 to 14±0.4 mm against all bacterial isolates.

Effect of Supplemental Heat on Performance in HD-k75 Piglets

Khrietseimenuo Chadi

Four HD-K75 litters of six piglets in each (T_0, T_1, T_2 and T_3) were reared providing supplemented heating with two 100 watt incandescent bulbs over creep area; T_0 control , T_1 for 1 week, T_2 for 2 weeks and T_3 for 3 weeks and experimental data were recorded till 8th week.

The average weight at birth were similar but attained significantly (P<0.01) higher weaning weights of 10.05±0.14, 10.81±0.16, 11.66±0.20and 12.94±0.09 kg respectively in T_0, T_1, T_2 and T_3. The average daily (ADG)and weekly body weight gain were found to be 0.157±0.004and1.10±0.03, 0.171±0.006 and 1.20±0.04, 0.186±0.006 and 1.31±0.04, and 0.207±0.008 and1.45±0.05 kg T_0, T_1, T_2 and T_3 groups respectively and revealed significant effect (P<0.01).

The overall values of body measurements(cm) of the piglets respectively in T_0,T_1,T_2 and T_3 groups were as, BL: 35.89±1.05, 35.45±1.11, 36.19±1.09 and 36.45±1.12 HG: 34.06±1.02, 34.14±1.03, 34.28±1.05 and 34.72±1.11 as well as HW:23.41±0.62,23.53±0.64,23.69±0.66 and 23.89±0.68. Both analysis of variance and correlation results revealed highly significant effect (P<0.01) of supplemental heating on all the three traits.

The overall weekly feed consumption of the four experimental groups of piglets were 0.966±0.051,1.010±0.050,1.047±0.052 and 1.093±0.060 kg in T_0, T_1,T_2 and T_3 groups respectively. There was no significant effect on feed consumption but the respective overall average FCR values of 0.81±0.03, 0.80±0.04, 0.76±0.03 and 0.69±0.03.in T_0, T_1, T_2 and T_3 groups respectively and were significant(P<0.01).

The average temperature (^{0}C) in the control and treatment farrowing pens were, 22.31±0.43 and 25.47±0.42 at 1st week , 20.97±0.19 and 24.13±0.20 at 2nd week ,and 20.51±0.45and 23.81±0.47 at 3rd week. The respective average humidity(%) were 74.64 ±0.63and69.64± 1.10 at 1st week , 73.71 ±1.14 and70.21 ±0.51 at 2nd week ,and 79.44 ±0.55and76.36 ±0.39 at 3rd week. Analysis revealed significant effect (P<0.01)of supplemental heat on both temperature and humidity.

Abstract of M.V.Sc. thesis

Department: Livestock Production and Management

Major Adviser: Dr. J.P. Bordoloi

The overall values of the physiological responses of the four piglets respectively in $T_{0,}$ $T_{1,}T_2$ and $T_{3.}$ were, respiration rate (breath/minute):42.37±0.71, 42.20±0.70, 42.07±0.69 and 41.98±0.71, heart rate (beat/minute): 127.20± 2.94, 126.80±2.95, 126.63±2.95 and 102.7126.09±3.00 and rectal temperature (^{0}F): 101.40±0.14, 101.40±0.12, 101.60±0.13 and 101.70±0.13.All the physiological responses varied within their normal ranges and they did not differ significantly (P>0.05) among themselves.

The average values of the haematological parameters in T_o, T_1, T_2 and T_3 respectively were, haemoglobin (gm/100ml): 10.27±0.31, 10.90±0.28, 11.03±0.21and 13.30±0.22; RBC count (m/mm3): 5.54±0.11, 6.15±0.13, 6.58±0.31 and 6.63±0.13, as well as TLC (m/mm3): 30.23±2.04, 18.50±0.58, 17.39±0.59and 17.88±0.52. The different values in respect of the haematological parameters varied within their normal ranges but supplemental heat treatment had beneficial and significant effect (P<0.01) on these traits.

In respect of the biochemical parameters, the average values in T_o, T_1, T_2 and T_3 respectively were, Total protein (gm/100ml): 5.57±0.21, 5.80±0.09,85.75±3.25 and 69.09±5.76; Glucose (mg/100ml): 81.67±5.30, 84.00±2.47, 85.75±3.25and 94.00±1.92, and Cortisol (n mol/L): 157.33±1.93, 140.22±22.49, 85.88±21.37 and 69.09±5.76. There was significant effect of supplemental heat treatment on the blood biochemical parameters of the experimental piglets. Total protein and Glucose were higher while Cortisol levels were lower in treatment groups.

There were not much incidence and two piglets (8.33 %) in the control group suffered from mild diarrhea in 2nd and 3rd week of experiment. There was no mortality of piglets in the experiment.

Both the total feed consumption (kg) and also total gain (kg) were highest in T_3 (6.555 and 11.69) followed by T_2 (6.283 and 10.40),T_1 (6.057 and 9.56) and T_0 (5.795 and 8.79). As a result, the net cost of feeding per kg gain(Rs) was lowest and most economic in T_3 (25.10)followed by T_2 (27.04), T_1 (28.36) and T_0 (29.51). It can be concluded that supplemental heat in the creep areas of the new born young piglets was beneficial for better performance of the piglets.

Effect of Supplementing Garlic Powder on the Performance of the Sahiwal Calves

Zara Kaku Sorang

The present experiment was conducted to investigate the effect of supplementing garlic powder on the performance of Sahiwal calves. Twelve healthy Sahiwal calves of both sexes of similar age and body weight were allocated to two experimental groups, control (T0) and treatment (T1) with six animals in each group. Calves of both groups were fed with a standard basal diet consisting of concentrate, green fodder, and paddy straw. While in the treatment group, garlic powder was supplemented @ 250 mg/kg body weight along with concentrate feed. The experiment was conducted as a feeding trial for eight fortnights and a digestibility trial thereafter for five days in the two experimental groups.

The average initial and final body weights in the 8th fortnight of the calves were 81.81±0.34 and 81.46±0.35 kg and 148.75±0.40 and 153.84±0.38 kg respectively in T0 and T1 groups. Analysis of the variance of the data revealed a highly significant difference ($P<0.01$) in average body weight in the control (T0) and treatment (T1) groups.

The overall fortnightly body weight gain was significantly higher ($P<0.01$) in the treatment group (603±17.00 g) than in the control group (558±17.00 g) of calves. The fortnightly body weight gain was higher ($P<0.01$) in the treatment group than in the control group from the 1st to 8th fortnight.

The overall average daily DM intake was 2.98±0.06 kg in the control group (T0) and 2.97±0.07 kg in the treatment group (T1). Feeding of garlic powder in treatment (T1) had no significant effect on dry matter intake all fortnights. Also, analysis of variance results revealed no significant ($P>0.05$) difference between the average values of DM intake between control (T0) and treatment (T1) groups.

The average FCR values were 6.10±0.07 and 5.26±0.08 in 1st fortnight 4.88±0.05 and 4.73±0.06 in the 8th fortnight in control (T0) and treatment (T1) groups respectively. On an overall basis, FCR values were 5.42±0.06 and 4.96±0.04 respectively in the control (T0) and treatment (T1) groups. Analysis of variance revealed that there was a highly significant ($P<0.01$) effect of supplementation of garlic powder

Abstract of M.V.Sc. thesis

Department: Livestock Production and Management

Major Adviser: Dr. Dilip Kumar Baruah

on the feed conversion ratio (FCR) of the experimental animals. Further, the C.D. test revealed that the FCR in the treatment (T1) group was significantly reduced from the 2nd fortnight to the 8th fortnight compared to the control (T0) group.

The overall mean values of the conformation traits in the control group (T0) and treatment group (T1) groups respectively were: 74.53±2.12 and 79.31±2.41 cm for body length; 86.40±1.74 and 90.80±1.91 cm for chest girth as well as 78.22±2.00 and 82.18±2.10 cm for height at wither. All the conformation traits revealed a highly positive correlation with body weight. Analysis of variance of conformation traits showed highly significant ($P<0.01$) difference between the control (T0) and treatment (T1) groups respectively.

The overall mean values of the physiological parameters in the T0 and T1 groups respectively were as: respiration rate, 28.61±0.21 and 28.79±0.14 breath per minute; pulse rate, 72.20±0.07and 72.20±0.07 beats per minute and rectal temperature, 101.36±0.04 and 101.30±0.03 oF. Analysis of the variance of the data revealed no significant ($P>0.05$) difference in respect of the three parameters between the control (T0) and treatment (T1) groups.

The blood biochemical and hematological parameters like. serum glucose, serum total protein, RBC and hemoglobin were within the normal range for Sahiwal calves in both the control and treatment groups. Serum glucose data did not reveal any significant difference ($P>0.05$). while serum total protein, RBC and Hemoglobin showed highly significant ($P<0.01$) difference between control and treatment group.

The average digestibility coefficient (%) in T0 and T1 groups respectively were: 67.73±0.12 and 73.41±0.14 for dry matter (DM); 71.08±0.2 and 76.28±0.14 for organic matter (OM); 66.73±0.25 and 71.76±0.14for crude protein (CP); 66.50±0.17 and 72.69±0.08 for ether extract (EE); 63.97±0.27 and 72.37±0.18 for crude fibre (CF) and 73.40 ±1.06 and 79.26±0.73 for nitrogen-free extract (NFE). Analysis of the data revealed significantly ($P<0.01$) higher digestibility of the organic nutrients in garlic powder supplemented treatment (T1) group than control (T0) group.

The economic analysis of the cost of feeding the experimental calves revealed the following: total DM consumption per calf was 357.19 and 356.02 kg, cost of per kg feed (DM) was Rs. 15.42 and 15.42, and the cost of feed per group was Rs. 5532.87 and 5489.90 , the total cost of garlic powder Rs. 0.00 and Rs. 300 , the net cost of feed per day per calf was Rs. 5532.87 and Rs. 5789.90 , net feed cost per dayper calf Rs. 46.12 and 48.25, weight gain per calf was 30.00 and 32.65 kg, and finally cost of feeding per kg gain was Rs. 184.42 and 177.33 in control (T0) and treatment (T1) respectively. From the results, it was observed that the total cost of feeding was a little higher in the treatment group than in the control group. However, the total body weight gain was higher in the treatment group (T1) than in the control group (T0) which resulted in a lower cost of feeding per kg weight gain in the treatment than in the control group.

The present study revealed that the supplementation of garlic powder at dosage of 250 mg/kg body weight in the Sahiwal calf ration is beneficial in terms of body

weight gain, feed conversion ratio, body confirmation traits, hematological parameters, blood biochemicals , digestibility coefficient (%) and economic of feeding.

Use of Neem (*Azadirachta indica*) Leaf Powder as a Litter Ameliorator in Broiler Chicken Rearing

Lavudia Rajiv Naik

This study investigated the effects of different experimental treatments on the body weight, feed efficiency, broiler performance, economic outcomes, ammonia emissions, litter pH and moisture levels, nitrogen content, footpad scores and incidence of footpad dermatitis, as well as microbial load in Day Old Chicks (DOC) over a six-week period.

The supplementation of Dried Neem Leaves (DNL) in litter of broiler chicken at various concentrations for a period of six weeks led to an increase in overall feed consumption compared to non-treated groups. As the concentration of DNL increased up to 7g per sq. ft. area, feed consumption also increased. The assessment of the body weight of COBB 400 Day Old Chicks (DOC) over a six-week period was studied.

The T3 group consistently exhibited higher body weights compared to other groups, with significant differences at the end of the trial. This indicates the significant influence of the experimental treatment on the growth and development of the chicks. Variations in Feed Conversion Ratio (FCR) values were observed among the groups, with the T3 group demonstrating better FCR values compared to others. This indicates that the experimental treatment of DNL at 7g per sq. ft. had a positive impact on feed efficiency.

The T3 group showed the highest Broiler Performance Efficiency Index (BPEI) value, indicating superior broiler performance compared to other groups. Additionally, the T3 group exhibited high livability percentages, highlighting the positive effects of the specific treatments on broiler performance and survival rates. The T3 group achieved the highest gross profit per broiler compared to other groups, emphasizing the effectiveness of the specific treatments and management practices in optimizing profitability.

The T3 group @ 7 g per sq. ft. area of the litter consistently maintained lower levels of ammonia emissions, indicating effective control and reduction of ammonia with the specific treatments. The T3 group also consistently maintained lower litter pH levels, suggesting the influence of treatments on the acidity of the litter environment in

Abstract of M.V.Sc. thesis

Department: Poultry Science

Major Adviser: Dr. Siddhartha Shankar Pathak

comparison to other treatment groups. The T3 group consistently exhibited lower litter moisture levels, indicating effective reduction of moisture with the specific treatments. The T3 group consistently displayed higher nitrogen percentages in the litter, suggesting the impact of treatments on nitrogen levels.

On examining the footpad scores at the end of the trial, the T3 group had the lowest incidence of footpad dermatitis and demonstrated better footpad health compared to other treatment groups, highlighting the potential benefits of DNL treatment in reducing footpad lesions at the level of 7 g per sq.ft area of the litter. It was also noted that the DNL treatment groups had better foot pad quality compared to the non-treated groups. The footpad quality was worst in T0 group which was indicated with highest score of 2 during the period of the study.

Microscopic examination (histopathology) of the footpads with different scores revealed progressive pathological changes associated with footpad lesions, providing insights for targeted interventions to prevent and mitigate footpad lesions in broiler production.

The DNL treatment, particularly at the highest dosage, showed potential in reducing microbial contamination, emphasizing its efficacy as a natural approach for mitigating microbial load. The findings demonstrate that the treatment with Dried Neem Leaves, particularly at the highest dosage (T3), resulted in a substantial reduction in microbial load throughout the experiment.

It may be concluded that the DNL at an amount of 7 g per sq.ft. area of the litter may be considered to effectively reduce the litter ammonia with no deleterious health effect on the broiler chicken. It may be a cost effective method in reusing the used litter in the deep litter system of rearing of the broiler chicken.

Key words: Dried Neem leaves, reused litter, broilers, ammonia, performance

Efficacy of Clamp Rod Internal Fixation and Bone Plating in Treatment of Long Bone Fracture of Canine Clinical Cases

M. Sai Shashank Reddy

The present study was undertaken to compare the efficacy of clamp rod internal fixation and bone plating in treatment of long bone fractures of canine clinical cases. A total of 12 long bone diaphyseal fracture cases that were presented to the Department of Surgery and Radiology and Veterinary Clinical Complex, College of Veterinary Science, A.A.U., Khanapara from September 2022 to July 2023 were included in the study. The animals were randomly divided into two equal groups, Group A and Group B. Clamp rod internal fixation was used for fracture fixation in Group A and plating was used for fracture fixation in Group B.

Clinical, radiographical and haemato-biochemical evaluation was done on 0 day, 15th, 30th, 45th and 60th days postoperatively. Lameness subsided earlier in Group B compared to Group A. In Group B complete weight bearing was observed by 15th day in one animal. By 60th postoperative day all the animals in both the groups had complete weight bearing except one animal in Group A which had grade III partial weight bearing. Earlier functional usage of limb was observed in Group B. Satisfactory pain scores without any pain on gentle palpation were observed in both groups by 60th day.

Postoperative radiographic study was done using '6A' evaluation. Apposition and alignment with 85% - 95% cortical contact was maintained between both the fracture fragments in all the animals, except in case no. 1 of Group A which had almost 75% cortical contact. Mild angulation was observed in two animals of Group A. In Group A all the 6 cases had secondary healing. In Group B primary healing was seen in 3 cases and secondary healing was seen in 3 cases. Implant stability was better in Group B compared to Group A.

On haemato-biochemical evaluation Haemoglobin, TEC, TLC, monocyte and eoisinophil count showed non-significant variations during the study period in both the groups. The PCV, neutrophil, lymphocyte, Alkaline Phosphatase, Ca and P values showed significant variations during the period of study in both the groups. All the variations were within the normal physiological limits.

Abstract of M.V.Sc. thesis

Department: Veterinary Surgery and Radiology

Major Adviser: Dr. Dwijen Kalita

Major postoperative complication was clamp slippage in Group A. The cost of implant was slightly higher in Group A (Rs. 3775.00) than Group B (Rs. 3640.00). The intraoperative time for Group A was 158 min. and Group B was 124.5 min. Based on the present study plating was found better as clamp rod internal fixator was not suitable for management of fractures in heavy breed dogs.

Role of Platelet Rich Plasma and Hyaluronic Acid in Management of Canine Corneal Ulcer

Ankita Nandi

The present work was on the evaluation of clinical efficacy of regenerative biomaterials namely Hyaluronic acid and Platelet rich plasma on canine corneal ulcers. Prevalence study in small animals (overall) was carried out in the Department of Surgery and Radiology and Veterinary Clinical Complex, College of Veterinary Science, AAU, Guwahati- 781022 for a period of one year w.e.f. 1st July 2022 to 30th June 2023. A total of 51 corneal affections were recorded out of 131 ocular affections in small animals with the prevalence rate as 38.93 per cent. Dogs recorded highest prevalence (68.62 per cent) followed by cats (25.49 per cent) and goat (5.88 per cent). Male mongrel upto one year of age group involving left eye were chiefly affected. Corneal ulcer was frequently found affection and various forms of trauma were the principle causative agent.

Radom selection of twelve corneal ulcers were equally divided into two groups viz. Group I –Hyaluronic acid drops @ 2-3 drops thrice daily were used for ulcer management whereas in group II- platelet rich plasma was used sub-conjunctively @ 0.5ml on weekly intervals. In order to increase the efficiency of the platelet rich plasma, topical drops of the same was added to address the complicated forms of ulcers. Neuro ophthalmic responses and schirmer tear test values improved from the initial readings towards the final days of treatment. Fluorescen dye test effectively helped in diagnosis of simple and stromal ulcers. *Staphylococcus spp* and *Streptococcus spp* isolates were involved in corneal ulcers. In both the groups, simple ulcers healed within seven days with excellent clinical recovery. Complicated ulcers like stromal, melting, staphyloma and descemetocele took 14,21,40 days respectively for clinical healing. Non significant ($p>0.05$) alterations were observed for haemoglobin, lymphocyte, monocyte, granulocyte, serum glutamate pyruvate transaminase, serum glutamate oxaloaccetate transaminase, total protein and catalase values. However, significant changes ($p<0.05$) between the days of treatment were seen in total leukocyte count, glucose, blood urea nitrogen, lipid peroxidation values. In case of serum creatinine, significant difference ($p<0.05$) was seen in between the groups and days of treatment. Based on the results, we

Abstract of M.V.Sc. thesis

Department: Veterinary Surgery and Radiology

Major Adviser: Dr. Bitupona Deuri

can conclude that both hyaluronic acid and platelet rich plasma therapies had promising outcome however, platelet rich plasma is a better choice in terms of quantity used, mode of administration, availability and concentration of enriched components in it.

Transabdominal Ultrasonography and Haemato-Biochemical Studies in Pigs

Md Umar

The Transabdominal Ultrasonography and Haemato-biochemical Studies in Pigs were conducted in Department of Surgery and Radiology, College of Veterinary Science, Assam Agricultural University, Khanapara. The study comprised of 18 apparently healthy Hampshire-crossed pigs divided into three groups based on their age as Group-I (Grower), Group-II (Finisher), and Group-III (Pregnant). The research was conducted by considering the external bony prominences as landmarks for identifying/locating the abdominal organ ultrasonographically. The right and left side of body were shaved for transabdominal ultrasonography. After proper restraining of pigs with snout snare or metallic crate (Group-I and Group-II) and physical retrain in Group-I pigs the transabdominal ultrasonography was conducted by applying coupling gel using a portable ultrasonography machine with curvilinear transducer frequency of 2-5 MHz and linear transducer of 5-12 MHz.

The transabdominal ultrasonography was successful to locate/identify abdominal organs with sensitivity of 100% for liver, stomach, spleen, small intestine, right kidney, left kidney, 66% for urinary bladder, 0% for ovaries. It was 100% sensitive for pregnancy diagnosis in pigs Group III. Abdominal organs reveal significant variations ($p<0.01$) in its proximity to the bony prominence between the groups, significant variation ($p<0.01$) in size of the abdominal organs were observed.

The echotexture of different abdominal organs ranged from hyperechoic to anechoic depending on the tissue composition, transducer position, and animal cooperation during ultrasonography.

Transabdominal ultrasonography of uterus revealed as multiple pockets with anechoic fluid accompanied by echogenic foetuses within an anechoic lumen. Furthermore, ultrasonography was successful in identifying the foetal structures such as the foetal lung, foetal liver, foetal stomach, and foetal heartbeats. The measurements of crown-rump length (CRL) were recorded as 12.37±0.13 cm and biparietal diameter (BPD) 3.79±0.06 cm. The variation of actual parturition day to CRL based formula was average of 19.4 days and on the basis of BPD was average of 6.5 days.

Abstract of M.V.Sc. thesis

Department: Veterinary Surgery and Radiology

Major Adviser: Dr. Chandan Kr. Singh

The clinico-physiological values estimated included respiration rate, heart rate, pulse rate, and rectal temperature. Significant variation ($p<0.05$) was noted in respiration rate between the groups, and a highly significant variation ($p<0.01$) was observed in heart rate and pulse rate among the groups. All clinico-physiological parameters were within the normal physiological limits, and Group-I pigs exhibited higher values compared to Group-II and Group-III.

The haematological parameters observed were haemoglobin, packed cell volume, total leucocyte count, and total erythrocyte count. Significant variation ($p<0.05$) was noted in packed cell volume between the groups, and a highly significant variation ($p<0.01$) was observed in haemoglobin and total erythrocyte count among the groups.

The biochemical parameters studied were Blood glucose, Total protein, Alanine Aminotransaminase, Aspartate Aminotransferase, Alkaline phosphatase, Lactate dehydrogenase, Blood urea nitrogen, Creatinine, and Cortisol. Non-significant variation was observed in Blood glucose, Total protein, and Aspartate Aminotransferase between the groups. However, significant variation ($p<0.05$) was noted in Alanine Aminotransaminase, Creatinine, and Cortisol between the groups, and a highly significant variation ($p<0.01$) was observed in Alkaline phosphatase, Lactate dehydrogenase, and Blood urea nitrogen among the groups.

Caponisation in Pati Duck: Its Impact on Growth Performance and Carcass Characteristics

Bali Yomgam

The experiments were carried out at the Dept. of Veterinary Surgery & Radiology and Duckery unit, Dept. of Veterinary Physiology, College of Veterinary Science, Assam Agricultural University, Guwahati-781022. The analysis of serum samples for biochemical constituents was carried out at the biochemical laboratory, Dept. of Veterinary Biochemistry, and that of meat samples at the All India Coordinated Research Project on Post Harvest Engineering and Technology, Khanapara Centre, College of Veterinary Science, Guwahati-781022.

The male Pati ducks were divided into four experimental groups A, B, C, and D, comprised of six ducks in each group. The ducks in Group A were kept intact (Control) comprised of intact ducks; Group B were caponized at 8 weeks of age; Group C were caponised at 10 weeks; and Group D were caponised at 12 weeks of age. Ducks from all the groups were raised until 24 weeks of age. The experiment was carried out to explore the suitable caponisation age and its effect on growth performance and carcass quality.

The caponisation times (min.) recorded were 31.50±0.96, 35.00±0.77, and 34.83±1.44, respectively, for treatment Groups B, C, and D. There was no mortality observed during the entire period of study. The physiological parameters, viz., cloacal temperature, heart rate, and respiration rate, were within the normal range, and the variation in mean values were statistically non-significant. The biochemical analysis revealed that the mean values of the parameters, viz., serum triglyceride (mg/dL), serum total protein (g/dL), serum cholesterol (mg/dL), and serum glucose, of the ducks in different treatment groups were estimated to be statistically significant ($p < 0.01$). There was a significant difference among the various days (0^{th}, 2^{nd}, 4^{th}, 6^{th}, and 8^{th}) and between groups as well. The body weights (kg) at 24 weeks were 1.52±0.04, 1.67±0.03, 1.66±0.02, and 1.71±0.01 for Groups A, B, C, and D, respectively. The attributes of flavour, texture, juiciness, and overall acceptability in the present study were significantly higher in Group D than in Groups A, B, and C, respectively. The lightness (L*) was significantly higher in capons than in intact but, the variations in mean values for yellowness (b*) and redness (a*) were not significantly different among the groups.

Abstract of M.V.Sc. thesis

Department: Veterinary Surgery and Radiology

Major Adviser: Dr. Parsha Jyoti Nath

The mean values of shear force in control group were higher than in treatment groups. The chewiness was found to be statistically significant and higher in intacts than in the capons.

From the present study, it was concluded that the most suitable age for caponisation of Pati ducks were 12 weeks. The surgical caponisation was found to have little or no effect on the physiological parameters at different time intervals in all the groups. The carcass of the ducks caponised at 12 weeks of age had significantly the highest flavour, texture, juiciness, and overall acceptability. The weight gain was insignificantly higher in capons of Groups B, C, and D than intact at 24 weeks of age.

Master of Fishery Science

- **Aquaculture (AQC)**
- **Aquatic Environment Management (AEM)**
- **Fish Processing Technology (FPT)**
- **Fisheries ResourceManagement (FRM)**

Evaluation of Nymphaea Nouchali Leaf Meal Based Diets on Growth and Health Responses of Catla Fingerlings (Hamilton, 1822)

Bhupen Kumar Daflari

Plant ingredients source is considered to be a viable approach towards meeting cost effective formulation of aquafeed which improves growth and provide health benefits to the cultured fishes. In this context, *Nymphaea nouchali* was considered to be a potential plant ingredient having nutraceutical traits that have positive impacts on growth and immunity of fish owing to the abundance of its phytoconstituents. In the present study, a 90 days experiment was conducted to evaluate the effect of *Nymphaea nouchali* leaf meal base diet on growth performance, digestive enzymes and health status of *Labeo catla* fingerlings. Four isonitrogenous diet with different inclusion levels of *Nymphaea nouchali* leaf meal i.e., 0%, 20%, 30% and 40% were formulated and designated as T-0, T-I, T-II and T-III. A total of 96 fingerlings of *L. catla* were randomly distributed in equal numbers into theeach experimental cisterns in triplicates following completely randomized design (CRD). At the end of the experiment, the weight gain % and specific growth rate (SGR) were significantly observed to be higher ($p<0.05$) and significantly lower ($p<0.05$) feed conversion ratio (FCR) were observed in T-II compared to the other experimental groups. Significantly lower ($p<0.05$) weight gain % and SGR with significantly higher ($p<0.05$) FCR were recorded in T-0 and T-III. The activities of digestive enzymes such as protease and amylase were found to be significantly higher ($p<0.05$) in the T-II with lower ($p<0.05$) values recorded in T-0 and T-III experimental groups. The red blood cell count (RBC) and haemoglobin level were found to be significantly higher ($p<0.05$) in the T-I and T-II groups compared to T-0 and T-III. Meanwhile, the white blood cell count (WBC) was significantly higher ($p<0.05$) in T-II and T-III as compared to the T-0 and T-I. In the present study, the water quality parameters did not show significant differences ($p>0.05$) among the experimental groups. The results of the present study demonstrates that inclusion of *Nymphaea nouchali* leaf meal with 30% inclusion level in the diet improved growth performance, nutrient utilization and better health benefits of *L. catla* fingerlings in the present culture condition.

Abstract of M.F.Sc. thesis

Department: Aquaculture

Major Adviser: Dr. Pabitra Kr. Saharia

Dietary Incorporation of Tubifex Meal Based Diet on The Growth Performance of *Anabas testudineus* (Bloch, 1792) Fry

Sangjukta Shyam

Feed is the primary component of the aquaculture sector and accounts for 40–60%of the overall operating costs.For the production of fish feed, aquaculture utilizes around 60% of the current fish meal output and about 80% of the current fish oil production. For asustainable aquaculture it is required to create diets with less fish meal and fish oil. Thepresent study was conduct to evaluate the effect of Tubifex meal-based diet on the growthperformance of *Anabas testudineus* (fry). The experiment was carried for 90 days, fromAugust-October, 2022. It was conducted using Completely Randomized Design in glassaquaria. The aquaria were separated into five treatments and each had three replications.The Tubifex incorporation % in the diet were 0% in Feed I, 25% in Feed II, 50% in FeedIII, 75% in Feed IV and 100% in Feed V. The fish were stocked @10 numbers per aquaria.At the time of stocking mean initial weight and length of fish varied from 3.43-3.50 g and3.13-3.33 cm respectively. After three months of rearing, final length and weight gain wasrecorded highest in (T4) and lowest value was recoded in (T0). Thus, we can conclude thatas the incorporation level of Tubifex increases, the growth performance is also increasing.Further, specific growth rate (SGR) and survivability % were found highest in (T4) andlowest in (T0). FCR value was recorded lowest as 0.70±0.02 in T4and highest in T0as1.10±0.03, this suggests that the fish were able to utilize the feed more efficiently whenTubifex powder was included 100% in Feed V. The water quality parameters recorded inthe different treatments did not vary significantly and was almost in the acceptable range conducive for fish culture. At the end, the total number of fishes 23, 24, 25, 27 and 29 wereharvested from T0, T1, T2, T3 and T4 respectively, the average weight of those fishwere22.12 g, 23.49 g, 25.01 g, 29.26 g and 33.47 g. The highest net gross yield and the benefitcost ratio (BCR) was in T4. Thus, from the point of the experiment, T4 is beneficial for thegrowth performance of *Anabas testudineus* fry and can be consider as a cost-effective feedoption for *Anabas testudineus* fry.

Abstract of M.F.Sc. thesis

Department: Aquaculture

Major Adviser: Dr. Kamaleswar Kalita

Utilization of Freshwater Mussel Meat as an Alternative Protein Source in Rearing of *Cirrhinus reba* Fingerlings (Hamilton 1822)

Sugandha Kashyap

The present study was undertaken to study the effect of replacing fish meal with freshwater mussel meal on growth parameters and enzymatic (digestive and metabolic) activities of *Cirrhinus reba* fingerlings. The experiment was conducted in 15 numbers of equal sized aquariums (75 cm x 35 cm x 35 cm) for a period of 90 days. Five different treatments viz. T0, T1, T2, T3 and T4 were used in triplicates with 0%, 10%, 20%, 30% and 40% replacement of fish meal with mussel meal, respectively. Each of the aquaria were stocked with 25 numbers of *Cirrhinus reba* fingerlings and were fed twice daily with the prepared feed. All the growth parameters and the water quality parameters were assessed at an interval of 15 days while the enzymatic activity were evaluated at an interval of 30 days. In this study, the treatment T3 with 30% replacement of fish meal with mussel meal had better results in terms of the growth parameters among all the treatments. The control group with 0% replacement had the lowest growth. The parameters like average final weight gain (6.31±1.09 g), total length gain (1.88±0.89 cm), protein intake (5.31±0.04) were found to be better in the treatment T3. Different enzymatic parameters showed significant difference ($p<0.05$) among the treatments. At the end of the experiment, the activities of the digestive enzymes like lipase (59.01±0.64 U/L) and protease (20.04±1.02 U/L) was highest in T1 and amylase (68.338±0.28 U/L) was highest T3. The ALP (5.73±0.09 U/L), LDH (15.40±0.30 IU/L) and serum glucose (22.80±0.41 mg/dl) were all higher in T2 among all the treatments. The Pearson Correlation among the growth parameters and the concentration of enzymes in *C. reba* fingerlings suggested that average weight gain, total weight gain and length gain are positively correlated with the digestive enzymes like amylase, lipase and protease but negatively correlated with LDH, ALP and glucose throughout the study period. The present findings of the study clearly indicated that a replacement level of fish meal with mussel meal upto 30% influences growth and enzymatic activity in *Cirrhinus reba* fingerlings in a positive way.

Abstract of M.F.Sc. thesis

Department: Aquaculture

Major Adviser: Dr. Binod Kalita

Effects of Sugarcane Bagasse Ash on Water Quality and Its Impact on Growth of *Labeo Catla* (Hamilton,1822)

Bitupan Gogoi

Water quality parameters in pond play a vital role in the sustainable production of fish from the aquatic ecosystem. The use of chemicals in lieu to increase production through improving soil and water quality parameters is not environmentally sustainable and have adverse impact in the environment. Recently, ash obtained from different plant-based materials has shown its potential for remediating array of problem related to agriculture; however, studies related to use of ash in aquaculture is still scarce. Therefore, an experiment was carried out to investigate the effect of sugarcane bagasse ash on water quality and its impact on growth of *Labeo catla* fingerlings for 90 days. In the experiment, three treatments with different concentration of sugarcane bagasse ash i.e., 3gm/L, 4gm/L and 5gm/L and one control was taken where no sugarcane bagasse ash was added. A total of 84 fingerlings of *L. catla* (9.59±0.34gm) were randomly distributed into 12 aquariums (100 L) in triplicates with 7 fish in each aquarium following completely randomized design (CRD). On 90th day pH was found 6.33±0.02 in control and 6.77±0.01 was found in 5gm/L sugarcane bagasse ash treatment. The maximum total ammonia was observed 0.170±0.03 mg/L at control and minimum was found 0.102±0.03 mg/L in 5 gm/L sugarcane bagasse ash treatment. The nitrite, total suspended solid and total hardness was observed maximum in control 0.086±0.002 mg/L, 144.30±0.650 mg/L and 152.10±0.45 mg/L respectively and minimum was found in 5gm/L sugarcane bagasse ash treatment like 0.068±0.002 mg/L, 133.52±0.625, 112.10±0.54 mg/L respectively on 90th day. The growth performance such as weight gain % and specific growth rate (SGR) were higher in 5gm/L sugarcane bagasse ash treatment like 308.63±48.50% and 2.05±0.10% as compared to control 258±32.25% and 1.70±0.07% respectively. The feed conversion ratio (FCR) was found less in 5gm/L sugarcane bagasse ash treatment (2.43±0.12) than control (2.53±0.12). The total erythrocyte count and hemoglobin count were found to be higher in the 5gm/L sugarcane bagasse ash treatment (4.200±0.014 g/dl and 1.500±0.035 million/106) as

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Department: Aquatic Environment Management

Major Adviser: Dr. Utpal Kr. Das

compared to control (4.000±0.012 g/dl and 1.360±0.015 million/106) on 90th day respectively. Whereas, control exhibits higher total leukocyte count (72.00±0.50 103/mm3) than any sugarcane bagasse ash treatment on 90th day. Therefore, the present study demonstrates that sugarcane bagasse ash application in waterbody can improve the water quality parameters which attributes towards better growth performance of *L. catla* fingerlings in culture condition.

In-Vivo Study of Sub-Lethal Effects of a Synthetic Pyrethroid Insecticide Lambda-Cyhalothrin on Freshwater Model Fish *Danio rerio* (Hamilton-Buchanan 1822)

Darshana Sharma

Pyrethroids have become increasingly popular for pest control, replacing other agricultural chemicals. Pyrethroids like λ-cyhalothrin are synthetic insecticides which are known to have detrimental effects on non-target organisms like fishes. It is widely used in agricultural crops like brinjal, tomato, pea in Assam, India. Literature search reveals that there is a scanty information of studies regarding on λ-cyhalothrin's effect on the behaviour as well as antioxidant and neurotoxic enzymes altogether on a model organism like zebrafish (*Danio rerio*) at sublethal as well as environmental relevant concentration. Therefore, a study was undertaken to study the behavioural changes, anti-oxidant enzymes and AChE activity in zebrafish upon chronic exposure to the pesticide λ-cyhalothrin for a period of 28 days. Three sub-lethal concentrations (1/5, 1/10 and 1/15) based on the 96h LC50 (1.94µg/l) were selected for the present study. Also, a solvent control was maintained along with the water control. Behavioural studies of fish exposed to the pesticide at sub-lethal as well as environmental relevant concentration (1/15 of 96hLC50) were done by performing Novel tank test and Shoaling test at every 7th,14th, 21st and 28th day by using AnyMaze 7.2 recording software. Parameters like number of entries to the top zone, total time in top zone, average speed of the fish, were recorded and calculation was done using the AnyMaze software. The study revealed that λ-cyhalothrin altered the behaviour even at low concentrations of the pesticide, by decreasing the average speed, increasing the number of entries to the top zone. Also, there was a dose and time dependent decrease in the shoaling behaviour of the fish exposed to the pesticide. Further, λ-cyahlothrin caused oxidative stress in the fish and increased the level of antioxidant enzymes like SOD, CAT and GPx in whole body tissues of zebrafish. Also, AChE activity in the brain of zebrafish was decreased gradually with respect to the control group. The present study expands the potential for future research in diverse areas such as molecular studies, genotoxicity assessments, enzymatic assays, all aiming for a deeper comprehension of the subject.

Abstract of M.F. Sc. thesis

Department: Aquatic Environment Management

Major Adviser: Mrs. Karishma Mili

A Study on Effects of Microplastics on Zooplankton-Carptrophic Ecology

Rimon Sarmah

Aquaculture is an indispensable component of the global food system, providing arich and affordable protein source. However, in recent times, it is threatened by contaminantslike Microplastics which when ingested by fish, pose significant threats to fish health whichultimately leads to health concerns for the consumers. Although various reports showed thatwild fish ingest microplastics mistakenly in lieu of their natural food, such behavioral studieson aquaculture species especially carps are not available. The current study is the first of itskind where a comparative investigation was carried out on the predatory performance andpredatory efficiency of two important species of carp i.e., *Cyprinus carpio* var. *communis*and *Labeo catla* fed with microplastics and natural food. In addition, the antioxidantenzymatic response of the carps was also studied post-ingestion of microplastics. In thisstudy, both the fish species were exposed to three test groups, Control (30 daphnia),Treatment 1 (30 microplastics), and Treatment 2 (15 daphnia + 15 microplastics) for 5minutes. In order to study the oxidative stress and neurotoxicity, if any, caused by PS-MP,we performed antioxidant and neurotoxic assays were done at 48h and 72h post-exposure toPS-MP. The decrease in predatory performance in Common carp suggests that they areconfused between microplastics and their regular prey, impacting their feeding behavior andpotentially affecting their survival and fitness. However, catla didn't consume a single pieceof microplastic. This phenomenon might be due to the different in feeding behavior of thespecies. Exposure to microplastics alone and in a mixture with daphnia induces oxidativestress and neurotoxic effects in Common carp, as evidenced by increased antioxidant enzymeactivity (SOD, CAT and GPx) and inhibition of AChE activity, respectively, might bebecause of ROS production in the species. The study suggests that microplastic consumptionin aquaculture is species-specific, leading to reduced growth performance and adverse healtheffects, raising concerns about food safety and human health risks. Addressing microplasticpollution in aquaculture through best practices and awareness is crucial for sustainable fishhealth and food safety, necessitating further physiological research to secure the future ofaquaculture in the global food system.

Abstract of M.F.Sc. thesis

Department: Aquatic Environment Management

Major Adviser: Dr. Rajdeep Dutta

Effect of Sous Vide Processing on Physico-Chemical, Microbiological and Storage Properties of Fish Sausage Prepared from *Ctenopharyngodon idella* (Grass Carp)

Tushar Gowala

The present study gives an insight on the effect of sous vide processing on physico- chemical, microbiological and storage properties of fish sausage prepared from *Ctenopharyngodon idella* (Grass carp). The objective of this study was to evaluate the effect of sous-vide at different processing time and temperature by keeping them in refrigerated storage period at 4℃ for a period of 120 days. The fish sausages were being optimized under vacuum packaging condition and were cooked at 50 ˚C for 120 mins, 60 ˚C for 90 mins and 70 ˚C for 60 mins by adopting a control where no treatment was applied and was studied at an interval of 30 days. The results of the present study showed that the cooking loss and gel strength of T1 were 2.03% to 7.10% and 4.20N to 39.70N respectively. Similarly, for T2 the cooking loss and gel strength were 3.03% to 6.02% and 41.47 N to 38.93N respectively. Also in T3 the cooking loss and gel strength were in the range of 0.71% to 3.72% and 43.12N to 40.47N respectively. Overall, it was found that the moisture, protein, fat and ash content of T1 were in the range of 66.66% to 62.49%, 27.33% to 26.88%, 6.22% to 6.08% and 4.05% to 3.72% respectively. Similarly, the moisture, protein, fat and ash content of T2 were in the range of 65.59% to 60.11%, 27.37% to 26.95%, 6.24% to 6.09% and 4.08% to 3.80% respectively. The findings of the biochemical composition revealed that the total volatile base nitrogen, peroxide value, free fatty acid content and pH of the control and the treated sausage samples increased during the entire storage period. Overall, it was found that the TVB-N, PV, FFA and pH content was in range 26.24 mg% - 27.12 mg%, 0.35 meq O2/ kg fat – 0.98 meq O2/ kg fat, 0.30 – 0.65 % as oleic acid and 6.16 – 6.23 respectively for T1 samples ; 25.16mg% - 26.12 mg%, 0.34 meq O2/ kg fat – 0.95 meq O2/ kg fat, 0.36% as oleic acid – 0.74% as oleic acid and 6.17-6.26 respectively for T2 samples; 14.06 mg% – 15.13 mg%, 0.33 meq O2/ kg fat - 0.91 meq O2/ kg fat, 0.41% as oleic acid – 0.80% as oleic acid and 6.20 – 6.27 respectively for T3 samples and that of control 28.24 mg%

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Department: Fish Processing Technology

Major Adviser: Dr. Sarifuddin Ahmed

– 29.12 mg%, 0.43 meq O2/ kg fat – 1.02 meq O2/ kg fat, 0.44% as oleic acid - 1.04% as oleic acid and 6.15- 6.26 respectively. The microbial analysis of the control and treated sausage sample during the study period also showed that the total aerobic count in the control was significantly ($p<0.05$) higher than that of the treated samples. There was also significant ($p<0.05$) difference in the treated samples compared to control during the storage period in the sensory evaluation. Based on the findings, it can be concluded that cooking of fish sausage at 70˚C for 60 minutes under vaccum condition followed by intermediate freezing is a suitable processing condition for sous vide fish sausage with good quality and better shelf life.

Evaluation of Different Composition of Compostprepared with Fish Waste and Its Microbial Analysis

Angshuman Saikia

The present study was conducted to evaluate the effect of different composition ofcompost prepared with fish waste. The objective of undergoing this study was to eradicate thewaste generated every day from the fish processing sites into a suitable product that could beused as an organic manure in the future. The compost prepared was designed in threedifferent ways (T1, T2 and T3) where the concentrations were altered by increasing theamount of fish waste or cowdung and incorporating sawdust and sugarcane bagasse. Thecomposts were harvested after 90 days of decomposition when it turned out to be fine smoothparticle with blackish brown in colour. The nutrient, physicochemical parameters andmicrobial analysis of the compost were carried out to evaluate the significance of the compost. The N, P, K values of treatment 1 was observed to be 1.54%, 1.07% and 0.27%respectively; for treatment 2 the results were 1.26%, 0.98%, 0.32% respectively and fortreatment 3 the values obtained were 1.12%, 0.92% and 0.41% respectively. Themicronutrients evaluated in the matured compost for all the three treatments was in thefollowing order Zn (2054 mg/kg- 2297 mg/kg) > Ca (1499 mg/kg-1800 mg/kg) > Fe (1498mg/kg-1565 mg/kg) > Mg (1100 mg/kg-1303 mg/kg). The moisture content in T1, T2 and T3(treatment 3) were 11.10%, 19.18% and 13.73% respectively. Similarly, temperature of thematured compost T1, T2 and T3 were 35.13 °C, 34.90 °C, 34.96 °C. It was observed that thepH of all the three treatments were in neutral range at the end of composting period andvaried from 7.03-7.23. The electrical conductivity of the matured compost after 90 days in allthe treatments were in the range 0.12-0.16. The germination index of the matured compostranged between 125 % to 139 % indicating the compost were phytonutrient-phytostimulant.

The yeast and mold count of the matured compost were in the range 3.96 to 4.03 log cfu/g.The bacterial isolates identified from the compost were: *Bacillus subtilis* strain FPTCOF:T1,*Priestia megaterium* strain W6, *Bacillus cereus* strain FPTCOF:T3. The isolates were also characterized for their plant growth promoting ability by conducting

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Department: Fish Processing Technology

Major Adviser: Mr. Inam Akhtar Hussain

IAA and phosphoroussolubilization capacity. *P. megaterium* strain W6 had IAA activity and on quantification theconcentration obtained was 8.94 µg/ml. The phosphorous solubilisation capacity in *B. subtilis*strain FPTCOF:T1, *P. megaterium* strain W6 and *B. cereus* strain FPTCOF:T3 were found tobe 149.52 ppm, 178.41 ppm and 155.47 ppm respectively. The study was able to throw aninsight on how the waste of fish can be converted into a fruitful product known as compostwhich have the ability to boost the yield of agricultural crops.

Effect of Different Processing Steps on Quality and Storage Properties of Fish- Based Soup Powder Prepared from *Amblypharyngodon mola*

Bijit Bania

The aim of the study is to determine the effect of different processing steps on qualityand shelf life of a fish-based soup powder prepared from mola (*Amblypharyngodon mola*). Forthis purpose, macro and micro nutrient (moisture content, crude protein content, fat content,ash content, fiber content, Na, Ca, Fe, Mg and Zn), physic-chemical characteristics (gastricdigestibility determination, in vitro protein digestibility, total phenolic content, antioxidantactivity, SEM analysis and color), of the prepared fish soup powder were evaluated. Toevaluate the shelf life of the fish soup powder during storage following parameters such asorganoleptic test, total volatile base nitrogen (TVB-N), free fatty acid (FFA), peroxide value(PV), pH and microbiological properties were enumerated using TPC and TFC methods.Moisture content, pH, TVB-N, PV and FFA values of all the treatments increased during thestorage period. However, these values are within the acceptable limits. The TPC was withinthe acceptable level and the pathogens were completely absent, furthermore the overallmicrobiological properties of the fish soup samples were found within the consumption limitsduring storage. Similarly, organoleptic evaluation of the prepared fish soup powder was ratedas good after four months of storage without affecting its nutritional attributes. As a result, astandard product in the form of fish soup powder has been obtained having high nutritionalvalue and rich in micronutrients. Moreover, the dual advantages of the fish soup powder arefinding ways for maximum utilization of the low valued mola fishes and providing protein richconvenience food products.

Abstract of M.F.Sc. thesis

Department: Fish Processing Technology

Major Adviser: Dr. Pranjyoti Sarmah

Evaluation of Microbial Properties of *Namsing*: A Traditional Fermented Fish Product of Assam

Kamakhya Kalita

The traditional food products harness the dietary history of particular community and therefore the indigenous knowledge of ethnic people for production of processed fish product for consumption is worth documentation. The present study was aimed on microbial evaluation of a traditionally processed fish paste product *Namsing* of Assam. A total of 7 group of bacterial isolates were isolated and identified as *Staphylococcus epidermidis* strain FPT N101, *Paenibacillus dentritiformis* strain FPT N112, *Paenibacillus popilliae* strain FPT N123, *Staphylococcus hominis* strain FPT N130, *Paenibacillus. dentritiformis* strain FPT N138, *Staphylococcus carnosus* strain FPT N 145 and *Bacillus* spp. strain FPT N152 following biochemical and molecular identification tools from 25 numbers of samples. The isolates were further characterized for enzymatic, antagonistic and probiotic characteristics which showed that none of the strains had proteolytic and amylolytic activity during the enzymatic assays and out of 7 nos. of strain, 5 nos. of strain showed lipolytic activity. The antagonistic properties revealed 3 nos. of the strains had inhibitory effect against common food-borne pathogens. None of the strain was found to produce biogenic amines in the applied method. Out of the 7 numbers of identified strains, 4 nos. of the isolates were hydrophobic in nature. Moreover, the antibiotic sensitivity showed 6 nos. of the isolates to be susceptible against the common antibiotics used in the study. Several in vitro screening tests were done to study the probiotic properties of the isolates which revealed the isolates were able to tolerate low pH levels, higher bile salt, high temperature, and higher concentration of phenol. The 25 nos. of *Namsing* samples were screened for incidence of three numbers of food borne pathogenic microorganisms *viz*. *Escherichia coli, Salmonella typhimurium and Listeria monocytogenes* and it was found that none of the samples carried these pathogens. The findings of the present work could throw an insight on the incidence of functional microorganisms in the traditionally fermented fish product *Namsing* and opened a new arena to take up research on optimization of the process of *Namsing* production as well as identification and selection of candidate

Abstract of M. F. Sc. thesis

Department: Fish Processing Technology

Major Adviser: Dr. Sarifuddin Ahmed

species to be used as starter culture for food fermentations, probiotic formulations for new food product development and further research on production of inhibitory compounds to reduce the level of pathogens.

Quality Evaluation of an Indigenous Traditional Semi-Fermented Fish Product "*Namsing*" Prepared by Mising Communities of Assam

Riya Riang

The present study was aimed to study the quality of *Namsing* - an indigenous traditional fermented fish product of Mising communities of Assam which were subjected to proximate composition, biochemical, mineral composition, microbial, protein quality and organoleptic analysis. The protein, moisture and fat content were 41.28 - 47.27%, 16.29 - 22.89% and 9.2- 13.5%, respectively. The biochemical analysis revealed that the pH, PV, FFA, TBA, TVB-N and NPN content in the *Namsing* samples ranged between 6.03 - 6.69, 15.26 meq/100g - 16.32 meq/100g, 5.17 % - 6.29 % as oleic acid, 0.42 - 0.54 mg malanoaldehyde/Kg, 39.8 mg % - 44.55 mg % and 14.51 % - 18.90 % respectively. The fiber and antioxidant content in the samples ranged between 4.43 % - 4.63% and 52.14% - 64.9 %, respectively. The highest mineral content was recorded for Potassium which was 260.52 mg/kg - 264.02 mg/kg followed by Calcium and Sodium which was 188.94 mg/kg - 198.4 mg/kg and 96.72mg/kg - 102 mg/kg, respectively. The APC and mould count showed 4.49 - 4.53 log cfu /g and 2.77 - 2.95 log cfu /g, respectively, there was no incidence of yeast in the samples. The result of protein fractionation showed that *Namsing* contained high amount of stroma protein followed by myofibrillar and sarcoplasmic protein. The SDS - PAGE showed common bands in all the samples ranging from 180 -135, 75 - 63, 25 - 20 kDa. It was also observed that a common band of 223kDa in all the samples indicating no degradation of the Myosin Heavy Chain (MHC). The low molecular weight protein bands found in the range of 45 and 20-25 kDa indicated that high molecular weight proteins have fragmented into smaller proteins. The organoleptic assessment exhibited high acceptability by the consumers. Overall, the results obtained in the present study can be used as standards for further research for quality standardization and mechanization of the process for commercialization of *Namsing* as a functional fish product in the North Eastern region.

Abstract of M.F.Sc. thesis

Department: Fish Processing Technology

Major Adviser: Dr. Sarifuddin Ahmed

Stock Structure Analysis and Reproductive Biology of *Rita rita* (Hamilton, 1822) Along The Middle Stretch of Brahmaputra River System Using Truss Network Analysis

Asifa Najnin

Rita rita, a freshwater bagrid catfish popularly known as 'Rita' is a commercially important food fish all along the Brahmaputra basin and its tributaries. A truss network was constructed by interconnecting 14 landmarks to form a total of 30 truss measurements, based on 300 samples collected from three populations representing Brahmaputra River, Jamuna River and Kopili River. The factor analysis (FA) of truss network indicated body depth related traits loading heavily on first factor, shape related traits belonging to caudal portion on second factor. The first principal component (PC1) explained 82.14% of the total variation, while PC2 explained 3.56% respectively. A total of 74% of the original groups were classified into their correct sample while 26% were misclassified individual using discriminant function analysis. In the present study, suggests the possible existence of two stocks of *Rita rita*, a single stock in the Brahmaputra River while Jamuna River and Kopili River contain the same stock. In the present study, data on reproductive biology containing sex ratio, condition factor, fecundity, hepatosomatic index and Gonado-somatic index (GSI) of *Rita rita* were assessed. Samples were collected from the landings centre located on the bank of river Brahmaputra at Tezpur, river Jamuna at Jamunamukh and river Kopili at Dharamtul from August,2022 to July, 2023. An overall sex ratio (M/F) of 1: 2.70 observed was statistically non-significant. The gonadosomatic index ranged from 0.22-3.81 in males and 0.65-11.45 in females, both showing peaks in the month of July. The hepatosomatic index (HSI) varied from 0.88-1.35 in male, 1.34-2.14 in females and 1.09-1.59 for the pooled sample, the value of HSI index gradually decreases with increase of GSI in both male and female.The fish was highly fecund and the fecundity ranged from10445.88 to 26262.52 with an average of 16,865.89. The fecundity was found to increase with the increase of total length, body weight and the ovary weight and the relationship was linear and significant among them However, the relative condition factor >1 suggested the species to be in good condition throughout the year in both the males and females.

Abstract of M.F.Sc. thesis

Department: Fisheries Resource Management

Major Adviser: Dr. Jiten Sarma

Occurrence and Characterization of Microplastics in Fishes From Thekera *Beel*, A Freshwater Wetland of Morigaon District, Assam

Garima Bora

The ubiquitousness of plastic is now a global threat. The non-degradable plastics undergo weathering process and are converted into microplastics (MPs). Various studies have been conducted in the marine ecosystem to identify and quantify the presence of MPs, while only a few studies are documented in the freshwater ecosystem. The Thekera *beel* is an open freshwater wetland having a connection with the Kolong river, a tributary of mighty Brahmaputra during the monsoon season. In the present study, the occurrence of MPs on the herbivore, omnivore and carnivore fishes was evaluated. In this study, 9 fish species (n=10) with different feeding habits and trophic levels were collected from the beel. MPs were observed in 100% of all the fish individuals examined, and there was an average abundance of 3.69±0.20 numbers per individual. Overall a total of 332 numbers of MPs were found in all the sampled fish species. Among all the fishes examined, *Glossogobius giuris*, a carnivore, exhibited the highest mean abundance of microplastics (5.50 ± 0.60 numbers per individual). The average abundance of MPs in carnivorous fish was the highest compared to herbivorous and omnivorous fish. The MPs were predominantly fibre shaped ranging from100-500µm. Transparent MPs were abundant in the fishes followed by blue coloured MPs. Polyethylene polymer was identified as the predominant polymer type in Herbivorous and Carnivorous while Nylon polymer was the most abundant polymer among Omnivorous fishes. Furthermore, a positive relationship was identified between the MPs abundance and the trophic level of organisms. These findings imply that MPs may transfer along the food chain and accumulate in the body of organisms of higher trophic level.

Abstract of M.F.Sc. thesis

Department: Fisheries Resource Management

Major Adviser: Dr. Ayub Ali

Status of Ichthyofaunal Diversity and Seasonal Physico- Chemical Variations of Charipunia Beel of Morigaon District, Assam

Bhagyashree Das

The present study was conducted to evaluate the ichthyofaunal diversity and habitat ecology of Charipunia *beel* (7.0 ha), Morigaon district of Assam, for a period of one year from May, 2022 to April, 2023. A total of 26 fish species belonging to 18 genera, 11 families and 4 orders were recorded from the *beel*. The order Cypriniformes comprised of 1 family (9.09%), 7 genera (38.89%) and 10 species (38.47%) contributing to the total. Five families (45.45%), 5 genera (27.77%) and 7 species (26.92%) made up the order Perciformes. With 2 families (18.19%), 3 genera (16.67%) and 6 species (23.08%), the order Siluriformes contributed a significant portion to the total number and percentage composition of the *beel*, followed by Clupeiformes with 3 families (27.27%), 3 genera (16.67%) and 3 species (11.53%). Fisheries of Charipunia *beel* was mainly dominated by *Amblypharyngodon mola, Puntius sophore, Mystus tengara, Mystus vittatus, Cirrhinus mrigala, Labeo rohita* and other miscellaneous species. As per IUCN Conservation status (2023), the highest species were recorded under Least Concern (LC) category with a total number of 20 and contributed 58.80%, majority of the species belonged to the family Cyprinidae with 8 (23.52%) followed by Bagridae 4 (12.48%), Channidae with 3 (8.82%) and Clupeidae, Heteropneustidae, Ambassidae, Gobiidae, Nandidae with 1 species contributed 2.94%. Under Near Threatened (NT) category, Siluridae contributed 2 (6.24%) and Cyprinidae with 1 (2.94%) species, respectively. Under Data Deficient (DD) category only Anabantidae contributed 1 species (2.94%). Under vulnerable (VU) category, Bagridae contributed 2 (6.24%) species and Cyprinidae, Heteropneustidae,Claridae, Channidae and Anabantidae each contributed 1species (2.94%). Margalef's Richness Index (d), Pielou's Evenness Index (J), Shannon- Weiner Index (H') and Simpson Index (1-λ) indicated high fish diversity in the *beel*, with a more or less even distribution of fish genera indicating that the *beel* was in good condition for fish production. During the study period, a total of 26 genera of phytoplankton and 11 genera of zooplankton were recorded in the *beel*.

Abstract of M.F.Sc. thesis

Department: Fisheries Resource Management

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Chlorophyceae was found to be dominated among the phytoplankton and rotifera were dominated among the zooplankton group. The majority of physico- chemical parameters were found to be in a favourable range for aquatic species growth and reproduction. Water temperature of Charipunia *beel* ranged from 18.60o C to 29.30o C, Water pH from 5.5 to 7.9, dissolved oxygen ranged from 4.5 mg/l to 7.6 mg/l, total alkalinity from 42.3 mg/l to 67.1 mg/l, total hardness from 51.3 mg/l to 70.2 mg/l, free carbon dioxide from 5.5 to 9.3 mg/l, turbidity from 3.1 NTU to 4.6 NTU, and ammonia nitrogen ranged from 0.14 mg/l to 0.32 mg/l. Although the condition of the *beel* was found to be favourable for fish production there is an urgent need for strict imposition and monitoring of fisheries regulations during the banned season. Also, identification and protection of feeding and breeding grounds of indigenous fishes as well as awareness among the fishermen is very much needed for sustainable use of the *beel*.