KEY NOTE ADDRESS

KN-01
Biotechnology based programme for social development

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Good Morning,

I am extremely happy and privileged to be with you on the occasion of "**National Conference on Enhancing Nutritional Security through Climate Smart Farming Practices**" held on 17th-18th March, 2017 at Regional Research Station, Kalimpong.

I would like to complement Dr. Sumit Chakravarty, Organizing Secretary and his colleagues for organizing the same by Cooch Behar Association of Cultivation for Agricultural Sciences (COBACAS) in collaboration with UBKV, Pundibari West Bengal.

The conference is very important in the light of climate change and demographic challenges to make improvement in the sustainable performance of the agricultural sector. Agriculture experts and thinkers have been suggesting promoting Climate Smart Agriculture (CSA) as a method to help the farmers to adapt to a changing climate and to mitigate greenhouse gas emissions while boosting agriculture production.

As a major towards increase food production and adoption of diversification towards high value crops (HVCs), horticultural farming, fishery, livestock production capacities from farming systems are developed suitable to different agro-climatic conditions to benefit the poor and marginalized farmers with their available land resources. The need of the hour is to identify key mechanisms underpinning climate change and its impacts on agriculture, horticulture, fishery, livestock and forestry and to select the best with management strategies.

The conference will also help traditional farmers and farming communities. There could be a better option for integrated farming with the adoption of sustainable models in agriculture. Under the Societal Development Programme DBT is promoting the use of biotechnological processes and tools for the benefit of the disadvantaged section of the society comprising women, rural population, SC/ST and weaker section.

The programme is very specific and to create opportunities for self-employment among the target population and diffusion of proven and field-tested technologies through Demonstration, Training and Extension based activities. The broad focused areas are:

- Agriculture and Allied Sector
- Health, Nutrition & Sanitation
- Value Chain and Post Harvest
- Agri-preneurship Development
- Biodiversity conservation

- Rehabilitation and Restoration measures during Natural Calamity

Under the scheme so far, large number of rural, SC/ST and women population have been benefited through implementation of these programmes. Excellent examples of innovative societal programme are "Network Project on Prasad Kit" and running of mobile ambulatory clinics for the farmers. Low cost poly house construction for raising nursery-planting material has also been developed for cultivation of medicinal and aromatic plants with the implementation of rural bio-resource complexes at seven SAUs including the one we have supported at UBKV and NBU on solid waste management, mushroom cultivation and fisheries. Almost in the entire component implemented in 08 districts of North Bengal shown good success.

Other programme for the rehabilitation of Tsunami victims has benefitted large number of coastal fisherman community. Projects have been supported for the relief of flash flood affected areas in Uttarakhand could help generation of alternate livelihood options for affected people.

In February, 2016 DBT has completed 30 years of its journey dedicating its efforts for the students, researchers and the scientists for promotion of high quality education and excellence in biotechnology. There has been a great focus for the socio-economic upliftment through the promising scheme like 'Biotech-KISAN'. As an offshoot of the social sector programme of DBT, DBT has launched a scheme on "Biotech-Krishi Innovation Science Application Network (Biotech-KISAN)" to bring Scientists and Farmers together for sharing knowledge and technology. This scheme has been launched by DBT for implementation in 15 agro-climatic zones of India in phased manner with the objectives to have:

- Direct linkage between Science laboratories and farms
- Make Indian Scientist understand the problems of the local farmer and provide solutions to the problems.
- Expose farmers to the scientific solutions available by bringing them to the scientific environment/laboratory.
- Promote need based research that allows innovative solutions and technologies to be developed and applied at farm level.

National Biotechnology Development Strategy-2015-2020 finalized by DBT started implementation for the welfare of the scientific community. In the biotech strategy major focus is given on brain drain issues, fellowships for the welfare of the young scientists including women scientists (Bio-CARe). Award of Fellowships to bring scientist working in international labs abroad to join good position in India and to work for the Country has also been initiated. Also giving emphasis on translational research and diffusion of technological know-how which may result to inclusive growth of the Country through NBDS guided policy.

Coming back to the National Conference, I could see that the theme areas have been addressed on:

- Climate change, geo-informatics, greenhouse effect and disaster management
- Biodiversity for crop/animal improvement, sustainable utilization and conservation of natural resources
- Biotechnology, biotic and abiotic stress management strategies under changing climate scenario
- Strategies of food and nutritional security, biofortification, product diversification/value addition and market linkages
- Impact of climate resilient crops/horticulture for hilly agro ecosystem
- Socio economic development through climate smart agriculture

Just to appraise you about the other schemes, DBT is also supporting R&D projects under the various research schemes with the theme of the conference through the Task Force Mechanism in the area of agriculture biotechnology, crop improvement, biodiversity conservation and environmental biotechnology. I am sure that some of the promising scientists and

researchers can take benefit of DBT schemes/ programmes by accessing DBT website (http://www.dbtindia.nic.in/).

I would like to extend my best wishes to all the participants and the organizers.
I wish the conference a grand success.
"Jai Hind / Jai Bharat"

KN-02

Enhancing Employment and Income of the Resource Poor Families for Achieving Nutritional Security

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Empowerment of resource poor families in rural areas is gaining momentum in most of the developing countries of the world. With low income and less knowledge and skill in economic activities, existing formal financial services can do little for their economic development. Towards this direction, providing skill based training and micro finance to initiate micro enterprises plays a significant role. For this, a concerted effort is need to be initiated by the development agencies to improve the living standard of resource poor families. Studies have shown that, delivery of micro finance to the resource poor families is highly productive, effective and less costly if these families are organized into Self Help Groups (SHGs). To overcome the weaknesses and for successful empowerment of resource poor families, three action research projects funded by Department of Biotechnology were executed to draw lessons. The major outcomes of these projects are; Enhancement of Socio-economic status of resource poor can be achieved through skill development on economic activities. Women in resource poor families are as efficient as men farmers and they can manage small scale agriculture related production units. If the women and youth in villages are encouraged to establish small scale production units of agricultural inputs, one can ensure their timely availability and quality inputs locally at low price. Action research mode of executing empowerment projects ensures commitment of all the stakeholders by enhancing higher degree of participation. It also ensures adoption of complex agricultural technologies among the farmers. Involvement of local institutions, NGOs and rural youth will strengthen the successful implementation of the project.Initial priority should be given to the development of the individual families instead of addressing the general problems.Involvement of the entire family in the program is essential for success.As most of the rural resource poor are hesitant about their ability to fight poverty, it is necessary to boost their confidence before initiating empowerment programs. As a complementary source of family income, the self-help groups proved to be a boon to the resource poor families not only in enhancing their financial status but also promoting entrepreneurship. The training and capacity building programs enthused the resource poor family members to initiate production units of *Trichoderma*, mushroom, fruits and vegetable nursery plants production under protected condition and biofuel oil extraction. The key domains impacting resource poor families are (1) Social capital among members of SHG, (2) Collective action and cooperation among members of SHG and (3) Empowerment lead action among SHG members. Thus, action research and self-help group

approach augments efforts of development departments in addressing challenges of climate change and facilitated to achieve food security.With concerted efforts of the development workers (Govt. NGOS, volunteers) by adopting action research and self-help group approach, it is possible to provide income generating skills even on the lab based sophisticated biotechnologies, with which resource poor women can produce agricultural inputs which are having greater demand among the farmers.

LEAD LECTURE AND ORAL PRESENTATION

Technical Session-1

Climate change, geo-informatics, greenhouse effect and disaster management, biodiversity for crop/animal improvement, sustainable utilization and conservation of natural resources

LL-1-01

Ensuring nutritional security through Horticulture: prospects and constraints in a climate changed world

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Hunger, malnutrition and hidden hunger continues to persist as a pressing Global phenomenon. Food, at the fundamental level, is viewed as a source of nutrition to meet daily requirements at a minimum in order to survive but with an ever greater focus on the desire to thrive. Hunger and malnutrition refers to the lack of macronutrients like carbohydrates and protein in the diet. “Hidden hunger” or micronutrient deficiency is a pernicious problem around the world particularly in the under-developed and developing countries that is caused by a lack of vitamins and minerals such as vitamin A, iodine and iron in the human diet and affects the health of about three billion people worldwide. Micronutrients refer to vitamins and minerals essential for the body’s physical and mental development, immune system functioning and various metabolic processes. Vitamins are organic micronutrients needed to maintain health and sustain life. Minerals are inorganic micronutrients needed for metabolic reaction. People suffering from hidden hunger may appear healthy and it is considered “hidden” due to the absence of the classic symptoms of hunger (i.e. starvation, “skin and bones” look, and protruding abdomen) and to the “invisible” quantity of vitamins and minerals in the food people eat. Vegetables and fruits are the important source of food containing essential micro-nutrients (vitamins, minerals) and phyto-chemicals as a vital accompaniment for the staple cereal based diet and hold the key in assuring nutritional security. With high income elasticity, the demand for vegetables and fruits and perception of diversified diet has been growing steadily. In India, both access and consumption of vegetables has been increasing in the urban and peri-urban population group. People are beginning to consume more healthful foods that can alleviate problems related to “diseases of overabundance” and diet-related chronic diseases, such as some types of obesity, heart disease, and certain types of cancer. However, meeting the requirements for macro and micronutrients for most of the population groups in rural households and communities of India and most of the South Asian countries seems far-off because of meagre presence of vegetables in the diet. The basic challenge is to make vegetables and fruits accessible to the huge poorer sections who are

by default starved and malnourished. Improvement of nutritional quality of vegetable crops appears to a rewarding activity for plant breeders in the 21st century. The most critical challenge to crop production is the attainment of enhanced productivities in farmers' fields, especially in developing countries. In the climate smart agriculture, farmers require suitable improved varieties of different crop that are genetically diverse, climate change resilient, input use-efficient, high yielding, have enhanced nutritional and other quality attributes and have been bred for adaptation to a range of agro-ecosystems and farming practices. The extremely narrow genetic base of the available varieties of different crops nullifies efforts to enhance productivities in farmers' fields, increase vulnerabilities and thereby imperil food and nutritional security. Different important traits from non-adapted genetic resources including landraces, mutants and crop wild relatives need to be incorporated in crop improvement programme to develop "smart" crop varieties of the 21st Century.

LL-1-02
Pulse cultivation for nutritional security and sustainable ecology

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Pulse crops are one of the most sustainable crops a farmer can grow. It takes just little water to produce same mass, compared with other crops. Pulses are rich source of protein to vegetarian people of India and second important constituent of Indian diet after cereals. They provide a number of nutritional benefits that positively impact human health. Pulses provide raw material to various small industries (*dal*, *chhatu,* roasted grain, *papad* industry, etc.) Pulse crops can be grown on almost all types of soil and climatic conditions. They can supply additional fodder for cattle. Some pulses are turned under the soil surface as green manure crops. Pulses being legumes fix atmospheric nitrogen into the soil. They play important role in crop rotation, mixed and intercropping, and they help to maintain the soil health and fertility. They add organic matter into the soil in the form of leaf mould. Pulse crops produce a number of different compounds that feed soil microbes and help to maintain soil health, thus, they have a significant impact on soil biology, increasing soil microbial population and activity even after the harvest.Pulses have also been shown to exude greater amounts and different types of amino acids than non-legumesand the plant residues left after harvesting have a different biochemical composition (*e.g.* better Carbon : Nitrogen ratio) than other crop residues. Crops' performance is better in soils that are more "alive" with a diverse array of soil organisms, as these organisms break down and cycle nutrients more efficiently, feeding the crops as they grow. In addition, a large, diverse population of soil organisms acts to 'crowd out' non-beneficial disease-causing microbes, making for healthier plants. Growing pulse crops in rotation with other crops enables the soil environment to support these large, diverse populations of beneficial soil organisms.The ability of pulses to feed the soil different compounds has the effect of increasing the number and diversity of soil microbes.They are helpful for checking the soil erosion as they have more leafy growth and close covering. With the introduction of improved varieties and promotion of best management practices, pulse crops can continue to be an excellent choice for farmers to maintain the ecology.

LL-1-03

CMIP5 GCMs based district-wise climate change scenarios and its impact on rice production over West Bengal

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Now-a-days simulations from Global Climate Models (GCMs) are extensively used for the purpose of impact assessment and decision making vis-à-vis crop simulation models are run to study the impact of climate change on agriculture sector. The present paper investigated how these models are able to provide useful information for policy making at sub-regional or local scale. The district level past rainfall change has been estimated from the monthly district level IMD data through dividing the whole last century into four periods 1901-30, 1931-60, 1961-90 and 1991-2000 and percentage change of rainfall has been calculated with respect to the base period 1971-2000. The annual rainfall trend of 100 years data has revealed that all the districts except Nadia, Jalpaiguri, South Dinajpur and Bardhaman have shown a positive trend. Except Jalpaiguri, South Dinajpur and Nadia, all other districts have received an increased amount of rainfall during monsoon season. Apart from observed station data, how different GCMs from CMIP5 reproduce the observed increasing/decreasing rainfall trends has been judged through conventional statistics. Finally a group of better performing models is identified for north Bengal and south Bengal district separately which can be used as an input for any decision making research. In addition, the future rainfall analysis using the better performing GCMs reveals that in the 21st century there is a significant increasing trend of seasonal and annual rainfall except the winter season. Analysis of percentage change of rainfall reveals that winter rainfall has shown 60-117% surplus in future for different RCP scenarios, whereas the post-monsoon has shown a 1-15% surplus of rainfall in future over North Bengal. Similarly, the annual rainfall over south Bengal has projected a deficient precipitation of 16 to 25% under different RCP scenarios and different climatological as well as long-term period while 3-24% surplus of rainfall is projected for different RCP scenarios in the post-monsoon season. Such a change can alter the productivity of rice as assessed through Oryza 2000, a crop simulation model for rice. Gangetic West Bengal is expected to experience nominal change in the either sides as rice production increases by about 10% with 1°C rise in temperature and falls by 30% with a rise of temperature by 2°C.

OL-1-01

Ethnomedicinal and ethnoecological evaluation of *Haematocarpus validus*: a threatened medicinal plant in Bangladesh

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Medicinal plants are alternative source for the antioxidants which don't possess side effects and more potent than synthetic drug.Iron is one of the much talked dietary micronutrient for women and children health. *Haematocarpus validus*is very rich source of Iron. Pulp is found to be rich in iron contents (0.56 mg/100 g) and seeds contain 0.14 mg/100g which is comparatively higher than the fruit which we use in our daily life like mango (0.2mg/100g), apple (0.1mg/100g), guava and cherries (0.3mg/100g). It was first time reported in Krisnomohan para of Khagrachari sadar in Bangladesh and Diglipur area of North Andaman. An ethno-medicinal survey was conducted in various parts of Khagrachari districts in Bangladesh with the aim to document ethnoecological and medicinal value of *Haematocarpus validus*. It has been used by ethnic communities since centuries in traditional system of medicine. Based on the results obtained, it was concluded that *H. validus*is a multipurpose plant. It is one of the commonly used plants for Fruit and medicinal purposes as well as due to its ethno-ecological importance. Various parts of *Haematocarpus validus*are used as: fruits, medicine and a source of resins. During the current study, it was also noticed that H*. validus* is distributed throughout the hilly ecosystem of CHT in Bangladesh. However, its population suffers from serious environmental problems such as deforestation, soil degradation, loss of biodiversity and unsustainable livelihoods. The study concluded that *H. validus* has high medicinal, economic and ecological values in hilly ecosystem of CHT. Nevertheless, its conservation status is highly threatened and detailed ecological study of *H. validus* is suggested to conserve its remaining population in Bangladesh.

OL-1-02

Genetic resources of tropical and subtropical fruit and its role for agro-biodiversity and food security in Bangladesh

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Bangladesh has many indigenous plants which are less utilized in agriculture genetic resources. Many of these plant species warrant further attention: they are more resilient to environment stresses such as droughts, can withstand salinity and poor soils better than many domesticated species and provide important additional nutrients to the local diet. A major threat to Bangladesh's future agricultural production is posed by the effects of global climate change. Its effects are already evident from variations in rainfall patterns and increased severity of floods in South Asia. The implications are not only localized disasters which ruin the livelihoods of the affected families, there is likely to be a large-scale loss of productivity in the medium to long term, contributed to by a likely deterioration of soil structure and quality, changes in cropping seasons and planting windows and resulting decline in productivity and yields. Considering the current

development problems in Bangladesh such as poverty and malnutrition, underutilized fruit trees that are indigenous and adopted to the country are important genetic resources for addressing these problems. These fruit tree species are good sources of food and important vitamins and minerals. The development of improved varieties and new products or by-products, and the expansion of planting of these underutilized tree species hold a great potential for improving nutrition and food security.

OL-1-03
Status of minor fruit diversity in Southern coastal zones of Bangladesh

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An intensive survey on agrobiodiversity, information collected from key informants, and Focus Group Discussion (FGD), were made of aquatic agricultural systems in three regions (polders) of Borguna, Satkhira and Khulna in southwestern Bangladesh. This research was conducted by Biodiversity International in partnership with the Fruit Tree Improvement Program (FTIP) of Bangladesh Agricultural University (BAU) and World Fish under the CGIAR Research Program on Aquatic Agricultural Systems (AAS). Key stakeholders consulted included farmers, businessmen, politicians, local leaders, local public representatives both male and female, Government and Non-government officials and religious leaders. The topics covered included species loss (minor fruits), cropping pattern, homestead diversity, food habit and marketing systems. Information was also collected on causes of loss, major constraints, potential actions, and responsibilities. Wide variations were observed in respect of species loss, cropping pattern, food habit and marketing system in the three polder zones. Homestead diversity of crops also varied significantly. Species loss was associated with natural disasters, sea level rise, increased salinity and political interventions.

OL-1-04
Diversity of underutilized fruits in ‘Kaptai’ Reserve Forest, ‘Rangamati’, Bangladesh

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A field survey was conducted during May 2015 to May 2016using semi-structured questionnaire, in ‘Kaptai’ Reserved Forest, ‘Rangmati’, Bangladesh. A total of 40 households (more than 50% population) in two enclaves of the locality were surveyed to determine the diversity of underutilized fruits both cultivated and wild. Plant species were preserved in herbarium sheet and were brought to the laboratory for identification consulting monograph and Taxonomist. A total of thirty one species belonging to twenty four genera and seventeen families of underutilized fruits were found to be used by the local inhabitants. Of these, eighty per cent were grown in wild and only nine percent fruits were cultivated. Most of the fruits come from Euphorbiaceae (12%)

followed by Rutaceae (9%), Moraceae (11%), Myrtaceae (9%), Anacardiaceae (9%), Oxalidaceae (6%), Flacourtiaceae (6%) and Ebenaceae (6%). Considering the conservation status9% vulnerable (VU), 3% endangered (EN), 3% not evaluated (NE) and 83% fruits were least concern (LC). Among the species *Diospyros rammiflora* of Ebenaceae was EN, *Haematocarpus validus* of Compretaceae VN, *Mangifera sylvatica* of Anacardiaceae VU, *Xerospermum laevigatum* of Sapindaceae family VU and was rarely found in wild. Such information is essential for the conservation of those underutilized fruits (especially those grown in wild) in order to safeguard them for future generation and avoid their genetic erosion.

OL-1-05

Verification trial of jute in tribal areas of West Bengal through soil test and target yield approach

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Studies on soil test crop response was conducted at experimental farm of CRIJAF, Barrackpore, West Bengal in order to develop fertilizer prescription equation for the desired yield target of jute (JRO 204). The basis for making the fertilizer prescription viz, NR (Nutrient requirement), CS (contribution from soil), CF (contribution from fertilizer) and CFYM (contribution from FYM) were computed using the experimental data. Making use of these basic parameters, fertilizer prescription equation (FPE) was developed under NPK along with FYM for the desired yield target of jute. Target yield equation developed for jute was verified through trials during 2015-16 in the tribal areas of Nadia district, West Bengal. The objectives of the trials were to verify the fertilizer dose based on soil test target yield (ST-TY) approach against farmers' practice. In Dakshin Bramhapur of Nadia district fifteen tribal farmers were selected. ST-TY based fertilizer application recorded higher fibre yield of jute than farmers' practice. Highest fibre yield (38.0 q/ha) was recorded in ST-TY (40q/ha) +FYM treatment. Target yield of jute was achieved in ST-TY treatment with (±) 10% yield deviation. Average fibre yield in ST-TY treated plots (without FYM) was 35.7 q/ha where as in farmers' practice jute fibre yields were recorded as 23.3 q/ha. Higher response ratio recorded under STCR + FYM treatment as compared to farmers' practices might be attributed to balanced supply of nutrient from fertilizers, efficient utilization of applied fertilizer nutrients in the presence of organic sources.

OL-1-06

Conservation agriculture based resource conservation technologies: prospects in jute based cropping systems in Indo-Gangetic plains

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Sustainable agriculture in any eco-system can be achieved through stabilizing the environment, enhancing the productivity and establishing dynamic equilibrium between natural resources and population. Thus top priority should be given for conservation of natural resources mainly soil and

water conservation. Conservation agriculture (CA) being practiced over an area of 155 M ha (FAO, 2014) worldwide, is a concept of resource saving agricultural crop production that strives to achieve acceptable profits together with high and sustainable production levels while concurrently conserving the environment. CA is a set of technologies, including minimum soil disturbance, permanent soil cover, diversified crop rotations, and integrated weed management aimed at reducing and/or reverting the negative effects of conventional farming practices. Chemical weed control is the most effective weed management option in CA; Residue retention strongly impacts weed emergence; several factors determine the extent of this influence including type and quantity of residue, nature of the residue, soil type, weather conditions, and prevailing weed flora. Jute (*Corchorus olitorius* L.), also known as "Golden Fibre of India" though occupies only 0.42% of gross cropped area, provides livelihood to more than 40 lakhs farm families. It also provides direct and indirect employment to another 10 lakhs people in the industrial sector. The production of raw jute has been increasing gradually over the decades while the area under jute has reached a plateau. The sharp increase in cost of production of jute has reduced the net return of jute farmers. Under this circumstance, there should be some innovative approaches of jute production which will attract the jute farmers. CA based resource conservation technology may be an innovative, feasible approach under Jute based cropping systems with their unique crop physiology of leaf shedding in the field, which takes care of crop residue management under CA. Moreover, there is scope for accommodating a number of crops like jute followed by rice followed by lentil/wheat/mustard etc. which will ensure higher net return. Preliminary study on this aspect resulted significant results at ICAR-CRIJAF, Barrackpore, West Bengal. Thus, adoption of CA based resource conservation technologies for increasing resource use efficiency and to foster sustainable jute based crop production systems is need of the hour.

OL-1-07

Determination of the morphological and physiological aspects of the flowers of selected Sri Lankan underutilized blue flower species

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Sri Lankan biodiversity accounts for more than 800 endemic flowering plants, out of which, the most of the species are underutilized. In Sri Lanka, floriculture industry is limited to a few major crops and introductions from under-utilized plants would be an innovative approach to compete in world market. The objectives of this experiment were to determine the flower morphology of selected underutilized blue flowering plants from Matara District of Sri Lanka and the physiology of the flower in terms of pigment type and vacuolar pH to be used in breeding blue colour flowers. Three blue flower colour species named *Commelina benghalensis*, *Clitoria ternatea* five accessions, accession"2" in family Convolvulaceae and three species with a blue and purple colour mix named *Ipomoea pes-caprae,* accession "1" in family Boraginaceae,*"Welmudu mahara"* were selected based on abundance. Morphological characters of the flower, flower pigment content and the vacuolar pH were determined. Five *Clitoria ternatea* accessions of two in blue colour, two in white colour and one in a mixture of both blue and white were observed. Accession "1", *Ipomoea pes-caprae,* accession "2" all these single flowers had five sepals and five petals. *Commelina benghalensis* is a flower with three petals and with three sepals including one reduced petal. As a flower modification 2-3 flowers of *Commelina benghalensis* were converged forming a honey sack. From the five *Clitoria ternatea* accessions the single petal ones had five

petals and five sepals where one petal was larger and the other four have become reduced. The other accessions had 3-5 main large petals. The pigment extracts of all the flowers turned dark blue with 0.1M NaOH indicating that anthocyanin is present in the extract. The highest anthocyanin content of 5.4 and the highest pH of 5.9 were given by *Clitoria ternatea* blue colour accession with multiple petals and the accession with single blue petal gave a pH of 5.8 and OD of 5.08. In *Clitoria ternatea* white accessions the pH was around 4.7and OD was zero and the accession with white and blue colour the pH was around 5 and the OD was 1.2. The anthocyanin content of the each flower was proportionate to the colour intensity of the petals. The vacuolar pH of 5.7and OD of 3.75 was recorded from *Commelina benghalensis* and the accession"2".The accession "1" also had a vacuolar pH of 5.4 and an OD of 3.15.The pH of 5.2 was given by *Ipomoea pes-caprae* and "*Welmudu mahara"* where in petals both blue and purple colours were observed. *Clitoria ternatea, Commelina benghalensis* and accession"2"should have the delpinidin and other three species with blue and purple colour mixture may have both delpinidin and cyanidin. In tested species having blue colour is due to the comparatively high vacuolar pH. Studying the physiology of the flowers of these species in terms of flower colour would be useful in genetic engineering of crops for blue colour. Further, consumer acceptance of above plants as potted plants should be tested in the future.

OL-1-08

Evaluation and domestication of Lasoda germplasm under semi-arid climatic conditions of Rajasthan

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Twelve Lasoda germplasm the fruits of which are used to prepare pickle and vegetable are being maintained to study their growth and yield performance at AICRP on Arid Zone Fruits Centre, SKN College of Agriculture, Jobner. On the basis of germplasm performance recorded during 2016-17, out of these Twelve lasoda germplasm JL-07 exhibited maximum plant height (5.77 m) , maximum leaf area(86.23 cm2) closely followed by germplasm JL-02 whereas the maximum plant spread (6.44 X 6.31 m) and trunk girth(95.0 cm) were recorded in JL-02 closely followed by JL-07. As far as the fruiting parameters and yield are concerned, the germplasm JL-07 performed superior over all the germplasm under evaluation. The maximum number of fruit bunches of 18.10 per branch; average weight of bunch 210 g and average fruit weight of 13.50 g were recorded in JL-07. The highest yield of 62.63 kg per plant was obtained in JL-07 germplasm which was significantly superior over the yield of all the germplasm of Lasoda being maintained at this centre. On the basis of the results obtained in present study, it may be recommended that JL-07 is better for obtaining higher yield of good quality fruits for preparing pickle and vegetable under arid and semi-arid climatic conditions of Rajasthan.

OL-1-09

The effect of forest fire on soil properties in Oak dominated forests of Garhwal Himalaya Uttarakhand India

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Fire is a global phenomenon occurring in many forest ecosystems which is one of the most important causes of impacts in ecosystem destruction. Fires have profound impacts on the function of forest soil. Changes to soil properties and processes caused by disturbance factors can be reflected in a wide range of immediate or long-lasting responses in the ecosystem. Their effects depend on the interactions of burning intensity, duration, frequency, fuel load, combustion type and degree of oxidation, vegetation type, fire climate, slope, topography, soil texture and moisture, soil organic matter content, time since last burning and the area burned. A study have been conducted on fire effects on soil properties associated with unburned, burned and 1-year after plots. The study has been conducted in Silkoti, Chamba, and Tehri of Garhwal Himalaya (N30 ° 23.001 E078 ° 22.233) on the Oak dominated forests. The soil samples were collected from both burned and unburned plot at depths of 0-5cm and 5-15cm and again after one year. An ANOVA was used to test the difference between unburned, burned and 1-year after plots. Statistically significant differences between the unburned, burned and 1-year after plots ($P<0.05$ at 0.05 significance level) were further analysed using Tukey Post Hoc Multiple Comparisons Test. The results showed that the effect of fire of soil physical properties was not determined, or considered statistically significant except on soil moisture ($F_{2,35}=23.20$, $P=0.00$ at 0-5cm depth and $F_{2,35}=10.66$, $P=0.00$ at 5-15 cm depth). The results also concluded that the effect of fire on C, N, OM, P, K, S, Cu, Zn, Fe and Mn was not determined, or considered statistically significant ($P>0.05$). From the findings of this study it can be concluded that fire has minimal effect on most of the physical and chemical characteristics when compared between unburned, burned and after 1 year samplings. However, further studies should be carried for the long-term effects of fire which may differ from the short-term effects.

OL-1-10

Human wildlife conflict, an assessment of predation in the various ranges of Rudrapryag Uttarakhand

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Human-wildlife conflicts are common phenomena from the past and have become significant problems throughout the world. Big cats, which play a vital role in maintaining the ecosystem balance through prey-predator interaction, are now on the verge of extinction since they require large habitats, but much of their habitats have been fragmented and degraded. Therefore, frequent encounters with humans and their livestock have caused human-carnivore conflicts which result in retaliation killings. Conflicts between humans and wildlife are escalating due to increasing human population, loss of natural habitats, and, in some regions, increasing wildlife

population as a result of successful conservation programmes. This study aimed at exploring the human-leopard conflict in terms of livestock depredation. In our study on leopard predation on livestock, the data was taken from Forest Department Rudrapryag of Uttarakhand. The data was taken for 6 ranges such as: Augastmuni, Khankhara, N. Jakholi, Rudraprayg, S. Jakholi and Unit Guptkashi. We collected data of livestock depredation from 2011-2015.The data (since 2011-2015) on livestock predation reveals that a total of 870 livestock individuals were killed in 6 ranges. Cow (43%) was the common prey of leopard in these areas followed by ox (28%) and goat (12%). The reason for maximum livestock killings in these ranges is that these villages are surrounded by forest. Maximum 110 (13%) number of livestock were killed in the month of December followed by May (10%) and April, August, January (9% each) and minimum 50 (7%) were killed in October. The most affected range where livestock depredation rate is higher are Augastmuni (43%) followed by S. Jakholi (20%) and N. Jakholi (13%), while as lower rate were found in Guptkashi (5%) and Khankhara (7%). The compensation given by the forest department for different livestock are as: cow (15,000 Rs), cow calf (3000 Rs), buffalo (40,000 Rs), horse (40,000 Rs), mule (40,000 Rs), ox (40,000 Rs), goat (3000 Rs), and sheep (3000 Rs). The highest rate of livestock was killed at steep terrain which shows that killings of livestock due to leopard are at hilly areas which are covered by forest. Mostly killings of livestock occurred in the evening near the forests and some of the killings of livestock also occurred inside home. It is recommended that awareness should be bring in community about leopard and its ecological role and giving training to people, mainly women that how they can use preventive measures to reduce direct killings of their livestock. For awareness program, distribution of pamphlets, seminars and training workshops of community level in the target areas in which safety measures for their property are explained could decrease direct killings of livestock from leopard.

OL-1-11

Contribution of wheat biomass to nitrous oxide emission in Ganga basin of West Bengal, India

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Management of N_2O emission from wheat crop is a great challenge to the climatologist. Different biophysical, climatologically factors are responsible for emission density of N_2O from wheat field. Especially wheat crop biometry played pivotal role on N_2O emission under different field management practices. To establish the fact two years field experiment (2012-2013 and 2013-2014) was conducted in the Gangetic West Bengal, India. Wheat variety K0307 was consider for the study with various nutritional amendments (100% synthetic, 50%synthetic+50%organic and 100% organic as vermicompost) sown on three different dates at 15 days intervals starting from 30th October. Over the 2012-13 and 2013-14 wheat crop season, nitrous oxide emission density was depended on different fertilizer amendments and dates of sowing. Experimental findings showed a pronounced inter-annual variation between plant biometry and Nitrous oxide emission potentiality. Maximum emission was noticed under 100% chemical fertilizer application especially in case of third date of sowing in both the years (14.60 and 13.58mg N_2O m^{-2} day^{-1} during 2012-13 and 2013-14 respectively). Dates of sowing also exhibit a same trend of variation. Significant associations were noticed among plant biometric parameters like plant height, biomass production components and nitrous oxide emission during different phenophases as influenced by dates of sowing and nutrients. During reproductive phases of wheat under 100% organic

environment negative N_2O emission potentiality was observed (-0.95 to - 6.51 mg /m^2 /day). Results also indicated that nitrous oxide emission from soil of winter wheat crop may also be greatly influenced by various nutrient amendments and date of sowing. Some compromising association was also established between the production component and N_2O emission. Overall assessment indicated that growth attributes of wheat have potential contributor of nitrous oxide emission from wheat field.

OL-1-12
Regenerative agriculture: replenishing soil carbon under changing climate

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Food security of the exploding population is expected to cross 9.7 billion marks globally and in India, 1.7 billion by 2050 compounded with a global declining GDP. High External Input Agriculture (HEIA) using synthetic fertilizers and pesticides, combustion of fossil fuel releases CO_2 and other major greenhouse gases like nitrous oxide, methane and a group of gases containing chlorine and fluorine such as Halo carbons, Per-fluorocarbons and Sulphur hexafluoride (SF_6). Soil organic carbon (SOC) levels have declined rapidly in conventional agriculture through repeated tillage in intensive cropping systems, deforestation, overgrazing and denudation of crop cover, affecting the physical, chemical and biological properties of the soil. Adverse impacts of SOC loss are reported in soil fertility, soil eco-system and bio diversity, drought and erosion tolerance, disease and pest resilience and agricultural productivity with an implied effect on food security and the quality of life. Agricultural soils are important sink of carbon through formation of soil organic matter. Restoration of the SOC pool in agricultural soils occurs through adoption of recommended management practices which increase carbon input in soils and decrease its decomposition, creating a positive carbon balance. Regenerative Agriculture, synonymously called as Carbon Farming, refers to a series of major interventions to restore the balance within the earth's carbon cycle in a way that will buffer the climate change, build resilience to drought and soil erosion, increase our agricultural productivity naturally through the practices that gains carbon more than of its losses. Regenerative agriculture targets to maintain a high percentage of organic matter in soils with reduced tillage, minimum use of chemical fertilizers, increased application of organic manures and adaption of mulching, cover crops and crop rotations with minimal soil disturbance to avoid SOC loss. Conservation tillage improves soil structure, reduces fossil fuel use and CO_2 emissions. Continuous cropping with reduced fallow frequency and no-tillage has a positive effect on aggregate formation and stabilization, as well as soil organic carbon. Crop residues are one of the major sources of organic carbon for microbes and fauna, which stabilize soil structure and provide physical protection of the soil surface against structure-altering processes like rainfall or vehicular traffic and its decomposition into simple carbon compounds, assimilation and repeating cycling of carbon through the microbial biomass facilitates the humus formation. Crop diversification improves soil quality with enhanced SOC, soil structure and aggregation and nutrients cycling. Soils under pastures tend to have a higher SOC than cropped soils because they have a higher root to shoot ratio than arable crops, are typically less disturbed and have lower rates of SOC loss. Agro-forestry systems maintain SOC by litter and root residues more so than of sole crops. Hence, worldwide adoption of Regenerative Agriculture is the way forward to salvage this ravaged planet destined towards the climate extremes and mass extinction of species.

OL-1-13

Effect of paddy straw plus non forage fibre sources based complete feeds containing different levels of neutral detergent fibre on milk composition parameters of lactating dairy cows

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A study of six months duration was conducted to assess the milk composition of lactating dairy cows fed on paddy straw plus non-forage fibre sources (NFFS) based complete rations containing different levels of NDF, in two phases, viz., early and mid lactation. Three isonitrogenous and isocaloric complete rations, T1, T2 and T3 with 25, 30 and 35 per cent NDF, respectively were formulated as per ICAR (1998). Paddy straw was the sole source of roughage NDF, with the rest of NDF being met from NFFS, in all the three rations. Eighteen dairy cows yielding approximately 10 kg of milk per day were divided into three groups of six each, and allotted to the three experimental rations. The milk composition parameters such as fat, total solids, solids not fat and protein, were similar ($P<0.05$) between the three dietary treatments. The milk urea nitrogen (MUN) content of cows decreased linearly and significantly ($P<0.05$), with increase in NDF content of the ration. The yield of four per cent fat corrected milk, fat and protein yield of cows in phase I was significantly higher for those fed on rations T2 and T3 ($P<0.05$) than T1, with T2 and T3 being similar ($P<0.05$). All these yields were highest in cows of T3, followed by T2 and T1, in descending order, with the values in the three dietary treatments being significantly different ($P<0.05$), among themselves in phase II as well as the total experiment. A thorough evaluation of the results obtained in the present study, reveal that the animals in all the three dietary treatments performed well, with the complete rations T3 with 35 per cent NDF and T2 with 30 per cent NDF, showing better performance than T1 with 25 per cent NDF. Among T2 and T3 which were more or less comparable in fat, TS, SNF and protein percentage, the cows fed on diet T3 had a significantly lower ($P<0.05$) MUN throughout the lactation and a significantly higher ($P<0.05$) FCM, fat and protein yield in the mid as well as total lactation than those fed on the diet T2, indicating that T3 was better than T2. These results suggest that complete rations with 25 to 35 per cent NDF, containing paddy straw as the sole source of roughage NDF, can be recommended for use among early and mid lactation dairy cows, with 35 per cent being the ideal NDF level.

OL-1-14

Self incompatibility study in cocoa (*Theobroma cacao* L.) accessions

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Cocoa (*Theobroma cacao* L.) is an important plantation crop grown as a mixed crop under coconut, arecanut and oil palm in India. Cocoa breeding programmes are mainly focused on increasing yield, quality and disease resistance. However, there are many problems that impacts cocoa production, among which self incompatibility is a major constraint. Therefore, in the present

investigation self incompatibility reaction was studied in 10 cocoa accessions. Based on the frequency of flower retention after manual protected pollination, trees were classified as self-incompatible or self-compatible. Trees with flower retention (FR) of 10% or less 15 days after pollination were classified as self-incompatible, whereas trees with 30% or more flowers after the same span of time were considered as self-compatible. About 16 to 51 flowers were self pollinated in cocoa accessions depending on the availability of flowers to determine their compatibility reaction, 16 flowers in cocoa accession VTLC-168 and 51 flowers in VTLC-155. Among the ten accessions studied flower retention varied from 0% to 6.6%. Maximum flower retention percentage of 6.6 was observed in the accession VTLC-156 and 0% flower retention was recorded in seven cocoa accessions viz., VTLC-144, VTLC-146, VTLC-148, VTLC-149, VTLC-155, VTLC-168 and VTLC-191. Remaining two accessions exhibited flower retention percentage of 2.9 (VTLC-151) and 6.4 (VTLC-153). Therefore, all the 10 accessions studied in the present investigation exhibited self incompatibility reaction.

OL-1-15

Potential and challenges of participatory approach in forest wildfire management using fire wise approach in forest-fire management at Uluguru Nature Reserve, Tanzania

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The wildfire is the world-wide problem destroys livelihood capitals; reduce biodiversity, and sometime killing people. Various interventions/approaches have been applied including Participatory Approach (PA) to reduce forest fire incidences. The PA worldwide has been incorporated into management theory and is being routinely applied by development agency including management of natural resources in Tanzania in 1990s.The study on the potentials/challenges of fire wise approach (FA) in forest wildfire managementwas conducted in Uluguru Nature Reserve (UNR).Qualitative data were collected and analysed using content analysis. It was found that wildfire incidences in UNR have been decreased from 2011 to 2014 indicating that FA intervention had positive contribution. However recently in October, 2015, huge wild fire emerged, which was mainly caused by human activities. The main reason identified for that huge fire incidence despite of having FA intervention were exclusion of some community members like hunters in the implementation of FA; and lack of alternative resources community used to collect before the Forest reserve changed to UNR. The study conclude that the FA is potential for fire management, However, Important community members like hunters were not aware on the AF despite that the approach was established since 2011. The situation creates the UNR susceptible to fire incidences in future. The study recommends that community members need training on forest management and all stakeholders in the area need to be involved in implementing AF including those with negative interest to management of UNR and plan with them, environmental friendly economic activities like beekeeping.

OL-1-16

Plant Diversity in contrasting forest management units in Govind Pashu Vihar Wildlife Sanctuary Uttarakhand, India- An implication of in-situ conservation

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The present study was carried out to assess the effect of different management regimes on floristic diversity and economic utilities of the plants in Govind Pashuvihar Wildlife Sanctuary in Garhwal Himalaya of Uttarakhand. Two management units' viz. Reserve forest and Civil Soyam were selected for the study. Stratified random sampling technique was followed and twenty 10 m X 10 m nested quadrates were laid randomly in each of the land use to assess the difference in diversity among differently management units. Shannon-Wiener diversity index (H), Simpson concentration of dominance, Species richness (SR), was calculated to understand community composition and ecological health of two differently managed forests. The H recorded for the Civil Soyam was 1.68 for Tree strata, 3.06 for shrub strata and 3.68 for herb strata while as the H recorded for Reserve forest was 2.40, 2.01, 3.86 respectively for trees, shrubs and Herbs. The Present results revealed that Reserve forests is more diverse in terms of Tree and herb density comparative to Civil Soyam and the disturbance in Civil Soyam led to increase in shrub diversity. The present study thus suggests that forest management has peculiar effect on the floristic diversity and serve as a major tool for sustainable conservation of natural resources.

OL-1-17

Studies on relationship between weather parameter, crop phenology and pest population build up in okra

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Causative relationship between weather parameter, crop phenology and pest population build up in Okra crop was studied in the Instructional Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar during 2015-16. The crop was planted three times in a year. The first one, pre-kharif, in 6th SW, second one, kharif, in 20th SW and third one, post-kharif, in 33rd SW. It was observed that the important weather parameters namely, temperature, relative humidity and rainfall played a dominant role in pest population build up during post-kharif season as compared to pre-kharif and kharif one. In pre-kharif season the aphid infestation showed negative correlation with temperature, relative humidity and rainfall where, the jassid, flea beetle and fruit borer population showed positive relation. The weather parameters posed negative impact in the population build up of all the pests in kharif and post-kharif season.Interaction between crop phenology revealed that incidence and subsequent damage due to aphid, jassid and fruit borer were higher during fruiting stage of each of the plating. The flea beetle damage was also observed in fruiting stage except vegetative stage in kharif season. With regard to planting time the incidence of aphid population was higher in post-kharif crop (0.01-5.00/leaf), jassid in pre-

kharif (0.16-17.57/leaf) and fruit borer in kharif one (1.06-27.68%). The flea beetle population was almost same in pre-kharif (0.02-1.83/plant) and kharif crop (0.06-1.67/plant). The yield was recorded higher for pre-kharif crop (23.40 q/ha) followed by post-kharif (22.31 q/ha) and the yield was lowest in kharif season (20.31 q/ha).

OL-1-18
Pollination of blossoming plants

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Pollination is the process of transferring pollens from the anthers of flowers to the stigma of flowers. It is a vital biological process that occurs in blossoming plants. It leads to the production of seeds that grow into innovative plants. Flowers are the main responsible device of the plant that use to make seeds through sexual reproduction. Pollination occurs in several ways. Natural and Induced pollination can be considered as the major types. Natural pollination can be further dividedinto two separate types as self-pollination and cross-pollination. Most of the time, flowers consists with morphological adaptations to acquire the relevantpollination method. Self-pollination is promoted by autogamy floral adaptations and this helps to acquire and maintain pure lines. Special adaptations of bisexual flowers and self-incompatibility avoid self-pollination and promote cross-pollination in plants. And also unisexuality, self-incompatibility, Protogyny and prototandy of flowers ensure the cross pollination and it helps to create genetic variation within apopulation. Pollens can be transferred from anther to stigma artificially and it is called artificial hybridization. Emasculation, bagging and rebagging are some major steps of artificial hybridization. Artificial hybridization acts a major role in agriculture and horticultural sector. When considering natural pollination, biotic and abiotic vectors act a vital role in pollen dispersal from the anther to stigma. Entomophilous and Zoophilies are the main biotic agents of natural pollination and Anemophity, Hydrophily and gravity are the main abiotic agents. Flowers have numerous adaptations to ensure their pollination by these agents accordingly. Pollination is a valuable natural phenomenon and it assures the sustainable livelihood of the ecosystem of the plannet.

OL-1-19
Effect of different tillage and residue management in productivity of chickpea under chickpea-maize-t.aman rice cropping pattern in High Barind soil of Bangladesh

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The field trial was conducted at the farmer's field of FSRD (Farming System Research and Development) site, Godagari, Rajshahi during *Rabi* season 2013-2014 with an objective to observe the effects on yield performance of chickpea under different tillage's and residue mulches for chickpea- maize-T.aman cropping pattern in the High Barind Tract. The experiment

was conducted in RCBD with three dispersed replications in the *Rabi* season 2013-14. Three tillage methods *viz.*, (i) T_1= strip tillage (ii) T_2=bed planting and (iii) T_3= conventional tillage in combination with three mulching practice *viz.* (i) M_1=farmers practices (ii) M_2=15% residue straw mulch (iii) M_3=30% residue straw mulch were studied. Interaction effect of tillage and mulching were found significant on soil moisture and also on chickpea yield. Bed planting along with 15% straw mulch produced significantly higher chickpea yield (1.147 t ha^{-1}) and gave higher economic benefit than that with other treatments. The results indicate bed planting coupled with 15% straw mulch might be a good option for better soil moisture conservation and higher economic benefit and yield of chickpea in High Barind Tract of Bangladesh.

OL-1-20

Genetic variability for grain yield and its attributing traits in Finger millet [*Eleusine coracana* (L.) Gaertn] genotypes

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Finger millet is an important nutri cereal crop amongst the small millets which is cultivated mostly as a rain fed crop for its valued food grains and its adaptability to wide range of geographical areas and agro-ecological diversity. It has an excellent nutritive value and good source of minerals like Calcium, Iron, Phosphorus, Zinc and Potassium. An insight into the nature and magnitude of genetic variability present in the gene pool is of immense value for starting any systematic breeding programme because the presence of considerable genetic variability in the base material ensures better chances of evolving desirable plant type. Hence, an attempt was made to estimate the extent of variation for grain yield and its contributing traits in 49 finger millet genotypes for six grain yield and its attributing traits (Plant height, No. of tillers/plant, panicle length, No. of panicles/plant, Number of fingers/panicle and grain yield) during kharif-2016 in College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka-577225. Significant differences were detected among the germplasm lines as evident by wider range and higher standardized range for all the traits indicating the prevalence of adequate variability. Higher PCV and GCV (>20%)were recorded for grain yield ,No. of tillers/plant and No. of panicles/plant respectively whichindicated higher magnitude of genetic variability among the genotypes except for plant height (10.42% and 8.34%), panicle length (19.92% and 12.89%) and No. of fingers/panicle (17.40% and 13.83%). Higher broad sense heritability (>60%) was recorded for grain yield,plant height, No. of fingers/panicle which indicated the role of additive gene action and hence selection would be rewarding for improvement of such traits except for panicle length (41.90%), No. of tillers (14.40%) and No. of panicles/plant (7.6%)which recorded moderate to lower levels of broad sense heritability and genetic advance (10.1-20%). The variability observed in the germplasm would be useful in identifying productive genotypes through selection and hybridization.

OL-1-21
Partial nutrient balance in rice-wheat cropping sequence under the influence of tillage, residue and bio fertilizer

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The study was conducted to assess the soil nutrient status using partial balance approach where N, P and K balance was estimated by subtracting the nutrient outflow from the total nutrient added to the eight treatment plots under two different levels of tillage, residue and bio-fertilizer and partial nutrient balance of the each treatment for the individual crop as well as system perspective of overall cropping system was evaluated. The study revealed that the net balance nitrogen (N) found to be negative in all the treatments except two, due to residue and bio fertilizer application and where only residue applied in conventional tillage (CT) system. It was observed to be higher net negative in all the treatments under wheat crop. The balance of phosphorus (P) in rice was positive in all the treatments and it was zero in two treatments where bio fertilizer added in both the zero tillage (ZT) and CT. In wheat it was found to be positive in all the treatments irrespective of tillage showed higher positive nutrient balance in treatments where residue and bio-fertilizer were applied. The net balance of potassium (K) in rice fields was found to be negative in all the treatments but the overall removal of K from wheat crop was comparatively lower than the rice fields. The net nutrient balance of N and P was relatively improved in 2nd year crop cycle as compared to first but the K failed to show any such improvement. The study highlighted the fact that there was higher yield in both rice and wheat under zero tillage and resulted in higher uptake of nutrients in ZT than CT. Application of residue alone and along with bio-fertilizer may improve the negative N & K balance in soils under rice-wheat cropping system. Inoculation of bio-fertilizer alone definitely improved nutrient use efficiency but inoculation along with residue would be the better option than the bio-fertilizer inoculation alone.

OL-1-22
Soil security: It needs to be protected

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Soil is asplendid charity of nature to mankind. Soil serves various functions. Some are ecological like biomass production, buffering and transforming actions, filtering, and providing a biological habitat and gene reserve;and others are linked to non-agricultural human activities like as a source of raw materials, as a physical medium, and as a cultural heritage – paleontological and archaeological treasures. As the world population increases, soil is under enormous stress and the natural capital of soil faces continuing decline. Some of the stresses commonly inflicted on soil include soil wetness, chemical degradation, nutrient imbalances, organic matter depletion, acidification, crusting, compacting, structural decline, reduction in soil biodiversity etc. These are ultimately manifested in declined productivity of crops even under best possible management practices and make soil “sick” to respond efficiently to fertilization and other inputs. Detrimental consequences include threats to food security, fresh water retention and biodiversity. The threat

of increasing carbon dioxide and methane emissions through soil degradation is significant. International policy makers have noticed this and few initiatives to address it came into view in recent times. However, a gap remains between what the science tells us about soil's functions in underpinning ecological and human sustainable development, and existing policies for sustainable development. Soil science should be properly translated to policy for sustainable development. The new concept of soil security is proposed to bridge the science–policy. Soil security is explored as a conceptual framework that could be used as the basis for a soil policy framework with soil carbon as a key indicator. As soil carbon under long-term management practices provide information on the pathways for C sequestration, maintenance of fertility and productivity of soil.

LEAD LECTURE AND ORAL PRESENTATION

Technical Session-2

Biotechnology, biotic and abiotic stress management strategies under changing climate scenario, strategies of food and nutritional security, bio-fortification, product diversification/value addition and market linkages

LL-2-01
Nutritional Security, Livelihood and Climate Smart Agriculture

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Agriculture is the backbone of Indian Economy and nearly 600 million farmers are dependent on agriculture. In India, this sector employs nearly 58% of the total Indian workforce, generates more than 55% of the rural income and engages more than 80% of the rural women directly or indirectly in agriculture. Many of our farmers are small and marginal and average per capita land holding is less than 1 hectare. Even though, farmers play a vital role in the food supply chain, their effort and produce is not yielding the intended results and the farmer, who feeds this nation, is now unable to feed himself forcing many to migrate to urban areas in search of alternative livelihood. The last two decades have seen knowledge economy taking a center stage of Indian economy and focus shifted away from the agriculture, and in the process farmers are pushed to the edge. We are now confronted with the colossal task of examining the pressing question of contribution to global food security and considering how to match the need to double food availability to feed a projected population of 9.1 billion people by 2050. This is compounded by the fact that arable land is reducing, resources at our command are diminishing in the face of human rural-urban migration, increasing urbanization and mechanization are on the increase and there is further an associated combat of climate change. Examination of the implications of technological advances, changing geo-political landscapes, and climate change on food security equations, we can identify strategies to ensure healthy and prosperous livelihoods in a rapidly changing world. Farming and technology have always had a strange relationship. Even though modern farming was made possible by technological inventions, traditional knowledge says that technology and the urban sprawl are at odds with the quiet, live-off-the-land mentality of farming. Plows allowed people to cultivate previously inaccessible earth; the industrial revolution allowed farms to become bigger and more efficient; even genetics played a part in helping our produce grow in quality, quantity and in size. The all encompassing aspects of crop production, livestock, land, water, fisheries, aquaculture and biodiversity contribute to optimizing the holistic approach to increased agricultural production. The acceptance of novel practices which include breeding technologies through biotechnological methods of hybridization, molecular biomarker-assisted selection, nuclear techniques and GMO crops has to take place. However, too much technology

and too much modification can backfire, as with the controversies around factory farming or concerns that genetically modified foods might not carry the same nutritional values as their hand-grown counterparts. Climate refers to the characteristic conditions of the earth's lower surface atmosphere at a specific location, while weather refers to the day to day fluctuations in these conditions at the same location. Climate change will affect all dimensions of food security – food availability, food accessibility, food utilization and food systems stability. Global warming is creating new climate changes which are unpredictable and pose greater risk. There is need to adopt agriculture system which produces more and better food under harsher conditions while protecting the environment. Climate smart agriculture is an approach to help guide actions to transform and reorient agricultural systems to effectively provide sustainable support development and food security under a changing climate. This concept was first launched by FAO in 2010, in the context of national food security and development goals, to tackle the main objectives of sustainable increase in food security, building resilience and adapting to climate change and developing opportunities for reducing green house gas emissions. Agro-biodiversity is a term which pertains to the biological array and variety exhibited among crops and livestock used for food and agriculture as well as organisms that constitute agricultural ecosystems. Agricultural biodiversity is necessary for improved livelihood, more food products development from neglected and underutilized species, improving ecosystem by nutrient cycling and soil fertility, water management, erosion control, carbon dioxide sequestration and climate regulation, pest and disease regulation. The marginal lands and crop residues are utilized by livestock as a source animal feeds, contributing to soil through fertilizer and soil conditioners. By- products of slaughter houses after proper and adequate processing are also a source of protein and animal nutrients in animal feed.

An agro-ecological approach recognizes the multidimensional aspects of agriculture and facilitates a broad range of sustainable benefits in the form of increased ecological resilience and reduced risk of environmental degradation, natural resource conservation, improved health and nutrition, reduced incidence of pesticide poisoning, climate change management, reduced fossil fuel consumption, increased energy-efficiency, increased carbon sequestration and moisture retention in soil thereby increasing social resilience and economic stability. Historically, the use of agro-ecological approach in agriculture has led to an exceptional global revolution and management of natural habitats, together with local agricultural practices and food systems. Over the next 20 years, the increased productivity and incomes would be from the small land holding cropper; livestock, fishery and forestry production systems will be key to achieving global food security. This is an opportunity to make climate and environmental finance work for the small holding farmer for scaling up the successful 'multi-benefit' approach to small scale agriculture which helps improve production while reducing and diversifying climate-related risks. Interestingly, of the 430 million youth in India, 86% drop out of school after 15 years and only 2% can access formal training. According to a government survey, 13 in 100 in the 18-29 year age group are unemployed. With 10 million youth entering the job market every year, the country faces a huge challenge of creating employment for them. The challenge is bigger in rural areas, where nearly 70% of the population live and depend primarily on agriculture; 65% of India's farmers, predominantly youth, belong to small and marginal category, which in cases of poor crop, flooding or drought is often forced to work as labourers in informal sectors. Skill Initiative in India aims to promote Green Colleges for skill development on green trades such as sustainable farming, animal husbandry, veterinary para professionals, integrated fishery, sustainable harvesting and processing of forest produce, solar lighting and so on. The training courses combine the traditional wisdom of these communities with modern scientific knowledge to help the small producers grow into `ecopreneurs' by having better access to business development skills, entrepreneurial skills and technology, thus ensuring higher income and bringing back pride

and dignity to these rural professions. Initiatives have begun to cater to the traditional farmer and to help with livelihood enhancing practices by identifying youth as 'kisan doots' to promote the agricultural skills. Success stories are pouring in from various parts of India as well as neighbouring countries like Bangladesh and Nepal. It is a primal urge of tilling the land, growing something from scratch and providing for yourself from the gifts of the land that runs through even the most cynical techie and is evidenced by the growing interest in "urban farming," green markets and home gardens in urbanites. While cities around the world are becoming hot beds for urban farming, transition is on with some 'innovators' creating neat ideas the Indian metros where there is paucity of open spaces. All these approaches for agricultural sustainability are essentially needed to enhance food production and security, livelihood, nutritional value and food safety for people around the world.

LL-2-02

Identification and scope of utilization of moisture stress tolerance genotype in *Olittorius* Jute

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Jute is the second most important fiber crop after cotton in term of production, productivity and availability. It is mainly a Kharif season crop for which it faces water stress specifically during seedling stage due to meagre or erratic rainfall during period of April and May. Seedling establishment mostly dependent on assured irrigation which the farmers may fail to afford. Tolerant jute line at initial stage may show abundant growth due to availability of water after onset of monsoon. Due to narrow genetic base within cultivated varieties of jute the development of moisture stress tolerant lines in dependent on enhancement of genetic variability with diverse genotypes. Sixty diverse genotype collected from CRIJAF, Barrackpore were evaluate under moisture stress and assured irrigated condition in Teaching farm of B.C.K.V for identification of assured moisture stress tolerant genotypes. The data were collected from 21 days old seedlings for the characters: root length, root volume, root fresh weight, root dry weight, shoot length, shoot fresh weight, shoot dry weight, leaf fresh weight, leaf dry weight and proline content and after harvesting for the characters are 50% days of flowering, plant height (cm), node number, internodes length (cm), base diameter, mid-diameter, bark thickness, green weight and fiber weight. Three moisture stress tolerant testers were combined with six moisture susceptible lines as female bearing desirable attribute concerned with high fiber yield to study the genetic control on moisture stress. On the basis of Mahalanobis D^2 analysis and principal component analysis the genotypes were found to be diverse. Through studies on seedling characters and characters at matured stage OEX29, OIJ177 and OIN791 were found to the most tolerant and the genotypes JRO524, JRO 632, JRO 3690, JRO 8432, OIJ 214 and OIN 970. These genotypes were found in different cluster with high genetic divergence. Both additive and non additive gene actions were found to influence the considered characters under stress. Among testers OIJ 177 and among lines JRO 524 and JRO 8432 were found good general combines for a number of characters at seedling and matured stages.

LL-2-03
Role of relay cropping in a climate changed world for sustaining productivity

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Depletion of natural resources, soil degradation and climate change are becoming the most prominent challenges for crop productivity and environmental sustainability in modern agriculture. In the scenario of conventional farming system, limited chances are available to cope with these issues. Relay cropping is a method of multiple cropping where one crop is seeded into standing second crop well before harvesting of second crop. Relay crop may solve a number of conflicts such as inefficient use of valuable resources, delayed sowing, fertiliser application, and soil degradation. Relay cropping is a complex suite of different resource-efficient technologies, which possesses the capability to improve soil quality, to increase net return, to increase land equivalent ratio, and to control the weeds and pest infestation. Here it is emphasized that relay cropping as a tool for crop diversification and environmental sustainability with special focus on soil. Briefly, benefits, constraints, and opportunities of relay cropping keeping the goals of higher crop productivity and sustainability have also been discussed. The gap between research and knowledge regarding this cropping has also been highlighted in order to guide the further studies in future.

OL-2-01
Improving the value chain and linking the market for fruit growers in quality management of post harvest systems in Bangladesh

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The demand for food in Bangladesh and around the world is changing rapidly. Driven by economic growth, rising incomes, and urbanization, demand is shifting away from traditional staples toward high-value fruit commodities. In Bangladesh, additional demand for these commodities is projected to be worth about $10 billion by 2020. More than 80% of people living on less than $2 a day in Bangladesh live in rural areas. This spatial distribution of poverty makes capitalizing on the opportunities afforded by high value fruit production and value additions an important strategic priority for those seeking to reduce poverty in the country. Insufficient processing capacity, the lack of cold storage facilities or a functioning cold chain, and the persistence of transport bottlenecks are significant constraints to organic produce, less post harvest loss and value additions of high value fruits in Bangladesh. The promise of generating higher income and increased export revenues by accessing international markets is matched by the challenges of meeting the exacting quality and safety standards that apply in those markets and by the prospect of having to compete with high quality imports from those markets. Some of the major fruits of Bangladesh have limited processing leading to value addition but most of the minor fruits don't have any processing or value addition. Recently, a number of agro-processing industry processing Bangladeshi fruits in various form for marketing in the home and to some

extent to export. Most of the farmers don't have adequate knowledge on value addition as well as processing facilities. The paper mainly deals with the organic fruit status, value addition, processing and marketing of fruits in Bangladesh. Suggestions were also made on the improvement of the organic fruits value chain, market access and house hold income.

OL-2-02

Long-term effect of soil test-targeted yield (ST-TY) based integrated nutrient management on soil health under jute-rice-lentil cropping sequence in Gangetic alluvial soil of West Bengal

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The effect of continuous use of inorganic fertilizer and organic manures on physico-chemical, enzymatic and biological properties of soil was studied after six years of experimentation with soil test-targeted yield (ST-TY) based integrated nutrient management under jute-rice-lentil cropping sequence at Barrackpore, West Bengal. The experimental soil was Typic Ustochrept with sandy loam in texture. There was ten treatment combinations including control, recommended dose of fertilizer and farmers practice besides different integrated nutrient management treatments based on ST-TY in combination with and without organics. Application of fertilizer on the basis of soil test targeted yield (ST-TY) basis with or without organics recorded higher values of available nutrients, enzymatic activities viz., dehydrogenase, urease, fluorescein diacetate hydrolyzing activity, phosphatase and biological parameters like soil microbial biomass carbon (SMBC), population of *Azotobacter* and phosphate solubilizing bacteria over control, farmers practice and recommended dose of fertilizer. Integrated application of inorganic fertilizer on ST-TY basis with FYM @ 5t/ha was found to be the best suitable INM practice which recorded higher available N, K, alkaline phosphatase, urease, SMBC and maintained proper balance of other chemical, enzymatic and biological properties in the soil after six years of cropping.

OL-2-03

Identification of profitable cropping system for rice fallow situation in NC zone of Andhra Pradesh

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Rice-pulse is the major cropping system in the zone especially in the Srikakulam and Vizianagaram districts covering an area of 1.0 lakh ha. However the overall productivity of the system is low, mainly due to the delayed sowing pulse in the system due to late planting of rice, owing to late onset of monsoon and delayed release of water in the canals in the recent past as a result of changed climate. Hence, the trial is being taken up with a view to identify a profitable ID crop under fallow (zero till) situation to enhance the system productivity in the changed climate. A field experiment was conducted during 2015-16 *Kharif-Rabi* seasons on sandy clay loam soils at

Agricultural Research Station, Ragolu, north coastal Andhra Pradesh, India. The trial was conducted in split plot design with three replications. Main plots consists three varieties of rice having 125, 140 and 155 days duration, Sub plots consists of six fallow crops (ragi, sorghum, Bengal gram, sunhemp seed crop, daincha seed crop and green gram) raised under zero till system. Grain yields of rice were significantly increased with increase in duration of rice. However, during Rabi in khrif rice fallow, there was a progressive decline seed/grain yields of Rabi crops with increase in duration of kharif rice respectively. Among different fallow crops green gram performed superiorly over other crops regardless of time of sowing Rice equivalent yields showed that green gram and sunhemp seed production were impressive after short duration rice whereas green gram and daincha seed crop were better after medium duration rice and ragi, green gram, jowar and daincha seed crop were better after long duration rice.

OL-2-04

Enhancement of nutritional traits in rice grains using relevant genes and QTLs through advanced approaches

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Rice breeding program needs to focus on development of nutrient dense rice for value addition and helping in reducing malnutrition. Mineral and vitamin deficiency related problems are common in the majority of the population and more specific to developing countries as their staple food is rice. Genes and QTLs are recently known for the nutritional quality of rice. By comprehensive literature survey and public domain database, a focus on nutritional aspects like grain protein and amino acid content, vitamins and minerals, glycemic index value, phenolic and flavonoid compounds, phytic acid, zinc and iron content along with QTLs linked to these traits have been provided. In addition, achievements through transgenic and advanced genomic approaches may be taken. The genetic basis of the accumulation of micronutrients in the grain, mapping of the quantitative trait loci (QTL) and identification of genes will provide the basis for preparing the strategies and improving the grain micronutrient content in rice. Integrating marker assisted breeding with classical breeding makes, the possibility to track the introgression of nutritional quality associated QTLs and genes into a popular cultivar from various germplasm sources. Till date, classical breeding has a significant impact on improving biofortification of rice cultivars by making crosses, backcrosses and selection of the desired superior rice cultivars with high nutritional value. However, by availing technologies such as DNA markers, genetic engineering and allele mining offers an opportunity to use them as a tool to detect the allelic variation in genes underlying the traits and introgression of nutrition related QTLs/genes to improve the efficiency of classical plant breeding via marker-assisted selection (MAS).

OL-2-05

Temporal Dissection of induced sieve element 'interactome'- A new perspective for better understanding of the plant defence response to aphids

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Nearly 250 amongst ~4300 aphid species (family 'Aphididae') are identified as agriculturally 'pests'. Some crops like Mustard, Bringal, Cotton, Cowpea etc are heavily damaged by aphids' direct as well as indirect ativities. Aphids have very proliferative capacity within a very short period of time to achieve the population level above the economic threshold. Characteristically, aphids are exclusively phloem sap feeders. They explore their slender stylets for tapping the sieve element sap which is rich in simple nutrients. Very interestingly, aphid stylet penetration follows intercellular route to minimize the cell damage. Two types of saliva are secreted and explored during the stylet penetration for achieving successful salivation. The gelling saliva which is proteinaceous in nature is explored mainly during stylet penetration. This saliva becomes solidified and encased the stylet to minimize the induction of plant defense response. Finally, aphid style punctures the sieve element cells and injects aphid salivary into the sieve element cell. This gel salivary secretion reverses phloem occlusion mechanism as well as callose deposition in the host plant and assures the aphid to feed continuously for many hours or even days from a single sieve element. The recent finding indicates that secreted effector molecules have crucial role in prolong contact between the aphid stylet and sieve element cell. The specific interaction at sieve emement develops 'induced' 'interactome' through molecular battle between the factors present both in saliva and sieve element cell defense biology. The specific interaction with the aphid saliva in the seive element in host plant determines duration of feeding timing that ultimately effect on the aphid population establishment. But in resistance host plant, the induced 'interactome' curtail the aphid population establishment as compared to susceptible host plant. Studies with resistant host of Green Peach Aphid indicate that the phloem sap of *Arabidopsis* wild type (Col-0) contains factor(s) that is detrimental to the insect facundity. Petiole exudates, which are enriched in phloem sap, collected from leaves of wild type *Arabidopsis*, when added to a synthetic diet had a detrimental effect on Green Peach Aphid (GPA) population. Previous studies have also indicated that aphid infestation results in alterations in the composition of phloem sap. Indeed, petiole exudates collected from GPA-infested leaves of wild type *Arabidopsis* (Col-0) showed higher inhibitory activity. So, it a new perspecive to dissect the induced interactome developed at sieve element cell in temporal sclae may be novel way to light on better perception of the molecular plant-aphid interaction biology for future exploitation for enhancing nutritional security through climate smart farming practices.

OL-2-06
Biopriming: getting ready to tackle stress in soil-plant-atmosphere continuum

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Crops experience simultaneous occurrence of different stresses at various stages of plant development. As profitability of agriculture depends on productivity crops at low production cost, the stresses become impediments for cost management of seasonal cultivation of crops. The challenge at the hands of the agricultural scientist in such a scenario is to promote a competitive and multifunctional agriculture which will care resource conservation as well as improvement in human health, climate and biodiversity. In order to successfully meet this challenge over the past decades, there has been increasing evidence demonstrating that among the available options, on-farm seed priming is a simple, proven technology that has been an age old practice, tested, and refined in laboratories, in experimental plots, and by farmers themselves in their fields. The priming-caused potentiation of plant defence responses frequently has been associated with enhanced resistance to various biotic or abiotic stresses and it is easy to use with a wide range of crops in many different farming conditions. Although priming with water or tiny amounts of phosphorus, boron and zinc is common but use of microbes can make a huge difference. Biopriming is becoming a potentially prominent technique to induce profound changes in plant characteristics and to encourage desired attributes in plants growth associated with fungi and bacteria coatings. Biological factors such as fungi and bacteria are used in biopriming which includes: fungi and antagonist bacteria and the most important of all are *Trichoderma, Pesodomonas, Glomus, Bacillus, Agrobacterium* and *Gliocladium.* Therefore, seed priming in combination with low dosage of biocontrol agents has been used to improve the plant performance, stabilize the efficacy of biological agents in the present set up of agriculture and reducing dependency on chemical inputs and giving the farmer reasonable access to further benefits in view of the impending climate change, with difficult consequences for economically profitable and ecologically and environmentally sound global agriculture.

OL-2-07
Bioefficacy of EC formulations of *Strychnus nux-vomica* extracts against *Plutella xylostella* Linn. in cauliflower (*Brassica oleracea* L. var. *botrytis*)

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A field experiment was conducted to investigate the efficacy of *Strychnus nux-vomica* extracts in managing the Diamondback moth, *Plutella xylostella* fed on cauliflower (*Brassica oleracea* L. var. botrytis).The extracts from different plant parts *viz.,* leaves, seeds, stem bark, root bark and fruit rind of *Strychnus nux-vomica* , extracted in different solvents *viz.,* ethanol, methanol, hexane, acetone, chloroform were evaluated. In field condition, it performed more or less equal to the standard check, emamectin benzoate. Maximum reduction of *P. xylostella* over control (ROC) was recorded in emamectin benzoate 5SG @ 11g a.i.ha^{-1} treated plot (58.79

per cent) followed by treatments hexane seed 4 per cent, hexane leaf 4 per cent, neemazal 1 per cent, hexane seed 3 per cent, hexane seed 2 per cent, hexane leaf 3 per cent and hexane leaf 2 per cent recording 52.97, 52.85, 41.14, 40.37, 38.43, 34.78 and 25.48 per cent respectively. Parasitoid reduction in field experiments revealed that *S. nux-vomica* is within safe limit up to four per cent concentration with the minimum parasitoid reduction occurred in hexane leaf extract 2 per cent recording 30.01 per cent reduction. Maximum yield was recorded in emamectin benzoate 5 SG @ 11 a.i/ha treated plots recording 20,848 kg/ha followed by hexane seed 4 per cent, hexane leaf 4 per cent, hexane seed 3 per cent, hexane leaf 3 per cent, neemazal, hexane seed 2 per cent and hexane leaf 2 per cent recording 19,208, 18,832, 17,664, 16,428, 15,828, 15,420 and 13,636 respectively.

OL-2-08

Weed management options for unpuddled transplanted rice in *Terai* zone of West Bengal

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Rice based cropping systems are dominating in the South-Asia where rice is an important staple food for poor people. Presently rice is grown under transplanting after intensive wet tillage which leads to inefficiencies of input resources because of deterioration of soil health due to intensive wet and dry tillage in sequence, scarcity of labour, water and energy as well as inefficient use of fertilizers. The conservation agricultural based new agronomic management practices are advocating in overcoming the above challenges. Unpuddled transplanting is one of such approaches which can address the issues related to both soil health and labour shortages. Again, weed management constraints are the big issue in adopting these technologies due to non-puddled land .To address the weed management problems in unpuddled rice; a weed management option trial was designed. The experiment was conducted in the Instructional Farm of UBKV in *kharif*, 2015.It was laid out in split plot design with 4 pre-emergence herbicides in main-plot (PH1: No pre-emergence ,PH2 : Pendimethalin @ 1000 g a.i.,PH3 : Oxadiargyl @ 90 g a.i $ha^{-1}$and PH4 : Pretilachlor @500 g a.i. $ha^{-}1$) and 5 post-emergence herbicides were allocated to sub-plots (PO1: No post emergence, PO2: Bispyribac @ 25 g a.i ha^{-1},PO3: Bispyribac + Pyrazosulfuron @20 g a.i. ha^{-1},PO4: Fenaxoprop @ 56 g a.i ha^{-1} + Ethoxysulfuron @ 18 g a.i $ha^{-1}$and PO5: Fenoxoprop fb Halosulfuron @ 67 g a.i ha^{-1}).It was revealed that among the pre-emergence herbicides, Pendimethalin recorded highest WCE (62.5%), while Bispyribac+Pyrazosulfuron as post-emergence application showed highest WCE(76.8%) when it was applied with Pendimethalin. Considering the combinations, Pendimethalin+bispyribac+pyrazosulfuron showed highest yield performances (4320 kg ha^{-1}) and B-C ratio (2.36) with highest WCE as well. However, Pendimethalin+Fenoxaprop + ethoxysulfuron also showed higher B-C ratio (2.31) despite lesser yield (3640 kg ha^{-1}) due to its lesser cost.

OL-2-09

Photosynthetic potential and water use efficiency of wheat genotypes under water stress condition

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Water availability is one of the most important limiting factors in agriculture worldwide, particularly in arid and semiarid regions. Six spring wheat genotypes, *i.e.* three UK cultivars Cadenza, Paragon, and Xi-19 and three synthetic-derived lines L-22, L-24, and L-38, were grown in a phytotron under well-watered (until 40 days after sowing) and drought conditions. The aim of the study was to evaluate the traits related to photosynthetic capacity (net photosynthesis rate, stomatal conductance, internal CO2 concentration, transpiration rate, carboxylation capacity, instantaneous and intrinsic water-use efficiency) and plant biomass production in the cultivars and synthetic derivatives of wheat genotypes under well-watered and water-limited conditions. Genotypic variations in gas-exchange traits including net photosynthetic rate, carboxylation capacity, instantaneous water-use efficiency, and biomass yield were found amongst genotypes. Drought significantly reduced the total dry matter per plant. The synthetic derivatives L-22 and L-24 showed higher performance of stomata for most of the stomatal aperture characteristics. Total dry matter was positively related to net photosynthetic rate and to instantaneous and intrinsic water-use efficiencies. Finally, net photosynthetic rate was also positively related to stomatal conductance and transpiration rate under both the well-watered and water-limited drought conditions.

OL-2-10

Molecular cloning and characterization of a *germin-like protein* gene (*SlGLPH*) for achieving abiotic and biotic stress resistance in tomato

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Detailed research works on plant germin-like proteins (GLPs) have strongly established the importance of this class of proteins in abiotic as well as biotic stress resistance in different plant systems. These heat and detergent resistant glycoproteins have been documented with basic structural similarity but with high level of functional diversity, where GLPs have been reported to have various enzymatic activities including superoxide dismutase, ADP glucose pyrophosphatase/phosphodiesterase and polyphenol oxidase activities. Though achieved in several crop plants, functional characterization of a GLP from the important vegetable crop tomato (*Solanum lycopersicum* L.) has remained under-explored. In this study, the GLP multi-gene family was identified and characterized *in silico*. Structural features of the tomato GLPs were analyzed through homology-based structural modelling of the proteins. Among the 15 putative genes, one promising candidate gene (annotated as *SlGLPH*) was observed to be expressed in leaf, stem, flower and fruit tissues of tomato plant. The gene was found to be transcriptionally up-regulated in tomato seedlings under different abiotic and biotic stress

conditions. The gene was amplified from the tomato genomic DNA and cloned in expression vector for producing recombinant SlGLPH (rSlGLPH) protein in bacterial system. After optimizing the recombinant protein expression system, a suitable protocol for chromatography-based purification of the rSlGLPH protein was standardized. The *SlGLPH* gene was further sub-cloned in plant gene transfer vector under the transcriptional regulation of a constitutive promoter and *nopaline synthase* (*NOS*) terminator, in order to achieve over-expression of the *SlGLPH* gene in plant systems. Using *Agrobacterium*-mediated plant transformation, two putative transgenic brinjal lines over-expressing the *SlGLPH* transgene were generated. For investigating the native transcriptional regulation of the *SlGLPH* gene further, different lengths of the 5´ upstream region of the gene was amplified from tomato genomic DNA and sub-cloned separately in plant promoter probe vector, containing the reporter gene *β-glucuronidase* (*uidA/gusA*) to exhibit the transcriptional activity of the cloned DNA fragment(s), placed upstream to it. These recombinant plasmids were then used for testing the activities of these putative promoter fragments through transient expression of the reporter gene. Using onion leaf epidermal cells (as a monocotyledonous system), the ~1 kb 5´ upstream region of the *SlGLPH* gene was found to confer strong transient expression of the reporter gene. On the other hand, following agro infiltration in the tobacco leaves (used as a dicotyledonous system), both the ~1 kb and 0.5 kb 5´ upstream region of the *SlGLPH* gene was found to drive strong transient expression of the reporter gene. In both monocotyledonous and dicotyledonous systems, the ~2.4 kb 5´ upstream region of the *SlGLPH* gene was observed to have restricted transient expression of the reporter gene, which indicated the possible presence of some specific regulatory *cis*-elements within the ~2.4 kb to ~1 kb upstream region of the *SlGLPH* gene. Taken together, results obtained in the present study describes the identification, molecular cloning and characterization of a germin-like protein gene which pave the way for exploring this gene for developing abiotic and/or biotic stress resistance in tomato and other plant system(s) in near future.

OL-2-11
Nutrient management in Onion

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Onion (*Allium cepa* L.) is by far the most important vegetable crop grown in India. Its cultivation on commercial basis has been increasing considerably with its increasing demand for local consumption as well as export. India ranks second in area as well as production in onion, the first being China. However, the production and productivity of onion in India are very low compared to many other onion growing countries of the world. Amongthevarious factorsaffecting the production of onion in the country, the most important factors limiting the productivity is the nutritional imbalance and unawareness of the farmers about the optimum requirement of plant nutrient for proper growth and development and also their judicious application at critical phase and appropriate time.Due to its inherent characteristic traits such as short stature, non-branching habit, sparse foliage, shallow root system and extremely slow growth during initial stages, the relatively high water and nutrient requirement of the crop must be supplied from a relatively small volume, requiring intensive cultural management. Interaction of moisture and fertilizers with the environmental conditions considerably affect plant growth responses, as a result, onion becomes sensitive to deficiencies of a number of nutrients. The deficiency of nutrients in soil plant system not only affect yield but in many cases accelerates disease infestation also. Onion responds very

well to added nutrients in the soil.Application of chemical fertilizer alone increased the crop yield in the initial years but adversely affected the sustainability at a later stage. The cost of chemical fertilizers is also increasing day by day. Moreover excessive fertilizers and delayed nitrogen application could hamper the keeping quality of onions. To reduce dependence on chemical fertilizers along with sustainable production are vital issues in modern agriculture which is only possible through integrated plant nutrient supply system (IPNS). Integrated nutrient management serve as the effective source of manuring to obtaining sustainable productivity without causing detrimental effects of soil in an eco-friendly manner. Besides fertilizers, there are several sources of plant nutrients like organic manures and bio-fertilizers. Use of organic manures help in mitigating multiple nutrient deficiencies. Application of organic manures to acidic soil reduces the soluble and exchangeable Al temporarily by forming complex and provides better environment for growth and development by improving in physical, chemical and biological properties of soil. Bio-fertilizers have emerged promising components of nutrient supply system. Application of bio-fertilizers which is environment friendly and low cost input, with organic and inorganic fertilizers as part of an integrated nutrient management strategy and play significant role in plant nutrition. The role of bio-fertilizers is perceived as growth regulators besides biological nitrogen fixation collectively leading to much higher response on various growth and yield attributing characters. Bio-fertilizers inoculations of onion increased the yield and saved the fertilizer requirement to some extent of 20-25%, thereby reducing the cost of cultivation. With the above in view, attempts have been made in this paper to throw some lights on the nutrient management in onion.

OL-2-12

Hydrogel application and water availability under different irrigation regimes in zero-tilled green gram - jute relay system

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The field study was carried out during the summer season at the Central Research Farm of the Bidhan Chandra Krishi Viswavidyalaya (Latitude $22^0 58^/$ N, Longitude 88051/ E altitude 9.75 m amsl), Gayeshpur, India to investigate the effect of the application of hydrogel in modifying the hydraulic properties of different irrigation regimes under green gram-jute relay system. The main treatments consisted of four different irrigation regimes (0.4 ETc, 0.6 ETc, 0.8 ETc and without irrigation). The sub-treatments consisted of three levels of hydrogel application (5 kg/ha, 2.5 kg/ha and control).Hydrogel was mixed with top 10 cm soil before green gram sowing. Soil samples were taken with a core auger on the fourth, seventh, 14th and 21st days after irrigation. The undisturbed soil of the rings of the core assembly was used for preparing the soil water retention curve, and the soil of the core was used for determining saturated hydraulic conductivity (Ks), bulk density and gravimetric soil water content. The measuring of soil water content (SWC) with a 2.5 kg/ha hydrogel application, the water release rates were relatively uniform throughout the entire period, whereas in 0.8 Etc, water release rates were very high initially (4-7 days) but fell appreciably afterwards. The result of the soil water characteristic curve revealed that water release per unit suction change in the 0.10 kpa range (unavailable to plants) in plots not treated with gel was higher compared to soil samples treated with gel. However, the water release per unit suction change in the 10-100 kpa range (available to plants) in soil samples not treated with gel was significantly lower compared to that in soil samples treated with gel for all irrigation regimes. The above result suggest that gel significantly improved the readily available water

capacity (RAWC) of the soils. The time at which a critical SWC (SWC corresponding to 100 kpa) was reached was studied in order to further examine the suitability of gel in improving soil water retention regimes. The critical SWC with the 2.5 kg/ha hydrogel treatment reached approximately 7, 14, 22 and 4 days after irrigation in 0.4 ETc, 0.6 ETc, 0.8 Etc and without irrigation, respectively. The above-mentioned results thus reaffirmed the suitability of gel for longer period water availability (22 days) at 0.8 Etc, while hydrogel was found unsuitable for 0.4 Etc.in which critical soil water was reached early (7 days).

OL-2-13

A comparative study on productivity, profitability and water use efficiency in SRI and conventional rice system in West Bengal

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Over exploitation of water for rice cultivation depletes water resources in several parts of India. So,the pattern of rice irrigation receives renewed attention. The system of rice intensification (SRI) has been adopted by the Indian farmers as an innovation in rice culture. A field experiment is conducted at Central Research Farm, BCKV, Gayeshpur during 2009-2011 to evaluate the productivity, profitability and irrigation water use efficiency in SRI compared to conventional rice system. Results exhibit that SRI increases paddy yield 28% and net income 72% over the conventional method, which being achieved with substantial reduction in water application by 35%, labour input by 11% and seed costs by 83% . The economic return from SRI is considerably high, giving farmers strong incentive to accept this new technique for irrigated paddy production. Hence, the cultivation of water consuming summer paddy with SRI promises to be a significant alternative not only for raising rice productivity, but also for savings of irrigation water and energy costs in the water scarce regions of West Bengal

OL-2-14

Enhancing the post harvest longevity and quality of ornamental flowers for decorations using household paraffin wax

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Untreated fresh floral decorations are easily subjected to loss their quality and appearance degradation when exposed to room temperature. There are so many methods to enhance the vase life and quality of ornamental flowers. But the problem is those flowers are quite expensive in commercial market. The undergo research was focused on to develop a low cost flower preservation method using household paraffin wax. Pure wax solution was prepared by melting household paraffin wax at 100^0c and maintained the temperature at 70^0c using a water bath. Selected flowers (Bougainville, *Plumaria acuminate*, Rose, Orchid) were submerged into the wax until entire up to the stem is covered. Then the flower was removed from the wax and it was

gently shaked to remove the excess wax. Just after dipping in the wax, flowers were dipped into cold water (20c). Waxed flowers kept in refrigerator in different durations (12hr, 24hr, 48hr and 72hr). After kept in refrigerator they were kept under room condition for different durations (6hr, 12hr, and 24hr). Appearance was recorded according to a scale based on flower colour and quality. Result showed that the waxed flowers of Bougainville and Orchid are significantly very good when stored in a refrigerator for 12 and 24 hours. The waxed flowers which are stored at room temperature were not look attractive when compared with chilled flowers. Waxed and 24 hours chilled flowers of Bougainville and Orchid are significantly very good even after replacing in room temperature for 12, 24 and 48 hours. The waxed flowers which are stored at room temperature were not look attractive when compared with chilled flowers. Household wax at 70° can use as effective method of preserving flowers with good appearance and quality. To enhance the vase life of waxed flowers refrigeration / chilling can use.

OL-2-15
Eco-agricultural-reclamation on mined out degraded land in Jharkhand: a successful approach by Bharat Cooking Coal Limited

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Coal resource is the main primary energy in our country, while Jharkhand is the most important state in resource. Therefore, Jharkhand is an energy base for our country and has a great significance in energy strategy. Continues mining since more than 100 years in Jharia coalfield of Dhanbad has resulted in severe land degradation due to mine fires and subsidence. Because of this heavy development of the coal resource, the ecological environment is worsening and the land is reducing continuously in state. “How to resolve the contradiction between coal resource exploitation and environmental protection” has become the imperative. Such negligence has posed serious threat not only to biodiversity but public health especially in the case of open cast mining. Thus the concept of “green mining industry” is arousing more and more attention and had become essential not only for conservation of biodiversity but also for public health and livelihoods. With this background a 3-tier Eco-restoration project “where grasses for the first tier, bushes/shrubs form second and trees form third tier” has been initiated by Bharat Coking Coal Limited (BCCL) over 204.67 Ha of mined out degraded land since 2011. The start-up of the project wasn’t that easy and faced lots of challenges viz-a-viz no vegetation, soil and microbial mass at all, abundance of weeds, the poor acceptance of such initiatives by local people, Interference from unsocial elements etc. However, despites all the challenges, BCCL has successfully implemented Ecological Restoration on 33 sites spread over 205 Ha and is now extending its leap to Eco-Agricultural-Reclamation. Now mined out degraded are being transformed into agricultural land in Bharat coking Coal limited (BCCL). ~20 Kg of *Govind Bhog* Rice has been harvested on mined out degraded land which has been found safe to consume. Following the footsteps of rice cultivation, organic farming of tomato, eggplant, cauliflower, cabbage, marigold, pea, coriander, chilly, wheat, Fenugreek etc is being carried out on ~5000m2 technically reclaimed/backfilled area. The exercise has been a success so far. By using this strategy local people could generate crop revenue sooner. So it may be concluded that the mined out degraded land can be used a source of livelihood too and BCCL has proved the proverb that the nature has the power to bounce back and that too in mined out degraded land.

OL-2-16
Bamboo shoot: traditional uses and value addition

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Bamboo shoots are considered as one of the useful health foods and form a traditional delicacy in many countries because of their rich contents of proteins, carbohydrates, vitamins, fibers, minerals and very low fat. It is preferred and consumed in different forms like raw, canned, boiled, marinated, fermented, frozen, liquid and medicinal. The consumption pattern of bamboo shoots in most of the countries is purely traditional, seasonal and region-specific with little or no value addition. Therefore, it's a great opportunity, particularly for the organized food processing sectors of the country to take up the processing of bamboo shoot-based food products in an organized manner. In India, bamboo is mainly preferred in Northeastern part of the country where they form an indispensable part of several traditional specialty dishes. Its importance and increasing demand in the industrial sector attract the scientists and policy maker. Modern research revealed number of health benefits of bamboo shoots such as improving appetite and digestion, weight loss and curing cardiovascular diseases and cancer. The shoots are reported to have anticancer, antibacterial and antiviral activity. Shoots have antioxidant capacity due to the presence of phenolic compounds. The increasing trends of health consciousness among consumers have stimulated the field of functional foods and bamboo shoots can be one of them. Bamboo fiber is now a common ingredient in breakfast cereals, fruit juices, bakery and meat products, sauces, shredded cheeses, cookies, pastas, snacks, frozen desserts and many other food products.

OL-2-17
Effect of pre drying treatments, drying methods and storage of dehydrated mature and ripe ber fruits cv Kaithali and Umran on non enzymatic browning

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The study was conducted to standardize the method of dehydration of without stone fruits of cv. Kaithali and Umran at mature and ripe stages. Fruits were blanched before drying and were treated with SO_2 by burning of sulphur powder @ 2 g/kg *ber* fruits for two hours; boiled in 1% NaOH for 1 minute then boiled in 0.5% citric acid and finally dipped in KMS solution 4000 ppm for 12 hours and in control-fruits were kept untreated and unbalanced for drying. Among pre drying treatments KMS treated fruits (Kaithali : mature 4.24, ripe 4.32; Umran : mature 3.27, ripe 3.97) recorded lowest non-enzymatic browning, followed by SO2 treated fruits however it was highest in untreated fruits in both the cultivars at each ripening stage. In drying methods, it was also recorded lowest (Kaithali : mature 4.45, ripe 5.59; Umran : mature 3.37, ripe 4.50) in oven dried fruits as compared sun dried fruits in in both the cultivars at each ripening stage. During the storage of dried ber fruits non-enzymatic browning increased with increase in storage period

(Increase from beginning to six months of storage Kaithali: mature 2.90-7.14, ripe 3.18-7.09; Umran: mature 2.05-6.44, ripe 3.01-6.91).

OL-2-18
Prospects of Indian Ramie for production of quality fibre and basic understanding of its degumming

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Ramie (Boehmeria *nivea* L. Gaudich.) is an ancient crop known since pre-historic times. It was a popular crop in East and South East Asia grown for its medicinal and fibre yielding properties. Ramie crop is cultivated in a limited part of the India. This fibre is superior than other commonly used plant fibres like jute, cotton, flax due to its inherent properties like better bundle tenacity, wet strength, fineness, ultimate fibre length and length to breadth ratio. It is one of the strongest but stiffest bast fibre due to high cellulose to hemicellulose ratio which favour a high degree of cellulose crystallinity. Besides having the unique physical properties, the silk-like appearance and anti-microbial property of the fibres as well as the medicinal value and antioxidant property of the ramie leaves make the plant utmost valuable in the international market. In India there is a huge scope to exploit this fibre to get maximum economic benefit. The sandy loam soil with slopping land and hot-humid weather conditions that are required for ramie cultivation is available in Indian North Eastern parts. The foothills of Himalaya and the Brahmaputra valley of Assam, along with Western Ghats and Arunachal Pradesh have great natural resource to promote ramie cultivation. There is a great demand of ramie fibre in the market but the production is not enough to meet the need. However, the basic lacuna resides with the fibre pack is the pectinacious materials commonly known as gum. Separation of fibre component from the gum is the toughest challenge for cultivation of ramie. ICAR-National Institute of Research on Jute & Allied Fibre Technology has made continuous and tremendous effort to develop the novel degumming technologies and has made some path breaking innovations. The ramie can revive its own old glory through the adoption of scientific knowledge and get the edge over the other fibres. In this paper an attempt has been made to explore the prospective ramie cultivation and the novel degumming technologies for paving a new path for sustaining rural livelihood.

OL-2-19
Nutritional security through climate smart agricultural practices in rice farming

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Climate-smart agriculture (CSA) is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change. Widespread changes in rainfall and temperature patterns threaten agricultural production and nutritional security which increases the vulnerability of people depending on agriculture for their livelihood. Soil degradation

reduces crop yields by increasing susceptibility to drought stress and nutritional imbalance. Low concentration of protein and micronutrients (e.g., Zn, Fe, Se, B, I) aggravate malnutrition and hidden hunger that affects 3.7 billion people worldwide, especially children. Climate Smart Agricultural practices in Rice farming includes improving water productivity by aerobic rice cultivation, residue mulching, improved drainage system and Water harvesting, enhancing soil fertility through use of bio fertilizers, organic fertilizers, slow releasing fertilizers, livestock management etc., and micronutrient availability through use of micronutrient fertilizers based on soil testing, adopting diversified cropping system etc., Further by adopting reduced tillage, crop rotation with legumes and conservation agriculture adapting to climate change help in enhancing soil quality. Improving biological nitrogen fixation, growing improved crop varieties and mycorrhizal inoculation, conserving and recycling water by drip/sub-drip irrigation etc are the other innovations for correcting nutritional stresses in crops. The adverse effects of soil degradation on human health and well being can be alleviated through strategies involving soil restoration based on management of drought stress, soil infertility, and deficiency of micro-elements with involvement of all the stakeholders in the decision-making process. Judiciously managed and properly restored soils have the capacity to grow adequate and nutritious food for present and future populations.

OL-2-20

GypCal: A Decision Support Desktop Application for Chemical Reclamation of Sodic Soil to Enhance Crop productivity in Indo-Gangetic Plains

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In the Indo-Gangetic plains, about 2.7 million hectares of area have salt affected soils where sodic soils are generally dominating. This area is progressively expanding because of improper soil and water management practices. Calculation of gypsum requirement of sodic is a tedious and time consuming laboratory process and thus using soil pH_2 for calculating appropriate amount of gypsum for sodic soil reclamation is easy. Also the availability of gypsum in recent years is becoming limited as mineral reserved are depleting fast. There is thus need to rationalize gypsum use by knowing exact quantity required for reclamation as well as following total protocol for chemical reclamation of sodic soil. We have collected large number of soil samples from 7 sodic soil dominant districts of Uttar Pradesh *viz*. Raebareilli, Unnao, Hardoi, Sultanpur, Barabanki, Faizabad, Lucknow, 2 sodic soil dominant districts of Bihar *viz*. Muzaffarpur and Samastipur and one district of Haryana, in order to assess the nature and extent of sodicity. The information about soil related constraints and average crop yields were recorded. Soil pH (1:2), ESP and Gypsum requirement (GR) was determined for all the samples as per standard procedures and then the relationship was drawn between soil pH_2 and GR. Further, the average crop yield from each sampled site was equated to predict the yield based on the soil pH for traditional as well as tolerant varieties. The GypCal software is a desktop based software application developed on visual basic platform. This software is user friendly and can be useful for field functionaries, researchers, line department officials as well as farmers desirous of chemical reclamation of sodic soil for optimizing crop production in Indo-Gangetic plains by calculating the gypsum requirement in bags (of 50 Kg), total depth of water required for leaching, expected yield of salt tolerant as well as traditional varieties of rice-wheat after chemical reclamation. It also estimates ESP of the sodic soil. The software calculates the gypsum

requirement on the basis of the mathematical equations obtained through curve fitting. In the input parameter, the requirement is only soil pH_2, depth of soil to be leached and dimension of the field to be reclaimed. The output generated shall provide the gypsum quantity required in bags for heavy, medium and light textured soil. Also the output information includes the depth of water required for leaching soluble salts in cm and expected yield of crops (rice and wheat) both for salt tolerant as well as traditional cultivars. This software application will allow straightforward decision support for reclamation of sodic soil following standard protocols and optimize crop yields in Indo-Gangetic plains of North India.

OL-2-21

Novel biopolymeric hydrogel based formulations comprising *Trichoderma harzianum* and zinc sulphate: preparation, shelf-life, fungicidal activity against *Rhizoctonia solani* and evaluation on health of rice seedlings

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Sheath blight caused by *Rhizoctonia solani* and zinc management are two major constraints in rice productivity. Present study was conducted with an aim to manage the disease and micronutrient simultaneously. Hydrogels, the cross-linked hydrophilic polymers with high water absorption characteristics have been explored to serve as carriers of fertilizers and pesticides. They are water insoluble and can be used to develop smart formulations of soil applied pesticides and nutrients/ fertilizers and other plant growth additives. Formulations of various insecticides, herbicides, pheromones and other bioactive molecules entrapped in the superabsorbent have been developed over past decade. Bio-agent *Trichoderma* spp. has been tested many times and established as potential bio-control strategy against *R. solani*. Hydrogel compositions containing zinc sulphate heptahydrate ($ZnSO_4.7H_2O$) were prepared by *in situ* entrapment during polymerization process. Dry formulation of *Trichoderma harzianum* was prepared by physical mixing of dry powder containing spores and hyphae of bio-agent with dry zincated ($ZnSO_4$) hydrogel composite. Wet formulation was prepared by entrapment of bio-agent spores and mycelia into the swollen matrices of zincated hydrogel composites. *T. harzianum* exhibited significantly high survival in the presence of pure zinc sulphate up to concentration of 150 ppm beyond which gradual decline in viability was observed. The prepared compositions were evaluated for the shelf-life characteristics in terms of viability of bio-agent spores as a function of temperature (5, 25 and 45°C) and time period (0, 7, 15, 30, 60, 90, 120, 150, 180 days).Shelf life study of both wet and dry compositions exhibited 100% viability of *T. harzianum* till the last day of study period (up to 180 days) without showing any sign of toxicity due to hydrogel carrier or impregnated zinc sulphate. Bioassay evaluation of developed formulations against soil borne fungal pathogen, *Rhizoctonia solani* revealed that the combinations comprising *T. harzianum* and zinc sulphate exhibited higher bio-activity than *Trichoderma* alone and zinc sulphate alone. A two months pot study of four zincated compositions conducted under greenhouse conditions to assess the performance of zincated hydrogels on the crop health exhibited significant increase in shoot length and wet biomass of rice plants in composition treatments as compared to controls where either no zinc was applied or was applied conventionally. Results of the present investigation showed that integrated formulations of *T. harzianum* and zinc sulphate represent a potential biotic and abiotic stress management approach.

OL-2-22

Symptoms and pathogen association studies in relation to rhizome rot and wilt disease complex of ginger in Darjeeling hills

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In a study conducted at different locations of Kalimpong subdivision (199 plots) has showed four characteristic types of symptoms manifestation. *Ralstonia*, *Fusarium* and nematodes are mainly associated with the incidence and severity of rhizome rot and wilt disease complex of ginger under hill agro-ecological region of West Bengal. Association of *Pythium* was only recorded in three villages. Higher disease incidence was recorded where *Ralstonia* and nematode were associated with the disease. The findings from the surveyed farmers' field at different locations thus indicated that *Ralstonia solanacearum* and nematode association had a synergistic effect on the severity of rhizome rot and wilt disease complex of ginger. The study also indicatedthat pathogen population and their association determined the symptom type and severity of the disease of that particular soil or in that field.Among the nematodes pathogen*, Pratylenchus* sp. appeared to be the predominant and most important nematode species associated with rhizome rot and wilt disease complex of ginger and carried over through seed rhizome in very high numbers.

OL-2-23

Study of photosynthetic efficiency in C_3 cycle of carbon metabolism for selected wheat genotypes

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The Calvin-Benson cycle (C_3 cycle) is the primary pathway of carbon assimilation in the majority of photosynthetic organisms. It is the single largest flux of organic carbon in the biosphere and assimilates about 100 billion tons of carbon a year. The regenerative phase of the cycle involves a series of reactions that convert triose phosphates into the CO_2 acceptor molecule i.e. Ribulose 1,5bis phosphate (RuBP). While the majority (five-sixths) of the triose phosphate produced in the Calvin cycle remain within the cycle to regenerate RuBP, one-sixth of the carbon exits the cycle for biosynthesis of a range of compounds. Therefore, the Calvin cycle occupies a central position in carbon metabolism and manipulation of this pathway has the potential to increase yield vis-à-vis production of secondary metabolites. Rubisco also initiates photorespiration by catalyzing the oxygenation of RuBP to form one molecule each of 2- phosphoglycolate and Phospho Glyceric Acid (PGA) causing a net loss of two Carbons per cycle. In this perspective we studied six genotypes of wheat to understand photosynthetic carbon metabolism between PCR and PCO cycles. The results showed non-significant variation for different photosynthetic traits such as net photosynthesis rate (A), rate of carboxylation (V_c), rate of oxygenation (V_o), ratio of oxygenation to carboxylation (φ), rate of regeneration of RuBP, etc. However, strong correlation was found between RuBP regeneration rate as well as highest values of A, $V_c$and V_o. Among the genotypes, DBW 46 was found to have highest photosynthetic efficiency as it possessed highest value of

RuBP regeneration rate, A, V_c and V_o. It also produced highest amount of intermediate compounds like PGA, DHAP, SBP, Xu5P, FBP along with highest ATP and NADPH consumption rate which also justified the superiority of this genotype over others.

OL-2-24
New Grading System of Ramie Fibre

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Ramie fibre is obtained from the stalk of the stemmed of *Boehmeria nivea* (L) Gaud. Ramie is a highly versatile, white, lustrous and eco-friendly fibre with excellent properties. In India, the cultivation as well as production of ramie is increasing because of its excellent strength, enhanced wet strength, lustre and microbial resistivity. At present there is no grading system in India. In view of the prospects of increased production and utilization of the fibre, a grading system for the decorticated fibres has been developed on the basis of fibre qualities. The fibres have been graded in to four grades viz. excellent, good, Average, Poor on a 100 point score card basis. The scores have been assigned on relative importance and weightage of the six fibre properties, viz. fibre length, strength, fineness, softness, colour and defects. The proposed grading system would help the growers and users for multidimensional applications are now being encouraged.

OL-2-25
Introduction of GLY II gene into Mosambi for increasing salt tolerance

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Owing to bottlenecks like large plant size, nucellar polyembrony, apomixes, high hetrozygosity and pollen or ovule sterility, genetic transformation of citrus for traits like biotic and abiotic stresses are realistic goals for biotechnology endeavours. Glyoxalse Iand *Glyoxalse II* have been proved to confer improved salinity tolerance in tobacco and rice. This work was carried out to produce transgenic Mosambi plants using *gly II* construct from *Oryza sativa* capable of imparting salt tolerance. Genetic transformation experiments were carried out with epicotyls segments. The selection percentage of transformed epicotyls on MS basal media supplemented with BAP 1.0 mg and hygromycin B 3 mg $L^{-1}$was 10.43% .Out of 326 epicotyl segments 12 putative transgenic plants were obtained. The putative tranformants showed the percentage of GUS gene expression of 8.33. Molecular analysis using PCR confirmed the integration of gly II gene into 2 plants with 0.61 per cent transformation efficiency. Genetic transformation protocol for Mosambi could be used with minor modifications for genetic transformation with traits of economic interest.The genetic transformation of Mosambi with salt tolerant gene Osgly II can be a solution from an economic and environmental point of view for the utilization of salt affected soils of Punjab for citrus cultivation.

LEAD LECTURE AND ORAL PRESENTATION

Technical Session-3

Impact of climate resilient crops/horticulture for hilly agro ecosystem, socio-economic development through climate smart agriculture

LL-3-01
Back to the roots: Wild edible fruits for crop improvement and nutritional security

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The unexploited wild edible plants are an integral part of the rural community and their exploitation has advocated for achieving the optimal dietary requirements. Wild plants contain potential bio-molecules both in organic and inorganic combinations. They are vital, inexpensive and lucrative source of vitamins, antioxidants, fibre, minerals and other nutrients for many economical deprived natives. Of particular importance are *Morus indica, Myrica nagi,Elaegnus latifolia,Myrica esculenta, Prunus nepalensis, Terminalia bellerica, Baccaurea sapida, Prunus cerasoides, etc.* that had significant level of micronutrient and minerals and its cultivation can be promoted for overcoming the chronic malnutrition problems. Besides being nutritionally rich, the wild plants also possess a big reservoir of untapped genes that have potential to be utilized in improvement of crops. Research on wild edible fruits have indicated that most common and potential underutilized edible fruit genetic resources occurring naturally in the region includes species like *Padus nepalensis, Elaeagnus latifolia, Myrica esculenta, Pyrus pashia, Prunus undulata, Docynia indica, Citrus medica, C. macroptera, C. ichangensis, C. medica,* etc.

LL-3-02
Assessment of arsenic infection in household level- a nutritional perspective

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Findings of different livelihood analysis concluded that vulnerable populations in the society are more susceptible to disease-proneness, climate change adversities and other negative health effects. It is also found from different studies that women are more vulnerable than the male counterparts in the society in respect to different livelihood indicators. Based on these perspectives, the present study was undertaken in four severely arsenic - affected villages of Manikchawk Block of Malda district (one of the most adversely arsenic-affected districts) of West Bengal, India, to assess the status of arsenic infection with a gender perspective. The extent of arsenic infection of the people was assessed by a team of non-medical scientists with the help of arsenic infection pictures (standardized by the medical experts specialized in Arsenic). Assessment was done in two consecutive phases. In the first phase, a random sample of 200 families was considered to assess the general infection status (in any extent) of arsenic and it was found that the severity of arsenic infection varied in terms of different livelihood indicators, although, they were exposed to food and water of similar arsenic status. Second phase survey was initiated to get more insight on arsenic infection in relation to sex and other indicators; and it was found that food-intake (quantity and quality) was one of the most important reasons for severity of arsenic infection. It was also found that the women members of the families were suffering more from the arsenic infection. Culturally, women food intake is less than male counter parts in the family which may lead to more infection and manifestation of arsenic attack among the women counterparts of the families.

OL-3-01
Role of Producer Companies in Nutrition- Sensitive Agriculture

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Over the years, in India, there has been a spurt of approaches to organize farmers in order to enhance their farm profitability. There are many legal forms of organizations for the primary producers to organize themselves. One such recent concept has been the Producer Company (PC) which is relatively a new legal entity. The modality for being members is primary producers. PC as a legal entity was enacted in 2002 as per section IXA of the Indian Companies Act 1956 that will empower and improve the bargaining power, net incomes and quality of life of small and marginal farmers/producers in India. PCs were selected from Tamil Nadu of India based on the type of PCs, which are community based, resource oriented and other commodity based, market oriented. The selected PCs were Government promoted, NGO promoted and individual promoted. A scientific thought-driven questionnaire was administered to collect data from thirty members from each PCs to evaluate the perceived-impact of producer members using seven-point continuum scale with social and economic indicators. Perception towards performance of the company was also

found using seven-point continuum scale. The perceived-opinion of members towards performance of the company were that on composition of membership being heterogeneous. With regards to the interventions avoiding domination of specific group of people and elimination of political intervention by adhering to rules and regulations were also perceived as effective with the concept of FPO. The other perceived opinion was on robust record maintenance, member cohesiveness and transparency of activities, which are the attributes that makes this concept beneficial. The other opinion that ranged from good to very good were selection/election of leader/board of directors, transparency of financial transactions, opportunity for participation in decision making, business activities of the company, ways of raising funds and dovetailing of govt. schemes are certain areas that needs improvement. Small landholders account for over 70 percent of food production and are therefore fundamental to national food and nutrition security. Organizing these farmers, into producer organizations will help them access value chains is vital in achieving increased productivity and profitability, and contributing to their food and nutrition security. The findings indicate that producer companies could potentially play an important role in strengthening pathways to food and nutrition security of the nation.

OL-3-02

Climate change versus livelihood- perception, of forest fringe communities from West Bengal

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Now, climate change is a topic of intense scientific, social and political concern and recognized globally the most critical issue affecting the survival of mankind in the 21st century. Climate shift will impact on ecosystem composition (like the forest) and distribution with ensuing resource scarcity leading to ramified socioeconomic effects on those who depend on such resources (like the forest dependent communities) for their livelihoods. A study was conducted during 2014-15 to document the perception on impact of climate change to livelihood of forest fringe community of Chilapatta Reserve Forest in Terai region of West Bengal, India. A total of 100 respondents through random sampling were selected for personal in-depth interview through close ended questionnaire. Majority of the respondents were male, literates and subsistently growing crops in their marginal land. Forest fringe community of Chilapatta Reserve Forest have considerable awareness and consistence on climate change and its effects on the weather, ecosystems, biodiversity and agriculture. Majority of them perceived increase in temperature as increase in day and night temperature, mildness in winter and warming of winds. Similarly they believed that monsoon is becoming unpredictable day by day with changed intensity and pattern but generally arriving late and withdrawing early over the past few decades along with decrease in cloudy and rainy days. Majority of the respondents (83 %) perceived negative impact of climate change on their livelihood will be through decreased fish catch (97 %) decreased NTFP collection (77 %) either for medicinal use (72 %) or food (71 %) and unhealthy unproductive cattle (97 %), increased misery, decreased income, and increase susceptibility to serious diseases. The study also revealed a need for scientists, government and non-government agents and other stakeholders to support efforts by farmers to adapt to effects of climate change through technological, policy and financial interventions with an aim of improving livelihoods and food security.

OL-3-03

Economical feasible cropping system for diversification in South-Western Punjab

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A field experiment was carried out for three years (2010-11 to 2012-13) at research farm of PAU Regional Station, Bathinda to study the feasibility of different crop sequences for south-western region of Punjab. The initial physico-chemical properties of sandy loam soil (0-15cm) comprised pH 8.4, EC 0.151dSm^{-1}, $CaCO_3$ 4.63 %, Organic carbon 0.29%, available phosphorus 15.9 kg ha^{-1} and 326 kg ha^{-1}available potassium content. Three crop sequences were *Bt* Cotton-Wheat/Barley/*Raya,* Cluster bean - Wheat/Barley/*Raya*and Green gram - Wheat/Barley/*Raya.* All other cultural practices were followed as per the recommendations of Punjab Agricultural University. The sowing of the *rabi* crops (wheat, barley and *raya*) was done according to the time of harvesting of previous crop (cotton, cluster bean and green gram) in same plots. The pooled mean of 3 years research data revealed that the cotton equivalent yield of cluster bean-wheat (3035 kg/ha) was at par with cotton-wheat (3276 kg/ha) system. In addition, monetary gains (Rs/ha) in cluster bean-wheat sequence was higher than cotton-wheat system and hence the B:C ratio. Water productivity of cluster bean-wheat cropping system was 0.358 kg /m^3 which was the highest among other cropping sequences. Moreover, the organic carbon status (0.37 %) available nitrogen 9118 kg/ha), available phosphorus (18.9 kg/ha) and available potassium levels (332 kg/ha) of surface layer of soil in cluster bean -wheat cropping sequences significantly improved as compared to cotton based cropping systems. Therefore, it may be concluded thatcluster bean-wheat cropping system can replace existing cotton-wheat cropping system, which can encourage crop diversification for higher economic returns, along with sustenance of soil and water resources and higher economic returns.

OL-3-04

Integration of spices, medicinal and aromatic plants for crop diversification and enhancing farm income in jute seed based cropping system

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Field experiments were conducted at Experimental Farm of the ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore during 2014-15 and 2015-16 to evaluate the economic feasibility of growing spices, medicinal and aromatic crops in jute (seed) based cropping system. The experiment was laid out in spilt plot design with three replications. The main treatments comprised of different spices, medicinal and aromatic crops viz., ashwagandha (transplanted) (*Withania somnifera*), senna (*Cassia augustifolia)*, stevia (*Stevia rebaudiana)*, isabgol (*Plantago ovate)*, fennel (*Foeniculum vulgare)*, ajwain (*Trachyspermum Ammi)*, dill seed (*Anethum graveolens)*, nagella (*Nigella sativa)*, coriander (*Coriandrum sativum)*, fenugreek (*Trigonella foenum-graecum)* and peppermint (*Mentha piperita)* along with a traditional vegetable crop tomato as control and was grown after the harvest of jute (seed crop) under two soil fertility

levels i.e. with recommended dose of fertilizer (RDF) and RDF + 5t FYM respectively. The experimental soil was sandy loam in texture with pH 6.8, medium in organic carbon 0.66%, medium in available nitrogen (290 kg ha), high in available P_2O_5 (36 kg ha) and potash (234 kg ha).Data for both the years were recorded and pooled. Considering the system as whole, the highest jute equivalent yield of 224.32 q ha^{-1} was obtained in jute (seed)-stevia-autumn rice cropping system followed by peppermint (6458 q ha^{-1}) and ajwain (81.54 q ha^{-1}) compared to traditional vegetable crop tomato (23.10 q ha^{-1}). Jute (seed)-ajwain-autumn rice cropping system registered the highest net income of Rs. 1,38,615/- which is 20% higher compared to the control (Rs.1,11,042/-). Evaluating the system economics, maximum benefit-cost ratio was recorded in jute (seed)-ajwain-autumn rice cropping system (2.68) followed by stevia (2.41) and peppermint (2.30) whereas it was found quite low in tomato (2.12). Hence in the present scenario of climate change the high value spices like ajwain, medicinal crop such as stevia and aromatic crop such as peppermint can be grown successfully in jute and autumn rice based cropping sequence. The spices and MAPs have flexibility to photo thermal requirement, tolerance to adverse condition of soil, water and infestation of disease and pest. They will ensure higher return to the jute growing farmers who wish to be self sufficient in jute seeds production.

OL-3-05

Mushroom cultivation for food security and rural development in Koshi region of Bihar

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Mushroom cultivation is one of the agricultural activity in which rural youth can play a vital role without sacrificing their household responsibilities. Its cultivation is very simple, low cost, landless based activity, labour intensive and environmental friendly and based upon the utilization of agricultural wastes with protein rich materials. It can provide self-employment and earning extra money for both the semi-urban and rural areas, especially suitable for small, marginal poor farm household, farmwomen, landless labourers, rural unemployed youth and even retired or in-service person in order to raise their social-economic status through skill development. Apart from the socio-economic status of the mushroom growers, it is not only solve the problems related to employment of both literate and illiterate person (specially women) *vis-a-vis* considered as an alternative source of income to uplift the living standards of poor people's and also to add high quality protein in their daily diets to eradicate malnutrition problems.The global food and nutritional security of growing population is also a great challenge, which looks for new crop as a source of food and nutrition. In this context, mushrooms find a favour which can be grown even by landless people, that too on waste material and could be a source for proteineous food. Use of mushrooms as food and neutraceutical have been known since time immemorial, as it is evident from the description in old epics Vedas and Bible. Earlier civilization had also valued mushrooms for delicacy and therapeutic value. In the present time, it is well recognized that mushroom is not only rich in protein, but also contains vitamins and minerals, whereas, it lacks cholesterol and has low calories. Furthermore, it also has high medicinal attributes like immunomodulating, antiviral, antitumor, antioxidants and hepatoprotective properties.Constraints to production include lack of quality spawn, problem of pest and disease, complex process of obtaining loan and lack of proper skills in production. Recommendations were made around the aspects of training on mushroom

cultivation, financial institutions should make loans flexible to farmers, government should encourage the use of laboratories to produce and distribute spawn and government should consider mushroom productions as an agricultural activities. It concluded that, mushroom farming may flourish like mushroom growth in the coming years; if the problems identified and attended urgently and remedial measures are undertaken at the earliest.

OL-306

Coconut inflorescence sap "Neera and its value added products" – a new approach towards making coconut more profitable

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Coconut plays an important role in the national economy of India. But due to different reasons gradually coconut farming is becoming non-profitable. Coconut inflorescence sap Neera and its milk based Neera sweets, are the latest additions to revitalize the prospects of coconut farmers. Neera is the sweet, honey colored unfermented phloem sap, a rich source of vitamins, sugars and minerals. As it is rich in minerals and vitamins it is considered as one of the best natural neutraceutical drinks. The most significant characteristic of Neera is its low Glycemic Index (35), an indicator to the extent of sugar absorbed into the blood. The global demands for low GI sugar are increasing because of diabetic patients. In W.B, if 1% of the total coconut palms are utilized for Neera tapping, then besides employment generation of 3431 numbers of man days /day, on an average 102.92 lakh litres of sap may be produced / year. A farmer can also earn Rs 15000/ per plant/year which will be much higher than the nut income of Rs800/ year. As value added products milk based Neera sweets like *Sandesh, Peda, Kanchagolla, Kalakand*, etc are also being prepared and marketed in W.B. As a result Neera and its latest value added milk based Neera sweets are generating a good daily return to the coconut farmer, the tapper and sweet makers which are ultimately contributing to the state GDP also.

OL-3-07

Enhancement of livelihood security of tribal farmers of North-24 Parganas through sustainable technological interventions

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Preliminary study on tribal farmers of villages under Baduria block of North 24 Parganas district of West Bengal revealed that they were economically not sound. Major source of their livelihood was farming (either in own land or in leased land), masonry, daily wage labour and allied activities on very small basis. Although many of the tribal farm women were registered under Self Help Groups (SHG), the activities of these groups were insignificant because of various constraints. Based on the study, two villages namely Makaltala and Farmania of Baduria block were adopted by ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore during the year 2014 under Tribal Sub Plan programme for enhancing the livelihood security of the tribal farmers.

Various location specific interventions were introduced in the villages (agricultural and allied activities) to improve upon the income of the tribal farmers. An assessment on the improvement of these villages after two years revealed that 86% of the tribal farmers were benefited from the TSP project in terms of increased income from agriculture due to adoption of modern technologies. An increase 63 % in cropping intensity was reported because of introduction of mung strip cultivation in jute fields and vegetable cultivation in rice field on soil based columns. Self Help Group(SHG) members (74%) became active in poultry and duckery and other group activities of their panchayat. Majority of the tribal farmers(89 %) revealed that the interventions had helped them to be self sufficient. Besides this most of the tribal farmers and farm women had acquired knowledge and skill on various improved cultivation practices and have gained confidence in farming.

OL-3-08
Food security against climate change through climate smart agriculture

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Climate change will influence crop adoption, distribution production of crops enhance the risk associated with agricultural activity. Globally cereal production reduced by 1-7% due to climatic variability Near about 22% 0f the cultivated area will be experience negative Impact from climate change by 2050 under the most important food crops and agricultural crops. The productivity of most crops will decrease due to increase in temperature and decrease in water availability. Adoption technique may play a role in mitigating adverse climate change affects. Current production system will be converted into climate smart production system which will not only be better adopted in terms of response production and sustainability but also will have reduced impacts on changing climate. Crop based approaches include growing crops and varieties that fit into changed rainfall and season development of varieties with changed duration that can over winter the transient effect of change. Organic agriculture provides management practices that can help farmers adopt climate change through strengthening agro-ecosystem diversifying crops and building farmers knowledge against climate change.

OL-3-09
Livelihood diversity in family farming in selected hill areas of West Bengal, India

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The diversity of livelihoods is a foremost feature of rural survival which is closely allied to flexibility, resilience and stability. In this sense, diverse livelihood systems are less vulnerable than undiversified ones; they are also likely to prove more sustainable over time precisely because they allow for positive adaptation to changing circumstances. Incomes were larger in the families with more diversity which results in a more sustainable rural livelihood. With this

backdrop, the present study was conducted in selected hill district of West Bengal. The data was collected from farmers with the help of Agriculture Officers (AOs), Training Officers (TOs) and Village Level Workers (VLWs) using structured interview schedule. The statistical methods used were Percentage, Mean, t-test and Correlation analysis as per the characteristics of data. The study reveals that there is difference in characteristics such as cosmopoliteness, extension media contact, land holding, total income and diversity between higher altitude and lower altitudes. Among the six primary occupations the highest income has higher diversification. Socio-economic parameters such as income from animal husbandry, income from marginal works and income from labouring, cosmopoliteness and extension media contact are positively correlated with diversity of farms. But land holding, income from agriculture, total income, household assets, average family education and maximum family education are negatively correlated with diversity of farms. At present, it is found that the farmers specially the youth are reluctant to undertake agriculture as primary occupation and they are diversifying it with other activities which are also found in this study.

OL-3-10

Study on organised self help group approach to increase profitability in dairying in draught hit cluster villages of Shivamogga district of Karnataka

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India stands first in world milk production, increasing its production to about 137.69 million tonnes in 2013-14 from 17 million tonnes in 1950-51. This is because of crossbreeding programmes which was initiated during the 1950s in India, mainly by crossing local breeds with Holstein Friesian (HF) and Jersey. These crossbred cattle gave higher milk yield than the indigenous cows and were more economical and increase the income of farmers and provide employment round the year. This programmes increased crossbred milch cattle from 14.4 million to 19.42 million, an increase of 34.78 % (19th Livestock Census- 2012) and similarly increased average per capita availability of milk in India to 307 grams compare to the world average of 294 grams per day in 2013-14 (Economic Survey- 2014-15). India is having 199.1 million cattle population, which includes 39.73 million crossbred. The study was conducted in villages of Government Veterinary Dispensary, Ripponpet jurisdictions of Shivamogga district of Karnataka state. The climates plays differently in these villages with heavy rain fall during rainy season and severe draught in summer. Although heavy rain falls, water holding capacity of soil is very poor leading to scarcity of fodder during summer and winter season. The farmers in these villages are rearing only local MALNAD GIDDA breed of cattle mainly for manure purpose as they are disease resistant, management free animal. These animals go out to forest area for grazing in day time and return back to home in the evening. The formers in these villages neglected husbandry practices & management, nutrition and milk production resulted in poor milk production. Therefore, farmers totally depended on PACKED pasteurised milk from milk federation and purchasing around 3000 to 4000 litres of milk every day. Since the life style of these farmers is different as they perform agricultural activities only in rainy season, the income status of farmers was very poor because there was no alternate income source other than agriculture. Further, the farmers were in the impression that the crossbred cattle will not survive for long time and there will be huge loss due to disease outbreaks. The government policy of making female self help

group (SHG) - STHREE AHAKTHI SANGHA came to rescue and around 20 plus females SHG groups were formed in different villages. Around 20 HF crossbred cattle was provided in first six months and later another 20 cattle were given to these group, which were in 1st or 2nd lactation period, yielding minimum of 10 to 12 litres of milk per day. The farmers were also given extensive training on scientific methods of cattle rearing and clean milk production. In the first month, farmers faced many husbandry & management related problems which were addressed scientifically and rectified. The main problem was sale of excess milk produced, which was also solved with the help of SHIMUL (Shivamogga milk union) who made milk producer's cooperative society (MPCS). The milk union started collecting around 500 to 600 litres of milk per day from that society and there by the economic status of farmers was improved. As the result, The farmers started getting more interest on dairying as it was profitable and gave employment round the year. The farmer started growing fodder crops for their cattle and there was no major disease problem encountered in these crossbred cattle due to improvement in the husbandry practices. This also changed villager's opinion about the rearing crossbred high yielding cattle and started dairying with crossbred cattle for their lively hood. Within year, the population of crossbred cattle was increased and the PACKED milk procurement was stopped. The farmers children were given fresh and hygienic milk, there by the health status was also improved.

OL-3-11
Sustainable utilization and conservation of natural resources in West Garo Hills region of Meghalaya

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The availability of natural resources for use by human beings are limited and humankind has realized that population, resources, environment and development problems are major threats to the future of humanity. Therefore, the problems of how natural resources can be allocated effectively and utilized rationally for generation after generation has become a fundamental issue for human society. There is "only one globe" and humanity shares a "common future". The state of Meghalaya has been blessed with rich natural resources which have contributed significantly to the livelihoods of the people. As the natural resource base is one of the nation's greatest strength and capital, it is imperative to ensure proper management of the ecosystem services, especially in terms of conservation and sustainable utilisation. Sustainable management of natural resources is important to ensure that current and future generations will continue to enjoy the benefits from nature's endowments while pursuing green growth. This paper makes an attempt to understand how various government agencies particularly West Garo Hills Community Resource Management Society (WGHCRMS), a project funded by the Ministry of DoNER and International Fund for Agriculture Development (IFAD) has promoted livelihood opportunities for the people in West Garo Hills district of Meghalaya with sustainable utilization and conservation of natural resources. It highlights various initiatives and success intervention, which has led to economic empowerment of the people with the best utilization of natural resources *viz.*, community forest conservation and sanctuaries, capacity building programmes through various livestock, horticulture and allied sectors and marketing linkages. Garo Hills region being blessed with abundant natural resources, the study reflects the role of WGHCRMS in making the people realise and harness the potential opportunities. One of the classic example of the organisation is

utilization of water hyacinth, which was considered a “weed” in the village, today finds it market in the region as a beautiful decorative and useful products as a group in the project village has made its utilization to enhance their livelihood.

OL-3-12
The effect of mobile radiation on agriculture in respect of hill topology

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As per Telephone Regulatory Authority’s (TRAI) Report total mobile subscribers in India is 1078.42 million as on October 2016. In Rural area Tele density is 51.98. It is proved by several researchers that microwave radiation has a strong effect on human body as well as on other animals and insects. Also some effects have been observed on plants. Hill Topology different from plains and microwave frequency works point to point in Arial distance. This study is to find out whether this mobile radiation has any effect on agriculture in respect of Hill Topology or not.

POSTER PRESENTATION

Technical Session-1

Climate change, geo-informatics, greenhouse effect and disaster management, biodiversity for crop/animal improvement, sustainable utilization and conservation of natural resources

PP-1-01
Multi-storeyed cropping system- a sustainable system forindigenous vegetables and medicinal plants

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Traditionally, multilayered tree garden or multi-storeyed cropping is practiced in and around the homestead of Bangladesh in an unsystematic manner. An initiative was taken to develop systematic multi-storeyed cropping system/models at the Germplasm Centre, Fruit Tree Improvement Program (GPC, FTIP), Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh. In coconut based multi-storeyed cropping system, indigenous vegetables like aroids, brinjal, yam, cabbage, spices like ginger, turmeric and medicinal plant like misridana grown very well as compared to sole crop. Similarly, in sissoo woodlot, the above vegetables, spices and medicinal plants also showed positive performance. In this system, natural resources were utilized properly, income per unit area increased substantially with this system. This approach ultimately helps to mitigate nutritional problems as well as poverty alleviation of developing countries like Bangladesh. So, incorporation of vegetables, spices and medicinal plants under multistoried cropping system in the homestead and/or orchard is inevitable. The developed model may be replicated in the orchard of mango/litchi (in north-west region) and jackfruit orchard (in eastern region) and also in the forest plantations of Bangladesh.

PP-1-02
Genetic resources of wild relative minor and medicinal fruit trees in BAU-GPC, Bangladesh

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Bangladesh, a flood plain delta, is a land of rivers and canals. It is situated in the north-eastern part of Asia. It is mainly an agricultural country and the agriculture sector contributes about 20-24% to the total Gross Domestic Product (GPD) (BBS, 2010). Fruit production scenario of Bangladesh in 2009-2010 is 45.25 lakh tons in the land of 1.46 lakh hectares where demand of 49.64 lakh tons of fruit. Deficit of fruit production was 9.60 lakh tons (BBS, 2010). For physiological balance of human body, the typical Bangladeshis consume 76 g/day/capita (BBS, 2010) which are behind the requirement of 85 g (FAO, 2008). Most of the people of our country cannot afford to buy even average requirements of fruits due to its unavailability and high price .The consequence of this event is, therefore, widespread malnutrition throughout the country. Wild/Indigenous/Underutilized/Ethnic fruits can play vital role to minimize the malnutrition situation of the country. Wild relative fruit trees viz. river ebony (*Diospyros peregrina*), velvet apple (*Diospyros discolor*), *cowa* (*Garcinia cowa,)* sapota, (*Manilkara zapota*), golden apple (*Spondias dulcis*), wax jambu (*Syzygium samarangense*), monkey jack (*Artocarpus lakoocha*), bullock's heart (*Annona reticulata*), elephant apple (*Dillenia indica*), wood apple (*Feronia limonia)*, star gooseberry (*Phyllanthus acidus)*, aonla *(Phyllanthus emblica)* etc. are widely grown in southern, hilly as well as floodplain areas of the country (Rahim *et al.*, 2011). These indigenous fruit and medicinal germplasm have been conserved at Bangladesh Agricultural University Germplasm Centre (BAU-GPC), Mymensingh as wild relatives' genetic resources.

PP-1-03
Genetic Divergence in Tomato under Alluvial Zone of West Bengal

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The present study was taken up at the Central Research Farm, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal during 2012-2013 for 15 characters of tomato genotypes. Based on the determination of divergence for the characters pertaining among all the 30 genotypes could meaningfully be grouped into 9 clusters. It was confirmed that cluster VII were high performance for equatorial diameter, fruit weight, lycopene, TSS, B-carotene, ascorbic acid total yield plant^{-1} and the above result of cluster mean clearly indicated that genotypes like BCT115dg, TPOPcould be selected as parents for future hybridization programme. The genotypes from the cluster I, IX and VIII could be selected for hybridization programme to produce highly heterotic genotypes as these were found to be most divergent with a number of desirable traits.

PP-1-04

Effect of Integrated Nutrient Management on Yield, Nutrient Uptake and Soil Fertility in Maize (*Zea mays*)

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A field experiment was conducted at Langate cluster of National Agricultural Innovation Project, SRLS-3 (Kupwara), during two *Kharif* season of 2008 and 2009 to steady the effect integrated of organic and inorganic sources of plant nutrients on growth, yield, nutrient uptake of maize (*Zea mays L.*) and residual soil fertility of the post harvest soil under temperate conditions of Kashmir. The experiment comprised 7 integrated nutrient management practices; T_1 (Control), T_2 (100% NPK 60: 60: 20 kg/ha), T_3 (100% NPK + vermi-compost 3 Tones/ha), T_4 (100% NPK + farmyard manure 3 Tones/ha), T_5 (50% NPK 30: 30: 10 + vermin-compost 5.5 Tones/ha), T_6 (50% NPK + farmyard manure 5.5 Tones/ha) and T_7 (vermin-compost 5.5 Tones/ha + farmyard manure 5.5 Tones/ha) were conducted in randomized block deasign with 3 replications. Application of 100% NPK + vermi-compost 3 Tones/ha recorded maximum kernals/cob, number of cobs/m^2 , 1000 grain weight and cob length, followed by 100% NPK + farmyard manure 3 Tones /ha. Maximum maize grain yield (3.26 Tones/ha) was recorded with combined application of 100% NPK + vermi-compost 3 Tones/ha, followed by 100% NPK + farmyard manure 3 Tones /ha. Highest nutrient uptake (95.1, 20.8 and 84.1 kg N, P and K, respectively) was observed with the integration of 100% NPK + vermi-compost 3 Tones/ha in maize crop, it was followed by 100% NPK + farmyard manure 3 Tones /ha in which nutrient uptake was observed to the tone of 93.3, 20.1 and 82.8 kg N, P and K, respectively. Application of vermicompost 5.5 Tones/ha + farmyard manure 5.5 Tones/ha to maize recorded soil available N, P and K status of 394.8, 21.37 and 169.8 kg/ha, respectively, which was significantly higher than the control.

PP-1-05

Effect of temperature on phenology, growth and yield of different sorghum (*Sorghum bicolor* (L.) Moench) genotypes

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Sorghum (*Sorghum bicolor* (L.)Moench) is one of the most major food grains of the world. It is cultivated in tropical and subtropical climates especially in semi-arid tropics. Sorghum is a source of the fodder and straw feed to millions of animal providing milk and meat for man. It is one of the most widely grown under dry-land for food grain in India. It does well in low rainfall region also. Sorghum grain is eaten by human beings in India in the form of 'Bhakari'. Geographically Parbhani is situated at the $19^o16'$ North latitude and $76^o47'$ East longitude and altitude of 409 meters above mean sea level in Marathwada division. Parbhani comes under subtropical climatic zone and Agro-climatologically under assured rainfall zone. A field experiment was conducted during r*abi* season of 2010-11at experimental field, Department of Agricultural Meteorology, College of Agriculture VNMKV, Parbhani to determine the effect of temperature on phenology, growth and yield of different *rabi* sorghum (*Sorghum bicolor* (L.) Moench) genotypes under rain

fed condition.Statistical design was used randomize block design for laid out the experiment with 20 genotypes of *rabi* sorghum and three replications. Statistical aanalysis was done by computerized software program SPSS 22.0. The weekly canopy temperature (CT) was measured at 13.30 - 14.30 hourwith the help of Teletemp model AG-42infrared thermometer. Average value of canopy temperature at each phenophases was taken for interpretation of the data. Daily temperature data from the nearby (Adjacent plot) agromet observatory were procured for the calculation of growing degree day (GDD) and further study. The observations on CT and GDD recorded at all phonological stages and at harvest grain yield and fodder yield.Result showed that the significant difference between the 20 genotypes of *rabi*sorghum under rain fed condition. The genotype Parbhani Moti showed significantly better performance among the all genotypes at all phenological stages and yield aspects at harvest. Thehighest grain yield was observed in Parbhani Moti (22.10 q ha^{-1}). The correlation between CT and grain yield was found significantly negatively correlated at boot stage and dough stage. It means that boot stage and dough stage are the critical growth stage of sorghum crop. The results clearly indicated that the yield of *rabi*sorghum decreases with increase in canopy temperature with respect to ambient temperature. The heat unit (GDD) recorded highest in Akola Kranti (1636 ^{o}C day) and lowest in K-606 and RSG-04005 (1510 ^{o}C day).The lowest Ct at different phenological stages, more GDD and higher grain yield as well as fodder yield showed sorghum genotypes having possess drought tolerance attributing characters.

PP-1-06
Forest fires in Uttarakhand: extent, justification and policy

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Forests face many hazards but the most common hazard is a forest fire. The most vulnerable stretches of the world to fire are the youngest mountain ranges of Himalayas. Fluctuating dry weather, high temperatures, fuel loads, steep terrain and windy conditions have caused the fires to spread on a bigger scale every year. Uttarakhand has witnessed a disaster of worst forest fire occurring in 1995, 1995, 2004, 2002, 2003, 2004, 2005, 2008, 2009, 2010, 2012, and now it has become an annual feature. As per Uttarakhand Forest Statistics 2011-12, fire affected an area of 32343.49 hectares of forests resulted in quantifiable timber loss worth around million of rupees from 2000-2012. Forest fires of 1995 and 1999 were very severe affecting 6, 77,700 hectares of forest area. In 2004 and 2005 forest fire devastated 4,850 and 1250 ha of forest. The real reason behind fires is that the rural folk believe that after fires grass grows better. These fires are also intentionally set up by the timber smugglers to hide the stumps of illicit felling. Besides directly damaging the forest trees and human lives, the fire also adversely affects forest regeneration, microclimate, soil erosion, and wild life etc. It has wide-ranging adverse ecological, economic and social implications. Most people are unaware of the long-term impacts of forest fires on the environment, rivers, and the ecosystem. An under-staffed, under-equipped, and under-motivated Forest staff cannot do more than put in a token effort in mountainous terrain. Fight fire by working together (The Van Panchayats, Mahila Mangal Dals, SHGs (Self Help Groups and Yuvak Mangal Dals), prescribed burning, fire lines, awareness programs be very active and supportive in order to stop the forest fires. Efforts for finding alternative uses for pine needles should be supported by the Government to reduce the accumulation of combustible material. In addition to it, there must

be punitive measures including penalties, arrest and punishment to those who indulge in starting fire is the need of the hour.

PP-1-07
Characterization of citrus germplasm

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Citrus fruits play an important role in the fruit world for its availability period and high market price. In Bangladesh we have a good number of citrus species which can certainly contribute to the nutritional improvement of the people of Bangladesh. Bio-piracy is an ill practice now adopting in different countries and plants are then characterized in different ways to protect them for their own. In these circumstances, characterization is a prime need for the fruit germplasm for any country. In situ evaluation of different citrus fruit varieties/lines is being conducted at the citrus research station Jaintapur Sylhet starting from July 2006. Citrus research Station is rich resources of plant gene pool, specially, for the citrus fruits. Among the different citrus species, an effort has been done for the in situ characterization of some of the citrus fruits including mandarin, malta, pummelo and satkara. Primarily, an effort has been made to characterize following IBPGR descriptor. A wide variability was observed in different characters among the different fruit varieties/lines studied. All the varieties/lines produced flowers in February and fruit setting was occurred in March. Plant, leaf and flower characters differed significantly. A wide variation was observed in different parameters of fruit varieties/lines studied. The varieties/lines showed different characteristics.

PP-1-08
Organic Farming to Mitigate Climate Change

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Climate change is the greatest threat to the mankind at present. The World Climate is changing mainly due to the increased temperature over the earth surface and increased concentration of Green House Gases such as Carbon dioxide, Nitrous oxide etc. in the atmosphere. Among the various causes of the increased concentration of Green House Gases in the atmosphere, agriculture is one of the greatest causes which contribute about 14 % of the atmospheric Green House Gases. The Modern improved techniques of agriculture using high inputs are adding more GHG in to the earth atmosphere which in turn causing global warming and climate change. However Organic farming can counter act the global warming through various ways. Organic farming is a method of agricultural production system in which mostly in farm inputs are used and the inputs from outside sources are minimized. In the organic farming, natural resources are mostly used. Organic farming can significantly reduce carbon dioxide emissions. It is a viable alternative to shifting cultivation and offers permanent cropping systems with sustainable productivity. Organic farming reduces Nitrous oxide release to the atmosphere as it minimizes the use of Nitrogenous fertilizers in crop production. Organic farming is a holistic food production management system, which promotes and enhances agro-ecosystem health, including

biodiversity, biological cycles and soil biological activity (Codex Alimentarius Commission, FAO/WHO). Organic farming can mitigate the climate change by reducingGHG emissions and improving carbon sequestration. Organic farming Recycles wastes of plant and animal origin in order to return nutrients to the land and thereby minimizes the use of non-renewable resources. Organic farming has a very good sequestration potential as it follows the key principle of tight nutrient and energy cycles through organic matter management in soils. The present paper reviews the ways by which organic farming can mitigate the climate change and up to what extent.

PP-1-09

Effects of the severe cyclone Aila on Agricultural crop productivity in Sundarban region

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The Indian Sundarban Delta (ISD) is part of the delta of the Ganga-Brahmaputra-Meghna (GBM) basin in Asia. The Sundarban, shared between India and Bangladesh is home to one of the largest mangrove forest in the world. About 53% of the coastal areas are affected by salinity. Agricultural land use in these areas is very poor, which is much lower than country's average cropping intensity. Soil salinity is a major global issue due to its adverse impact on the environment, agro-ecosystems, Agricultural productivity and sustainability. Saline soil is significant as formations of ecosystem on the earth affected by high concentrations of soluble salts, and as means of crop production with little economic value. Many plants either fail to grow in saline soils or their growth is retarded significantly. However, few plants grow well on saline soils; therefore soil salinity often restricts options for cropping in a given area. Crop productivity has either become static or shown a decline in some locations. Ecological degradation due to salinization has also affected the types and productivity of the crops and freshwater fishes. It is understood from the tonal variation in multi-dated satellite images of the area affected by Aila, a severe cyclonic storm that occurred on 25th May, 2009, that the ingress of saline water on agricultural land and subsequent infiltration and evaporation of water has left large areas fallow. Food crops have to be produced on the shrinking land resources as few suitable lands are available for cultivation. The perceived rising temperatures and uncertainties in rainfall may have serious direct and indirect consequences on crop production and hence food security of this region. At this point, innovations in the type of crops and process of cropping are of most necessity. This paper highlights the geographical impacts of Aila on the agriculture, occupation and life of the people in the Sundarban region.

PP-1-10

Effect of paddy straw plus non forage fibre sources based complete feeds containing different levels of neutral detergent fibre on production and reproduction parameters of lactating dairy cows

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A study of six months duration was conducted to assess the effect of different levels of neutral detergent fibre (NDF) in paddy straw plus non-forage fibre sources (NFFS) based complete feeds for cows in two phases, viz., early and mid lactation, on the basis of production and reproduction parameters. Three isonitrogenous and isocaloric complete rations, T1, T2 and T3 with 25, 30 and 35 per cent NDF, respectively were formulated as per ICAR (1998). Paddy straw was the sole source of roughage NDF, with the rest of NDF being met from NFFS, in all the three rations. Eighteen dairy cows yielding approximately 10 kg of milk per day and within two weeks of calving were divided into three groups of six each, and allotted randomly to the three experimental rations. The average daily dry matter intake (DMI) of cows fed on the three experimental rations were similar ($P<0.05$), from the third fortnight onwards till the end of the experiment, even though the DMI tended to be higher in T3 and T2 as compared to T1. The average daily milk yield of cows fed on the experimental rations, T1, T2 and T3, in phases I and II were similar ($P<0.05$), even though the milk yield of the animals tended to increase with increase in NDF content of the ration. The milk yield of cows fed on ration T3 attained peak yield in the second fortnight while those fed on rations T2 and T1 reached the peak in the third fortnight only. The cows fed on ration T3 remained in peak milk yield for a total of six fortnights, while those fed on T2 and T1, remained in the peak for only five fortnights. During the first four fortnights of phase I, the cows fed on ration T3 had a significantly higher ($P<0.05$) body weight than those fed on T1 and T2, while T1 and T2 were similar ($P<0.05$). From the fifth fortnight onwards till the end of the experiment, the body weight of animals fed on all three rations, were similar ($P<0.05$), even though it tended to be higher with in cows fed on ration T3, than those fed on T1 and T2. Average period for the first postpartum heat of cows fed on the three rations were similar ($P<0.05$), even though it was earlier in case of cows fed on the experimental ration T3 than those fed on T1 and T2. A thorough evaluation of the results obtained in both phases as well as the total experiment revealed that cows in all the three dietary treatments performed well, with the complete rations T3 with 35 per cent NDF and T2 with 30 per cent NDF, showing better performance than T1 with 25 per cent NDF. Among T2 and T3 which were more or less comparable, the cows fed on the diet T3 had a higher average daily milk yield, reached the peak yield earlier and had greater persistency of milk yield than those fed on diet T2. Similarly, the cows fed on ration T3 were able to manage negative energy balance better, started gaining weight from the first fortnight onwards and came into heat earlier than the animals fed on rations T1 and T2, indicating that T3 was the best ration. These results suggest that complete rations with 25 to 35 per cent NDF, containing paddy straw as the sole source of roughage NDF, with the rest of NDF being met from NFFS, can be recommended for use among early and mid lactation dairy cows, with 35 per cent being the ideal NDF level.

PP-1-11

Assessment of genetic diversity in tropical Indian cauliflower (*Brassica oleracea* var. *botrytis*) using molecular markers

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Cauliflower, a member of the Cruciferae family, is a cool season vegetable crop, cultivated in almost all the parts of India. A group of tropical cauliflower evolved in India is characteristically different from the temperate cauliflower group which is tolerant to high temperature and humidity. Temperature plays important role in curd initiation of cauliflower; tropical Indian cauliflower can produce curd an average of 20-27°C temperature. Whereas, temperate cauliflower is require minimum of 10-16°C temperature. The nature and magnitude of genetic variability on a population is of prime importance for improvement of a trait. Hence morphological characters are generally quantitative in nature and are highly influenced by the environmental factors. Molecular markers can be used to predict the exact variability existing in the genotypes. As genomic information is not a prerequisite, the inter short sequence repeat (ISSR) markers are powerful tools for assessing genetic diversity at molecular level in different crop plants, where detailed genomic information is yet to be developed. In the present study, 8 advance tropical cauliflower genotypes along with two checks *viz*., Sabour Agrim and Pusa Kartik Sankar have been used to analyse the genetic diversity, at molecular level using 8 IISR primers. The amplified bands were visualized through agarose gel electrophoresis and scored for the presence (1) or absent (0) of a particular band. The genetic relationship among the accessions was evaluated with phylogenetic trees constructed on the basis of similarity co-efficient values. Through diversity analysis, all the test entries could be distinguished from each other, where the genotype HZP 117 was observed to be unique from the other 9 entries. This genotype was most distantly related to the genotype Pusa Kartik Sanker. On the other hand, the genotypes Pusa Kartik Sanker was found to be most closely related to the genotype Sabour Agrim**.** From the cluster analysis based on ISSR data, all the genotypes except HZP 117 were placed in 2 different clusters. The cluster 1 contained 3 entries, whereas rest 6 entries were placed in cluster 2. The cluster 2 was further sub-divided into 2 sub-clusters, where sub-cluster 1 contained 4 and sub-cluster 2 contained 2 entries, respectively. This molecular characterization study, thus, documents the uniqueness of the test entries at molecular level, which will pave the way for further molecular breeding works in cauliflower, in near future.

PP-1-12

Evaluation of phosphate solubilizing microorganisms from rhizospheric soil of paddy of Vidharbha region

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Rice (Oryza sativa L.) is among the three most important cereal crop of the world and its production exceeds from that of wheat. It is important grain providing one-fifth of caloric requirement of humans globally. Phosphorus is one of the major macronutrients required by

plants. But, most of phosphorus present in soil is in insoluble forms and un-utilizable by the plants. Phosphate solubilizing bacteria (PSB) existing in rhizosphere solubilizes insoluble, in-organic and organic phosphorous forms thereby making soluble phosphate retrieved by the plant root from the soil environment. The rhizospheric soil of paddy was investigated for the study of phosphate solubilisation by bacteria and fungi. In the present study 82 soil samples were collected from paddy cultivating areas of Vidharbha region (different villages of Gadchiroli, Chandrapur, Gondia and Bhandara Districts) at nursery and flowering stage, among these samples, 28 samples showed the ability to solubilise the inorganic insoluble phosphate. From the study it was observed that the bacteria, i.e., *p*seudomonas spp. have more solubilizing ability of inorganic insoluble phosphate than fungi (*aspergillus* spp., hence the application of biofertilizer prepared by above mentioned fungi Should be helpful to increase the crop yield by solubilizing large concentration of inorganic insoluble phosphate.

PP-1-13

Inheritance of lemma and palea color in a segregating population derived through a cross between two Sri Lankan rice varieties (traditional rice *Inthiankaruppa* and improved rice Bg 379-2)

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A variety of pigments is detected in morphologically diverse Sri Lankan traditional rice germplasm. The Inheritance of lemma and palea color in the segregating generation of the intra-specific cross between Sri Lankan traditional rice variety *Inthiankaruppa* (Accession number 4734) and improved rice variety Bg 379-2 was studied in the field of Faculty of Agriculture, University of Ruhuna, Sri Lanka. *Inthiankaruppa* parent possessed purple lemma and palea, while those of Bg 379-2 parent were straw coloured. The parents and F1 in one growing season and parents and F2 in the subsequent season were grown (long day season and short day season) during 2014 and 2015. Lemma and palea colour of parents, F1 and F2 were determined based on a modified descriptor of SES for rice. Pearson's chi-squared test for the goodness of fit was carried out to determine the presence of a specific gene interaction for the lemma and palea color using a representative subset of the F2 where there were 153 pigmented and 11 non-pigmented spikelets in average of 3 replicates. The gene interaction was further elaborated through checking for the complimentary gene action, dominant suppression epitasis and duplicate gene interaction of 9:7, 13:3 and 15:1 ratios respectively. A duplicate gene interaction ratio of 15:1 was confirmed at 5% probability level (X^2=0.058, P=0.3-0.5). Above result indicates that the two genes involve in the pigmentation of lemma and palea for above cross.

PP-1-14

Integrated nutrient and water management for sunflower (*Helianthus annuus* L.) in an Inceptisol

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Sunflower (*Helianthus annuus* L.), as a major oil seed, is widely cultivated in the world. It is an annual, erect, broadleaved plant with a strong taproot and prolific lateral root system. This experiment was established to develop protocols for integrated management of nutrients for sunflower in an *Inceptisol*. This experiment was carried out to assess the performance of sunflower under three moisture regimes [30, 50 and 70% available soil moisture depletion (ASMD)] and five integrated nutrient management (F_1-RDF [N:P_2O_5:K_2O::80:60:40 kgha^{-1}]; F_2-STCR based NPK administration; F_3: F_2 + Boronated fertilizer @ 10 kgha^{-1}; F_4- [½ (N+ P_2O_5) + Full K_2O] of F_2 + FYM @10 t/ha + Azotobactor + PSB and F_5- F_4+ Boronated fertilizer @ 10 kg^{-1}). Results demonstrated that the effect of different irrigation regimes was significant on growth attributes like plant height, basal girth, LAI, CGR, NAR, seed yield, harvest index, water use efficiency and RWC. Larger basal girth and better seed yield and water use efficiencies were supported by 50% depletion (I_2) of available soil moisture. It was observed that interaction effect of treatments was significant in improving water use efficiencies, yield attributing parameters and augmenting yields. N, P, K uptake by plant was significantly influenced by integrated management of nutrient (F5) whereas no significant effect was found in any moisture regime. The nutrient-moisture interactions revealed that 50% depletion of ASM with integrated fertilizer NPK supplemented with FYM and substantiated with boronated fertilizers and bacterial inoculation (I_2F_5) resulted highest seed yield and maximum water use efficiency. The total water used throughout the growth period of sunflower was highest in case of I_1 i.e. at 30 % ASMD level followed by I_2 (50% ASMD) and I_3 (70 % ASMD).

PP-1-15

Soil seed bank composition and diversity in temperate forests of Garhwal Himalaya

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Soil seed bank is a product of site history, previous seed input, and seed losses due to germination and mortality. Soil seed banks are defined as all the viable seeds found in and on the soil or in associated leaf litter. Seed bank composition was determined with the seedling emergence method. The sampling was done both horizontally and vertically (20 cm × 20 cm × 9 cm depth in blocks) in four layers (litter, 0 – 3cm, 3 – 6 cm, and 6 – 9 cm) positioned in a regular way along the diagonals of the quadrat. The litter layer was included with the soil samples as 4th layer because this layer contains a high number of seeds. Overall 196 species were recorded from the soil seed bank, out of 196 species 135 species were recorded from the Adhwani, 116 from Phairikhal, 108 from Mohankhal and 85 species from Triyuginarayan. Among the identified 196 species, the overall soil seed bank was dominated by herbs, followed by shrubs and tree,

categorized life forms were identified as Herb (154) > Shrub (30) > Tree (12). Among trees both small sized and large sized seed trees were found in soil seed bank (e.g. *Ficus* species and *Quercus leucotricophora*).Seed density for current study ranged between 2325 – 37275seed/m^2 with species richness of 26 to 92 plants. Data of the present study indicate that small seeded species are dominant in the soil seed bank. Shannon-Wiener index (H') showed variation in diversity within the depth and with the season. The results suggest that the seed banks provide important information as what species may have existed in the standing vegetation of the past and/or represent pool of regeneration potential.

PP-1-16

Status of sugarcane woolly aphid, *Ceratovacuna lanigera* Zehntner (Homoptera: Aphididae): an overview

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The sugarcane woolly aphid (SWA), *Ceratovacuna lanigera* Zehntner (Homoptera: Aphididae) became a threat to the sugarcane crop as well as sugar industry. In India *C. lanigera* has been reported as a serious pest of sugarcane in Maharashtra and Karnataka states during July and September, 2002, respectively. It was first reported by Zehntner 1897 from Java and it has been observed in 23 Asian countries of which Java, Philippine, Indonesia, Taiwan, and Malaysia etc are of importance. In India, Basu and Banerjee in 1958 reported it for the first time from West Bengal. During 2002, the pest epidemic was reported from Maharashtra and Karnataka. By the end of 2004 it had spread to almost all the sugarcane growing areas in the country. *C.lanigera* was recorded in 1905 on sugarcane in Sri Lanka and the outbreak of the pest were reported during 2006 causing heavy losses to the sugar industry .The crop of six to 12 months old was more vulnerable to the attack by this pest. Its infestation usually occurred in patches in the beginning and then spread into the entire field within a short span of two to three weeks. Both nymphs and adults of these aphids desap the under surface of the leaves along the midrib and then they spread to the entire under surface, covering it with flocculent waxy secretion. These aphids excrete honeydew which often covers the entire upper surface of the leaves, leading to growth of sooty mould. Gupta and Goswami in 1995 assessed the effect of 25 and 100 per cent aphid infested leaves on some yield and quality parameters of the sugarcane and found that cent per cent infestation had detrimental effects on reduction of length (11.6%), girth (3.5%), weight (16.6%), length of internode (18.4 %) and width of leaf (4.5%). Like other sucking pests, if we consider the SWA management, though several synthetic insecticides are effective against the aphid, they do not find place in sugarcane ecosystem for reasons like operational hazards during application of insecticides, improper coverage of crop canopy after seven months and difficulty in spray operation. Hence, the practices like wider spacing or paired row planting, proper water and nitrogen management, stoppage of movement of seed cane from infested areas, release of predators are some suggestions to suppress the pest. Over a hundred years since the discovery and description of the sugarcane woolly aphid in the year 1897, about 37 natural enemies including seven parasitoids, 27 predators and three pathogenic fungi have been reported to attack the SWA from the areas of its occurrence. *Encarsia flavoscutellum* Zehntner was the first parasitoid to be studied as potential agent for the control of SWA. General predators like *Synonica grandis* (Thunberg) and *Anisolemnia dialatata* (Fabricius) and *Chrysoperla carnea* (Stephens) have not been encountered in adequate numbers in sugarcane ecosystem to rely

upon them. Though the pyralid predator, *Dipha aphidivora* (Meyric) has been reported to be a potent one to manage SWA, the *Micromus igorotus* Banks was reported to be a potent and amenable predator even for mass production and utilization in SWA management in India.

PP-1-17
Winter rainfall statistics over the Western Himalayas of India: a probabilistic approach

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The climate of Himalayan region is regulated through the occurrences of the western disturbances (WD) during winter (Dec-Feb) season and the southwest monsoon during rainy season (Jun-Sep). During the winter months westerly winds associated with WDs cause precipitation. The primarily aim is to identify any in homogeneity (shift) in the rainfall records of 22-numbers of station data during the period of 1901-2005 over the Western Himalayas. Majority of the stations showed that the most probable year of rainfall shift is 1961. Secondly station-wise rainfall statistics were carried during a recent homogeneous period of 1971-2005 after shift year. Highest amount of rainfall is recorded during the February month along with lowest variability (CV), indicating successive rainfall events. However, less occurrence of rainfall events in December month arise due to higher CV values. Three statistical goodness of fit (GOF) tests namely Kolmogorov Smirnov (KS), Anderson Darling (AD) and Chi-squared (CS) were carried out in order to select the best fit from the four probability distributions functions namely Johnsons SB (JSB), Generalised Extreme Value (GEV), Geneneralised Pareto (GEP) and Normal distributions. In general results from the three goodness of fit test indicates that GEV is the best fit distribution for winter rainfall whereas JSB is found to be best fit distribution in December and February months. Conditional probability analysis shows that there is nearly 70% and 50% chance of getting more than 40 mm of rainfall during the January and February months respectively while during the whole winter season, the probability of getting more than 100 mm of rainfall is 60%.

PP-1-18
Assessing centennial scale past rainfall change over Hill Agro climatic Zone of West Bengal using multi-sources data

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Majority of agricultural activities over all six agro climatic zones of West Bengal state are highly depended on the variability of seasonal as well as annual rainfall. Under the context of climate change, some zones are expected to receive excess rainfall whereas others may show deficit rainfall which may caused a great concerns for the policy makers as well as farmers to know how much rainfall has so far changed (excess/deficit) in each agro climatic zones with high level of accuracy as different sources of data resulted as different historical rainfall change scenarios.

Therefore, present study attempted to provide a comprehensive comparative rainfall change scenarios over one of the most important agro-climatic zones situated in Eastern Himalayas, viz. the Hill agro climatic zone of West Bengal using multiple gridded data sources. To put more confidence of results three type of gridded data set namely IMD high resolution (0.25°×0.25°), IMD low resolution (1.0°×1.0) and CRU (0.5°×0.5°) gridded rainfall data has been used. The whole dataset has been divided into different short-term periods namely 1901-26, 1927-52, 1953-78 and 1979-2003 apart from a long-term period (1901-2003). Rainfall change trends have been quantified through linear and parametric trend test to see how rainfall has fluctuates in different short periods. In addition, the percentage change of rainfall has been estimated with respect to the base period 1901-26. It is revels that the annual rainfall has shown decreasing trends by 1.4-4.2%, 6.2-9.3% and 1.3-2.4% respectively in three successive periods of 1927-52, 1953-78 and 1979-2003. Similarly monsoon rainfall also indicated decreasing trends over Hill zone for each period. On the other hand, an increasing trend of rainfall was noticed in pre-monsoon, post-monsoon and winter rainfall in the most recent period. It has been found that IMD high resolution gridded data is more reliable than others for the assessing the rainfall change over this zone.

PP-1-19

How do well the Rice Simulation model (ORYZA2000) able to reproduce realistic rice yield over new alluvial Zones of West Bengal

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An attempt was taken to investigate whether the ORYZA2000 model is able to reproduce yield components of rice variety IR-36. To evaluate the model performance, a field experiment was conducted at the farm of the Bidhan Chandra Krishi Viswavidyalaya in the new alluvial zone of west Bengal for the *Boro* season of the year 2013-14. Firstly, an experiment was designed to assess the impact of nitrogen fertilizer and irrigation regimes combined on rice yield components and the treatment were chosen accordingly @ N_1 (150.0 kg N/ha), N_2 (112.5 kg N/ha), N_3 (75.0 kg N/ha) and N_4 (120.0 kg N/ha) whereas three irrigation regimes were I_1 (continuous ponding of 5 cm of water throughout), I_2 (Irrigation applied 1 day after complete disappearance of water) and I_3 (Irrigation applied 2 days after complete disappearance of water). All the necessary environmental, management parameters and varietal information were adjusted through the new values after running the D-rate program. It was noticed that model has a tendency to simulate higher values of final yield and its different yield components such as grain yield, biomass etc. under different nitrogen doses and irrigation scheduling conditions. As for example, it was observed that the simulated values of grain yield (WRR14) were significantly different compared to actual observed yield obtained from field experiment. It was observed that the highest grain yield was found to be6.83 tonnes/ha under N_1 followed with continuous ponding (I_1) whereas model simulated yield was 8.9 tonnes/ha under the same condition indicating the nature of overestimation of rice yield. On the other hand, under certain stress situations, the simulated yield was reduced in same faction as observed yield changes. The maximum yield was observed in the combination of N_1I_1 in the field condition but model simulate maximum yield was noticed under combination of N_4I_1. It can be concluded that the models are able to reproduce realistic yield under different nitrogen doses and irrigation regimes to some extent although has its own overestimation nature therein.

PP-1-20
Mean Performance and the effects of Component traits on Fodder and Grain Yield in Oat (*Avena sativa* L.)

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A field experiment was conducted with fifteen genotypes of Oat (*Avena Sativa* L.)to estimate the mean performance of yield and its component traits and also to determine their effects (direct and indirect) towards yield (fodder & grain yield). Considering green forage yield and dry matter yield it was observed that the genotype NDO-609 produced the highest and significantly higher mean for both the characters. However, considering the mean values for different characters of cut and uncut management of oat the genotype Kent and JHO-99-2 had highest total grain yield per plant and number of grain per panicle. Path analysis was carried out considering grain yield as the dependent variable. Chlorophyll 'b' content showed highest positive direct effect towards grain yield where one cut was practiced at 55 days of the crop which was followed by chlorophyll 'a' content, number of grain per panicle, Crude Protein (%), length of panicle, tiller number per plant, Weight of flag leaf. But when no cut was practiced, characters like number of grain per panicle,green forage yield per plant, total chlorophyll content, tiller number per plant, number of spikelet per panicle, 100 seed weight and length of panicle has direct effect towards grain yield.

PP-1-21
Studies on organic seed management techniques in rice (*Oryza sativa*) cv. ADT-45

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Studies were undertaken to evaluate organic method of seedling production, to fix optimum organic seed management technique for seed crop management and to assess the storability of organically produced seeds in rice cv. ADT-45 carried out at Annamalai University, Chidambaram, Tamil Nadu during 2012-14. Experiment on organic nursery showed increased seedling length, dry matter production, number of leaves and tillers per plant, root value and chlorophyll content of seedlings in the nursery plots applied with vermicompost + Panchakavya spray 3%. Organic seed crop management experiment revealed earliness for days to first and 50 % flowering while plant height, total number of tillers and chlorophyll-A, Chlorophyll-B and total chlorophyll content, number of productive tillers, panicle length, total number of spikelets per panicle, number of filled seeds per panicle, number of unfilled seeds per panicles, seed yield per plant, seed yield per plot, computed seed yield per ha, seed recovery, seed to husk ratio, seed hardness, 100% seed weight, germination %, root length, shoot length, dry matter production, vigor index, protein content, alpha-amylase activity and dehydrogenase activity were maximum for neem cake + Panchkavya 3% spray treatment followed by inorganic treatment. Natural aging of organically produced seeds showed that the seeds produced with neem cake + Panchkavya

was better starter than other treatments. The above treatments registered low moisture content, electrical conductivity, high germination %, seedling length, dry matter production and vigour index when compared to other treatments.

PP-1-22

Soil moisture conservation as influenced by mulching and tillage and its effect on potato yield in high Barind tract of Bangladesh

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Moisture stress is a major limiting factor in crop production during *Rabi* season in High Barind Tract of Bangladesh. To find out the ways of overcoming the stress an on-farm trial on potato was conducted in the area of FSRD (Farming System Research and Development) site, Godagari, Rajshahi during *Rabi* season 2013-2014 with different tillage's and mulches to observe their effects on soil moisture conservation and performance of the crop. The experiment was conducted in split plot design with six dispersed replications. Two tillage methods *viz.*, (i) minimum tillage (one ploughing) and (ii) conventional tillage (four ploughing) in combination with three mulching practices *viz.* (i) rice straw mulch @ 3 t/ha, (ii) rice straw mulch @ 5 t/ha and (iii) no mulching were studied. Potato was planted during the third week of November after tillage operation and covered with the mulch. Only a single irrigation was applied during 30-35 days after planting for establishment of the crop. Interaction effect of tillage and mulching were found significant on soil moisture conservation and also on potato yield. Minimum tillage along with straw mulch at the rate of 5 t ha^{-1} conserve more soil moisture than the other treatments. Consequently, this treatment combination also produced significantly higher potato yield (25.08 t ha^{-1}) and gave higher economic benefit than that with other treatments. The results indicate that minimum tillage (one ploughing) coupled with straw mulch at the rate of 5 t ha^{-1} might be a good option for better soil moisture conservation and higher economic benefit and yield potato in High Barind Tract of Bangladesh.

PP-1-23

Effect of sowing dates and pulses in relay cropping with T. aman rice in high Barind tract of Bangladesh

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An experiment was carried out at farmer's field of FSRD (Farming System Research and Development) site, Kadamshahar, Godagari, Rajshahi during the season 2013-14 to find out the optimum sowing date for growing different pulses as relay with T. aman rice and to observe the suitable one to grow with T. *aman* rice as relay in High Barind Tract of Bangladesh. There were three treatments and six dispersed replications. The study was designed with RCB and sowing

dates were 15, 10 and 5 days before harvesting of T. *aman* rice and pulses were lentil (BARI Masur-6), grass pea (BARI Khesari-1) and mustard (BARI Sharisha-14). The yield and yield components of lentil, grass pea and mustard were significantly influenced by the different sowing dates. Treatment T_1 (15 day before harvest of T. *aman* rice)produced the maximum grain yield 937 kg ha^{-1} for lentil, 1420 kg ha^{-1} for grass pea and 1120 kg ha^{-1} for mustard. The highest economic return was found with treatment T_1 (15 day before harvest of T. *aman* rice). It produced the maximum gross margin of 44155 Tk. ha^{-1} for lentil, 38800 Tk. ha^{-1} for grass pea and 26300 Tk. ha^{-1} for mustard, although its variable cost was 16750 Tk. ha^{-1} for lentil, 16250Tk. ha^{-1} for grass pea and 18500 Tk. ha^{-1} for mustard during 2013-14 . So, the treatment T_1 (15 day before harvest of T. *aman* rice) was optimum for maximizing the yield as well as economically profitable and viable for relay lentil with T. *aman* rice in High Barind Tract soil.

PP-1-24

Climate change, carbon sequestration and soil carbon stock is directly proportional to deforestation

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In this work an evaluation is done on soil organic carbon and as well as organic matter pool to find out a carbon sequestration index which possess a direct relation with climate change. Four different soil samples from forested and adjacent deforested land were analyzed in the laboratory to assess various types of carbon stocks. Soil organic carbon, organic matter, humic acid, fulvic acid was extracted from these soils and characterizes by various experimental tools. E_4/E_6 and E_5/E_6 value increases where as cation exchange capacity reduces drastically with deforestation. On analysis it was established that molecular weight, aromatic- aliphatic ratio, -COOH, - OH functional groups and total acidity reduces with declining forest. Intense vegetation possess more carbon sequestration power which is reflected from organic pool analysis is a good index for restoring climate change.

PP-1-25

Soil Quality Indicators for Rice based cropping system in New Alluvial Zone of West Bengal

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Quantitative assessment of soil quality is required to determine the sustainability of cropping system in terms of environmental quality and plant productivity. Our objective was to identify the most appropriate soil quality indicators and to evaluate the impact of three most prevalent cropping systems (rice-rice, rice-potato-jute and rice-potato-maize) on soil quality in New Alluvial Zone of West Bengal. We collected 72 soil samples (20 cm depth) and analyzed them for 17 physical, chemical, and biological soil attributes. For selection of soil quality indicators, principal

component analysis (PCA) was performed on the measured attributes, which provided four principal components (PC) with Eigen values >1 and explaining at least 5 % of the variance in dataset. The five PCs together explained 84.14 % of the total variance. Based on rotated factor loadings of soil attributes, selected indicators were: mean weight diameter from PC-1, organic carbon from PC-2, microbial biomass carbon from PC-3, available potassium from PC-4 and available Zn from PC-5. Indicators were transformed into scores (linear scoring method) and soil quality index (SQI) was determined, on a scale of 0–1, using the weighting factors obtained from PCA. SQI rating was the highest for the rice-potato-jute (0.825) followed by rice-potato-maize (0.817) and the lowest for the most intensively cultivated cropping system rice-rice (0.805). Overall contribution (in percent) of the indicators in determination of SQI was in the order: MWD (42.29%)>organic carbon (13.78%)>MBC (11.08 %)>available K (9.08 %)> available Zn (7.89 %). Results of this study suggest mean weight diameter, organic carbon and microbial biomass carbon acts as the most powerful indicators of soil quality in study area. Thus, organic carbon and microbial biomass carbon holds the key to improve soil quality under new alluvial zone of West Bengal.

PP-1-26

Impact of integrated nutrient management on maize (Zea mays L) based intercropping system under rain fed condition

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A study was carried out to investigate the effect of integrated nutrient management on maize (*Zea mays* L.) and cowpea (*Vigna unguiculata*) intercropping system. Among the cropping systems, yield attributes, yield and harvest index was recorded highest under sole crop of maize but when maize grown as intercrop 2:2 row ratio combinations produced highest yield attributes, yield and harvest index as compare to 2:4 row ratio combination. In case of integrated nutrient management, treatment supplied with 75 % RDF + PSB + *Azotobacter* + Vermicompost (VC) @ 5.0 t ha^{-1} (N_3) produced highest yield attributes, yield and harvest index was recorded under 100 % RDF + PSB + *Azotobacter* (N_2). However, the productivity of system in terms of maize equivalent yield, LER, relative crowding co-efficient (RCC), competition index, aggressivity and monetary advantage was found to be higher with 2:2 row ratio combination followed by 2:4 row ratio combination. Among the integrated nutrient management, the productivity of system in terms of maize equivalent yield, LER, relative crowding co-efficient (RCC), competition index, Aggressivity and monetary advantage found to be higher under 75 % RDF + PSB + *Azotobacter* + vermicompost (VC) @ 5.0 t ha^{-1} (N_3). From this study, it may be concluded that maize grown as intercrop with cowpea in 2:2 row ratio combinations and supplied with 75 % RDF + PSB + *Azotobacter* + Vermicompost (VC) @ 5.0 t ha^{-1} (N_3) is best for obtaining overall gain.

PP-1-27

Dynamics of soil carbon and soil aggregation under three distinct ecologies of northern part of West Bengal

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Northern part of the Indian state West Bengal is having diversified land use ecologies. The major part of land is under cultivation while this region is also home for several national forests and sanctuaries. In the present study, we have tried to identify the carbon (C) and aggregation dynamics in soils of this region. Soil samples was collected under 3 ecologies *viz*. agricultural lands, forests and land converted from forest to agricultural practices (under anthropogenic pressure).We have analysed the basic soil properties, soil texture along with soil C pools. Spectral analysis using Fourier transform infrared spectroscopy (FTIR) is going on for the soil samples to identify the major C associated functional groups and their variation along the ecologies. We have done soil aggregate analysis (dry sieving) and aggregate associated C estimation is going on to identify the magnitude of physically protected C in soils under different ecologies. Further, we are going to perform FTIR analysis of soil aggregate fractions to get the change dynamics of C associated functional groups with aggregate size and with change of land use ecologies. The outcomes so far achieved indicates that forest soils have higher soil organic C ($\bar{x}$11.56 g kg^{-1}) followed by soils of converted lands ($\bar{x}$9.25 g kg^{-1}) and agricultural lands ($\bar{x}$8.30 g kg^{-1}). And this variation is not affected by soil clay content. Soil aggregate analysis so far done indicates higher microaggregate formation as well as microaggregate within macroaggregate under forest ecology. Further, the mean weight diameter and geometric mean diameter of soil aggregates were also greater under forest ecology. It depicts better possible physical protection of C in forest soils.

PP-1-28

Pre-harvest yield forecasting models for winter potato in *terai* region of West Bengal using weather indices

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The weather data from the year 1988-2014 and potato yield data was used for developing the statistical models for the *terai* districts of West Bengal. The pre-harvest forecasting models were developed for forecasting of winter potato yield for Cooch Behar and Jalpaiguri districts respectively. The weather indices like Z41, Z151 and time were able to forecast the yield of potato for Cooch Behar district. Similarly, Z131, Z51 and time were found to be most efficient predicators for Jalpaiguri district. The model validation was done for a period of two years from 2014-15 and 2015-16. The forecasting models were able to explain the inter-annual variation in

the potato production to an extent of 68 % and 84% for Cooch Behar and Jalpaiguri districts respectively. Hence, the model can be used to forecast the potato yield at pre-harvest.

PP-1-29

Multi-kernelled rice (*Oryza sativa* L.) cultivar from West Bengal- a unique distinctive character for IPR

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Rice is generally single seeded fruit and it bears one kernel per spikelet. Old literature on developmental anatomy concludes that rice spikelets are primitively three-grained, of which the two lateral have become vestigial (hence 'sterile lemma'). However, many traditional rice cultivars were identified that were multi kernelled. *Jugal* a traditional rice cultivar collected from Cooch Behar have multiple (2-3) kernels per spikelet. Occurrence of single, double and triple kernels per spikelet in *Jugal* was 58.82, 27.54 and 13.59%, respectively at maturity. The number spikelet bearing two kernels per spikelet was more during early flowering stage (74.82%) and gradually it decreases with advancement of maturity of grains. It would be interesting to know if the multi-grained spikelets are a reversion to primitive type, or a new splitting of the central grain. Other salient features of this cultivar are- highly photoperiod-sensitive (it can be grown only during *Kharif* season), tall, highly lodging tolerant, bold grain (single seeded), brown coloured kernel and having moderate grain yield ability. Double kernelled is an exceptional character which is not present in the *Table of Characteristics* in the "Guidelines for Conduct of Test for Distinctiveness, Uniformity and Stability on Rice (*Oryza sativa* L.)" published by PPV and FR Authority, Government of India for Rice (PPV&FRA, 2007). This may be included as distinct character for varietal identification and registration under PPV & FR Act (2001).

PP-1-30

Genetic diversity of farmers' varieties of rice (*Oryza sativa* L.) with special orientation to lodging characteristics

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Lodging status of rice is an important consideration for determination of grain yield and acceptability of the cultivar among the rice farming community. In this communication, 59 Farmers' varieties of rice were screened for lodging tolerance under three different cultivation environments. Boichi and Seshaphal were found to be highly lodging tolerant under all the three conditions. Majority of the Farmers' varieties were reported to be susceptible to lodging. The numbers of highly susceptible Farmers' varieties towards lodging were 55, 29 and 15 at irrigated, drought created by spraying KI under irrigated condition and normal terminal drought environments, respectively. Lodging was more frequent in irrigated condition than the normal terminal drought condition or drought situation created by spraying of KI along with normal irrigation. The mean reduction in yield was more in the drought situation created by spraying of KI along with normal irrigation (20.62%) than the normal terminal drought (18.66%). The average lodging susceptibility also reduced in normal terminal drought condition (3.58) as compared to the

drought situation created by spraying of KI along with normal irrigation (6.32). It has been reported that in most of the cases lodging caused remarkable yield loss.

PP-1-31
Surface charge is a function of physico-chemical properties and mineralogical compositions of soil

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A study of the distribution of the electric charges in the surface horizons of two highly weathered Fluvaquent and Haplaquept of West Bengal, India was made by means of potentiometric titration and by direct measurement of adsorption of ions in the presence of varying concentration of electrolyte. The titration curves at different ionic strengths crossed at the common point of intersection, the pristine point of zero charge or the pH at which the net electric charge is zero. The results show that pH_0 varies with soil according to the variation in organic carbon and sesquioxide/allophone content. Organic carbon strongly affects the variation of negative charge with pH, but sesquioxide/allophone is responsible for positive charge variation. Surface charges is a function of organic carbon, clay content, composition of clay and amount of Fe, Al and there oxides.

PP-1-32
An insight of blood fruit [*Haematocarpus validus* (Miers) Bakh. f. ex Forman]: an underutilized plant with immense nutraceutical and therapeutic potential

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Blood fruit [*Haematocarpus validus* (Miers) Bakh. f. ex Forman] is a promising, anti-oxidant rich and medicinally important lesser known fruit with immense potential. Blood fruit is native to South East Asia and is mainly distributed in India, Bangladesh, Indonesia, Singapore and Sri Lanka. In India, the species is found growing wild in Andaman & Nicobar Islands, Assam, Mizoram and Meghalaya (Garo Hills region). This iron-rich fruits are slightly acidic, sweet in taste when fully ripe and are eaten raw. The fruits have high anthocyanin content which gives true blood red colour which can be used as a colouring agent and as a natural dye for food products. Fruit extracts can also be used in colouring soft drinks and desserts. Moreover, use of natural dye from this fruit will be very much helpful in avoiding health risk in human. Ripe fruits are a good source of iron, anti-oxidants and Vitamin C and are used for treatment of anaemia and other blood disorders. Fruits have a vitamin C content of 13.15 mg/100gm, carotenoids 1170 µg and β-carotene 9.0 µg. Ripe fruits are sliced and soaked in a glass of water overnight and taken as medicine the next morning.Blood fruit is relatively a new fruit to be explored for its full potential and it needs publicity and promotion in the domestic and international market. This paper

includes comprehensive information on potential uses, morphological and biochemical information of blood fruit.

PT-1-33

Diversity of wood specific gravity in Rasomati forest of Pundibari range, Cooch Behar, West Bengal, India

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Wood Specific Gravity (SG) is a measure of the amount of structural material a tree species allocates to support and strength. In recent years, wood specific gravity has become more important when exploring the universality of functional traits of plants and estimating their global carbon stocks. The study was conducted in Rasomati forest located between 26° 27' 44.0'' N latitude and 88° 19' 57.8'' E longitude with an elevation of 196 feet above mean sea level. The present study involved a collection of wood samples from 26 tree species belonging to 14 families. Wood samples were collected in February–April 2016; trees were cored at breast height of 1.37 m for the sample collection. The specific gravity was calculated using the maximum moisture content method (Smith, 1954). Among all the average specific gravity was 0.475gm cm^3 (ranged from 0.317 to 0.71), recorded average D.B.H and height were D.B.H (27.4 cm) and height 13 m. The highest specific gravity was recorded in *Syzygium jambos* (0.71) and lowest in *Alstonia scholaris* (0.317).The specific gravity is highly deviated may be due to the difference in developed genetic anatomical characteristics of the species and prevailing climatic condition & edaphic factors in the particular area.

PP-1-34

Genetic Variability and Character Association in Rice (*Oryza sativa* L.) over Different Seasons

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Seven rice genotypes tested for variability and character association in two seasons of kharif and boro, indicated that Dular in kharif and Jaya in boro were the best performers in respect to yield. Other yield attributing characters like grains/panicle was maximum for Dular and test weight for Jaya, which might be responsible for giving high yield among these varieties. Though the total yield of Dular was low in the boro season, its performance was fairly uniform over the two seasons. Estimates of genetic parameters showed the presence of wide genetic variation for most of the yield attributing characters over the seasons. GCV and PCV differed only for the characters like tillers/plant and panicle length in kharif season. The characters like plant height, grains/panicle and grain yield had shown high heritability accompanied by high genetic advance. Thus it may be suggested that these characters are predominantly controlled by additive genes. From the character association studies, it was found that plant height showed strong association with grain yield, grains/panicle and test weight. Panicles/plant and grains/panicle also had

substantial positive association with grain yield over the seasons. Selection of season specific and season nonspecific genotypes may be done with the help of presently identified yield attributing characters such as grains/panicle and grain yield, which showed high heritability as well as genetic advance and strong positive associations.

POSTER PRESENTATION

Technical Session-2

Biotechnology, biotic and abiotic stress management strategies under changing climate scenario, strategies of food and nutritional security, bio-fortification, product diversification/value addition and market linkages

PP-2-01

Integrated horticultural management practices for controlling post harvest diseases and pests of fruits in Bangladesh with special emphasis to organic production

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The paper mainly deals with the scenario of huge amount of post harvest losses of fruits due to insects and pests, ill post-harvest handling and management system. Major problems like pre- and post harvest pest and diseases incidence, ill handling, transportation, storage and marketing system also reflected in the paper. Research and education on post harvest system are inadequate in Bangladesh. Some research were conducted by the Germplasm center of Bangladesh Agricultural University (BAU-GPC) and found some effective measure to control pre- and post-harvest pests and diseases of mango, guava, banana etc organically. Among them, judicial application of organic fertilizers, integrated horticultural managements (pruning, weeding, spading, sanitation measure), use of sex pheromone significantly controlled the fruit fly, fruit weevil of mango; anthracnose and stem end rot of mango during storage. Hot water treatment, resistant varieties, using coating materials also been explored. Scope of future collaborative research and development program in the post harvest quality management system may be explored. Future prospect and practical steps to overcome the huge post harvest losses specially the insects and diseases in Bangladesh are properly addressed.

PP-2-02

Integrated crop management for controlling fruit pests and diseases during storage

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The paper mainly deals with the success technologies for controlling a number of fruits pest and diseases through integrated horticultural management mainly organic way. Controlling wilt of guava, anthracnose of mango, fruit fly of mango, hopper of mango through ICM has been discussed. Anthracnose of mango has been successfully controlled by the application of garlic extract (10:1- Water and garlic). Floral malformation of mango can be controlled by the application of NAA at 200ppm and the vegetative malformation can be controlled by the application of cu-fungicides. Fruit fly of mango has been controlled by the application of sex pheromone, bait trap and bagging of individual fruits. Mango hopper also successfully controlled by smoking at the time of flowering. Wilt of guava (*Fusarium oxysporum*) completely is controlled by using wilt resistant guava rootstocks (poly guava, strawberry guava and grape guava).

PP-2-03

Affect of abiotic factors on Paddy Yellow Stem Borer *Scirpophaga incertulas* (Walker) adult activity in North Coastal Zone of Andhra Pradesh

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The rice Yellow Stem Borer *Scirpophaga incertulas* (Walker**),** adult activity was monitored through light trap for two years during 2011 and 2012 at Agricultural Research Station, Ragolu in North Coastal Zone of Andhra Pradesh.Peak catch of yellow stem borer adult insect was observed 4th week of January, 2011 during rabi, whereas, highest moth catch was observed during 4th week of November during kharif, 2011 which coincided with white ear incidence in the field. Similarly, during second year, the highest moth catch was observed during 4th week of January in Rabi, 2012 and at 2nd week of November in kharif, 2012. The average moth catch was lowest from April to October during both the years. Studies on relationship of abiotic factors with adult activity of YSB during 2011 indicated that minimum temperature (-0.62), rainfall (-0.41) and evening relative humidity (-0.42) showed highly significant negative correlation, where as sunshine hours showed highly significant positive relation (0.43); similarly in 2012 minimum temperature (-0.46), evening relative humidity (-0.48) and rainfall (-0.37) had significant negative relation with moth catch in light trap, whereas, sunshine hours showed significant positive relation (0.33). Based on the results obtained in both the years, it can be concluded that the abiotic factors temperature, rainfall and relative humidity had negative relation; where as sunshine hours had significant positive relation with adult activity of yellow stem borer. Based on the incidence and abundance of YSB, a package can be generated and accordingly time fitted seedling transplantation as the precautionary measures may be highlighted in the Zone.

PP-2-04

Effect of sulphur fertilization on different forms of sulphur in soil under mustard cultivation in acidic *terai* region of West Bengal

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A field experiment was conducted growing Indian mustard with added doses of sulphur (S) (@ 15, 20, 25, 30 kg ha^{-1}) each from two sources namely bentonite-S and single super phosphate (SSP) to evaluate effect of S addition on different forms of S in an acid soil under mustard cultivation. The preponderance of S in initial soil followed the order: total sulphur> organic sulphur> non-sulphate sulphur> heat soluble sulphur> adsorbed sulphur> water soluble sulphur > sulphate sulphur. The analysis of soil after harvest showed that all S forms decreased in the control plot at harvest. The total S content was increased with higher addition of S. The organic S content decreased in all treatments. Although this decrement was lower down with addition of S. The status of the SO_4^{-2}-S in the soil at harvest has no much variation across the treatments. Non-Sulphate S, adsorbed-S, heat soluble S and water soluble S was significantly increased with the sulphur addition. Significant positive correlations of oil content and grain yield were noted with different forms of S. The Bentonite S had shown the better S use efficiency by the plant but SSP was found to be better in increasing the oil content of the crop particularly at higher doses.

PP-2-05

Role of humic acid and micronutrients on Rapeseed (*Brassica campestris*) crop grown in New Alluvial Zone of West Bengal

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Role of humic substances and the way they influence plant growth and development and nutrient uptake is crucial for developing sustainable cropping systems that improves overall soil quality. Field experiment was conducted to study effect of IFB Humigold on nutrient uptake and yield of Rapeseed during winter season of 2015-16 at University Farm ($22^0$95'N latitude, $88^0$49'E longitude) located under New Alluvial Zone (NAZ) of West Bengal and the interaction effect of Humic acid and applied micronutrient on the growth and yield of Rapeseed crop (cv. Binoy). Significant improvement in growth parameters, in terms of plant height, LAI, dry mass/m^2, was noticed in the treatment where humic acid was applied. Application of humic acid (IFB Humigold) and micronutrients (Zinc and Boron) significantly influenced the rapeseed (cv. Binoy) growth and yield attributes over the control. The seed yield varied from 1.23 t/ha (T_8- RDF ($N_{80}P_{40}K_{40}$) + $ZnSO_4$ 20 kg ha^{-1} + Borax 10 kg ha^{-1} + Humigold @7.5 l ha^{-1} (15 ml/plot) with compost (10 t ha^{-1}) which was statistically at par with T_9 (RDF ($N_{80}P_{40}K_{40}$) + Humigold @7.5 l ha^{-1} (15 ml/plot) with compost (10 t ha^{-1})+Humigold Foliar Spray One time @ 1 ml $litre^{-1}$) with an yield of 1.2 t/ha to a minimum yield of about 0.71 t/ha in T_3 ($^1/_2$RDF (($N_{40}P_{20}K_{20}$) + Humigold @7.5 l ha^{-1} (15 ml/plot) with compost (10 t ha^{-1}). Humigold showed good compatibility with micronutrients (Zn and B) applied in the experiment. Interaction effect of Humigold and applied micronutrients was positive

and significant. Thus it may be stated that Humigold can be successfully applied with Zn and B. Foliar application of Humigold was also found better and cost effective.

PP-2-06

A simple method for rapid isolation of genomic DNA from medicinal and aromatic plants suitable for polymerase chain reaction

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Advancement in the field of plant molecular biology has made the molecular characterization of crop plants through the robust technique of polymerase chain reaction (PCR). Though in PCR, only a minute amount of input genomic DNA is required, the quality of the genomic DNA determines the success of the reaction. The isolated DNA must be free from different contaminants, which can potentially inhibit the PCR. On the other hand, the medicinal and aromatic plants contain different biomolecules, presence of which in the isolated genomic DNA might hinder the efficiency of PCR. Hence, in this study, we report the applicability of a simple and rapid method for isolating genomic DNA from medicinal and aromatic plants, which can be successfully applied for PCR-based genotyping of these plants. Using the detergent (SDS)-potassium acetate method in a modified form, we isolated genomic DNA from the mature leaf tissues of 7 different medicinal and aromatic plants, viz., slender dwarf morning-glory (*Evolvulusal sinoides* L.), horse mint (*Mentha longifolia* L.), centella (*Centella asiatica* L.), brahmi (*Bacopa monnieri* L.), ashwagandha (*Withania somnifera* L.), vasaka (*Adhatodav asiatica* Nees.) and sarpgandha (*Rauwolfia serpentina* L.). The isolated genomic DNA from ~50 mg leaf tissue was dissolved in 60 µl water and 1 µl from each was used as template in PCR. The PCR was carried out with different inter short sequence repeat (ISSR) primers in 10 µl reaction volume. Gel electrophoresis of the PCR products revealed the presence of sharp bands, where the amplification profiles of all the seven plant samples were distinguishable from each other. Hence, we advocate the utility of this method for isolating genomic DNA from medicinal and aromatic plants, which will ultimately help the molecular breeders involved in crop improvement programmes of medicinal and aromatic plants.

PP-2-07

Influence of irrigation and spacing on productivity of summer baby corn in New Alluvial Zone of West Bengal

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Baby corn, the de-husked cob used as vegetables, it is an important nutritional and cash crop in south-east Asia. Recently the crop has been gaining popularly in India; however, the standardization of agro-techniques for baby corn is essential to popularize its cultivation among farmers. A field experiment was carried out at Central Research Farm of Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, West Bengal during the summer season of 2010 and 2011 on a sandy loam soil with neutral soil reaction to study the effect of irrigation and plant spacing on growth and productivity of summer baby corn (*Zea mays* L.). The experiment was laid out in a split plot design with three levels of irrigation in main plots (IW:CPE at 0.6, 0.8 and 1.0) and three different plant spacing (30 × 30 cm, 45 × 20 cm, 60 × 15 cm) in sub-plots replicated thrice. The variety "Golden baby (H-102)" was in middle of March and harvested in May. The findings reveal that both irrigation levels and spacing treatments significantly influence the growth, yield attributes and yield of baby corn. The higher cob yield and nitrogen uptake was obtained with IW: CPE 0.8 and 45 × 20 cm spacing. This treatment combination was found superior to other combinations. However, the water-use efficiency of the crop was recorded highest with IW: CPE 0.6 and 45 × 20 cm spacing. Therefore, irrigation scheduling at IW: CPE 0.8 and 45 × 20 cm spacing can be recommended for summer baby corn cultivation in new alluvial zone of West Bengal.

PP-2-8

Response of NPK fertilizer schedules on stem rot caused by *Macrophomina phaseolina* (Tassi) Goid. and yellow mite *(Polyphagotar sonemuslatus)* (Banks) of jute (*Corchorus olitorius* L.)

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Recently, jute *(Corchorus olitorius* L. and *C. capsularis* L.), also known as 'golden fibre', has emerged with stronger attributes due to its eco-friendliness with more oxygen producing, carbon dioxide absorbing and higher fuel wood producing capabilities, apart from its biodegradable diversified products. Stem rot of jute caused by *Macrophomina phaseolina* (Tassi) Goid. and yellow mite (*Polyphagotar sonemuslatus* (Banks)) are the most important pests affecting both yield and quality of fibre in both cultivated species, namely, *C. olitorius* L. and *C. capsularis* L. Stem rot is the common name but the pathogen attacks any part of the plant in fibre and seed crop from germination to harvest producing various symptoms. The disease is seed, soil as well as air borne. *Tossa* jute being mostly cultivated, this investigation was undertaken to determine the effect NPK fertilizer on stem rot and yellow mite of jute in the field on a new jute variety JRO 8432 at CRIJAF, Barrackpore. Application of more nitrogenous fertilizer enhanced stem rot and yellow mite of jute. But increase in phosphatic and potassic fertilizers reduced stem rot. Among the different NPK fertilizer schedules, 120:30:30 attracted more stem rot of jute with 47.9 %

disease at 120 DAS, followed by 120:40:40 with 40.5 %, 100:30:30 with 36.1 % and 80:40:40 with 35.2 % stem rot. With similar dosage of nitrogen, when phosphate and potash were increased, lower stem rot was recorded. Phosphate and potash fertilizer moderated the effect of deleterious effect of nitrogen by reducing the stem rot incidence. In check, stem rot increased from initial 0.3% to 2.2% in 45 days and finally to 21.6 % during the maturity of the crop. The progress of disease over time was typically slowest in case of NPK 40:30:30. Moderate infestation of yellow mite (96.73 mites/cm^2 leaf) during peak period at 55 DAS was recorded in 80:40:40 kg/ha as compared to higher doses *i.e.,* 120: 40: 40 (138.52 mites/cm^2leaf). Although positive correlation exists between N- fertilization and mite population, the fibre yield was highest with highest N dose, *i.e*., 120: 80: 80. Although the NPK favoured mite population (3 times more in 120 kg/ha N than check) and stem rot, it may also replenish the damage caused by both pest and disease with higher fibre yield in higher NPK dosages. Application of balanced fertilizer with farm yard manure based on soil test is preferable to keep pest damage to jute crop at lowest.

PP-2-09

Comparative study of some biochemical characters of some turmeric (*Curcuma longa* L.) germplasm

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Turmeric is a spice crop which is obtained from rhizomes of the plant *Curcuma longa* L. (family Zingiberaceae). Curcumin is the most important compound of turmeric which is responsible for its colour and biological activity. It has several medicinal uses such as anti-inflammatory, anti–HIV, antitumor, antiviral, anticancer, antifungal and antiparasitic activities. A total of 190 turmeric germplasm provided by AICRP on Spices, UBKV were evaluated for their biochemical characterization. The curcumin content of all the germplasm were estimated and the turmeric germplasm were classified into three class namely high, medium and low based on their curcumin content. The biochemical characters like antioxidant activity, total phenol and iron content of some selected germplasm from each group were estimated and any possible correlation among the above biochemical characters was explored. It was found that curcumin content and antioxidant activities were correlated showing a correlation coefficient of 0.65. The correlation coefficient between curcumin content and total phenol content was 0.45 and that between antioxidant activity and total phenol content was 0.29. So from the results it can be inferred that there is a good correlation between curcumin content and antioxidant activity of the studied germplasm.

PP-2-10

Pesticide Residues: their hazards and minimizing techniques in fruits and vegetable crops

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"All substances are poisons; there is none which is not a poison. The right dose differentiates a poison…."*Paracelsus (1493-1541).* Pesticides are known to improve agriculture yield to meet population demand globally by protecting crops, thus, the prudent use of presides actually improves our diet by decreasing the cost of food and increasing the availability, abundance, quality and variety of foods. e.g. fruits and vegetables, from insects, pests, weeds and fungal diseases. Presently, enough evidence is available to suggest their misuse and overuse in the last few decades in most developing nations. Fruits and vegetables are vital to human health as they are known for boosting the immune system. Many studies have identified phytochemicals, minerals, and others in fruits and vegetables to be very essential in human development. Despite the beneficial effects they bring forth, the use of pesticides, however, is quite controversial. Pesticides, in particular, are compounds with known inherent toxicity thus, the presence of pesticide residues in food commodities is a source of great worry; pesticide applied to crops during the entire period of growth and sometimes at the fruiting stage, what makes it more complex is that some of these fruits and vegetables are consumed fresh or semi-processed which may contain elevated levels of chemicals compared to other food crops of plant origin. The most at risk for adverse health outcomes from exposure of pesticides to foetuses, infants, growing children, pregnant and nursing mothers, and women of child bearing age. Thyroid disease has recently been linked to pesticides and can lead to a reduction of a child's IQ by up to 7 points. If you are interested in limiting your exposure to pesticides, buying organic food is a sensible option. Moreover, developing countries in the tropics are guilty of increased usage of pesticides, for example, in fruit and vegetable baskets for export, to meet the supply and demand throughout the year from developed nations.

PP-2-11

Effect of various locally available botanical extract on weed management in scented rice (Gobindabhog)

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Herbicides are synthetic chemicals used to kill or suppress unwanted vegetation .It is found that synthetic herbicides, have been detected in ground water in some areas of the country. Some formulations of 2,4-D can be highly toxic to fish. Heavy treatment of soil with pesticides including herbicides can cause populations of beneficial soil microorganisms to decline. Some plant extracts (compound mixtures) potentially possess multiple phytotoxic compounds and hence multiple modes of simultaneous herbicidal attack, making it more difficult for weeds to develop herbicide resistance and most products show wide windows of crop safety. There are so many

locally available plants having potentiality to act as botanical herbicides like jangli dhan (*Echinochloa colona*), Mutha gash *(Cyprus rotundus*), segun (*Tectona grandis*), Bamboo (*Bambusa vulgaris*), cocklebour (*Xanthium strumunium*). In order to evaluate effective herbicides in rice (cv. Gobindabhog) one experiment was conducted in C block farm in Kalyani with eight treatments i.e.,T1 : untreated control ,T2 : Two hand weeding @ 20 DAT & 30 DAT ,T3 : Mechanical weeding at 20 DAT and 30 DAT, T4 : *Cyprus rotundus* extract + one mechanical weeding at 30 DAT , T5 : *Echinochloa colona* extract + one mechanical weeding at 30 DAT ,T6 : Bamboo leaf and shoot extract + one mechanical weeding at 30 DAT ,T7 : Cucumber leaf extract + one mechanical weeding at 30 DAT , T8 : *Xanthium strumunium* leaf extract + one mechanical weeding. The experiment was laid out in randomized block design with three replications. Highest grain yield(36.67 q/ha) was obtained under treatment T_4 (*Cyprus rotundus* leaf extract + one mechanical weeding at 30 DAT) followed by T_6 (bamboo leaf and shoot extract + one mechanical weeding at 30 DAT) , T_8 (Xanthium strumunium leaf extract + one mechanical weeding at 30 DAT) and T_5 (Echinochloa colona extract + one mechanical weeding at 30 DAT) with no significant difference .Population of grassy weeds were found more than the broad leaved weeds and their population was maximum at 30 DAT. Lowest population of *Cynodon dactylon* was found under treatment T2 followed by T4 and T_7 (cucumber leaf extract + one mechanical weeding at 30 DAT) whereas population of *Cyprus rotundus* was recorded in T7 followed by T4 and T5. Among the broad leaved weeds, *Alternanthera sessilis* was found in lowest number in T7 followed by T4 and T5 without any significant difference among them. Hence, *Cyprus rotundus* leaf extract + one mechanical weeding at 30 DAT is the potential botanical herbicide based weed management in rice.

PP-2-12

Bio-efficacy of Diafenthiuron 50% WP against White fly, Aphid, Jassid, Thrips and natural enemies in Cotton Crop

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The field experiments were conducted at instructional farm of UBKV, Pundibari, West Bengal during Pre *kharif season* of 2013 and 2014 to evaluate the bio efficacy of Diafenthiuron 50% WP at four doses *viz.,* 150, 300, 450, 600 g a.i. ha-1 along with standard checks Mainstar (commercial standard formulation ofDiafenthiuron 50% WP) @ 300 g a.i./ha and control with water spray for the control of Jassid, Aphid, Thrips and White fly in cotton crop.The present result confirmed that diafenthiuron 50% WP @ 600 g a.i./ ha) was found highly effective and gave optimum reduction in per cent of insect population in both spray of jassid (82.84 and 97.24%), aphid (97.24 and 89.38%), white fly (84.08 and 97.00%) and thrips (84.17 and 97.10%) respectively along with significant increase in yield (32.00%) over untreated check and the standard dose of Diafenthiuron 50% WP @ 300 g a. i./ha were statistically at par with highest dose.The result also showed thatDiafenthiuron 50% WP @ 600 g a.i./ha was toxic to these natural enemies, while Diafenthiuron 50% WP @ 450 g a.i./ha, 300 g a.i./ha and 150 g a.i./ha were considered as less toxic against them.Considering the bio-efficacy and yield, diafenthiuron 50% WP @ 300 g a.i./ha was found effective against major sucking pests in cotton

PP-2-13
Value addition in Palmyrah palm (*Borassus flabellifer* L.)

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Palmyrah palm possess a great capacity to yield several products of economic importance and hence it is called “Wishing Tree” or “Tree of Life” which means a palm that yields anything and everything. It is an underexploited palms with over 800 various uses. Palmyrah fruit pulp is nutritious and has a yellow colour due to Carotenoids which are precursors of Vitamin-A. Pulp is also rich in Vitamin-C. It stands first in the world in terms of its wealth, with a population of nearly 122 million palms in India about 50% in distributed in Tamil Nadu. The Government of Tamil Nadu recognized it as the “State Tree of Tamil Nadu” since 1978. Palmyrah is found abundantly in the dry or sandy localities of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Madhya Pradesh, Chhattisgarh, Orissa, West Bengal, and Rajasthan. It is also grown in Assam, Gujarat, Maharashtra and Uttar Pradesh. More than 88 % of Palmyrah is used for the welfare of the people, it serves as food (fruit, sap, young shoots), as a building material (stem, leaves). It is also used in the pharmacopoeias (roots, inflorescences) and the leaves are used to make a variety of objects. The products of Palmyrah palm, Jaggery, and Candy are natural and environmentally safe, have good market potential. Palmyrah yields 13-20 tonnes ha^{-1} as sugar compared to 5-8 tonnes ha^{-1} by sugarcane which drains the ground water potential, as well from nutritional point of view, fruit pulp, seed, shoot and flowers are the most important. Successful promotion of these as food for general consumption depends on subjecting the fruit pulp to debittering process and the seed shoot flower, to initiation detoxification process. It is less exploited species. Palmyrah fibre is ecofriendly and exported to more than 20 countries like Japan, USA and UK accounting for nearly 80% of total exports. Flabelliferin FB, a steroid isolated from Palmyrah fruit pulp, has anti bacterial properties. Utilization of the fruit for pharmaceutical uses can also be explored. Palmyrah that needs minimum inputs can be promoted in waste lands. Despite this they are the least studied of the entire palm. There is immediate need to study about existing utilization and scope of post-harvest techniques for value products regarding the Palmyrah palm.

PP-2-14
Performance of aonla cultivars for growth and yield under semi-arid conditions

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Present study was carried out at Chaudhary Charan Singh Haryana Agriculture University, Regional Research Station, Bawal (Rewari) to study the growth and yield attributes of six aonla cultivars namely NA-6, NA-7,NA-10, Chakaiya, Kanchan and Krishna. It was observed that maximum plant height (4.63 m) and spread (3.63x 3.60 m) were recorded in variety NA-10 followed by Krishna (4.41 m). The stem girth was also highest in NA-10 (77.3 cm) followed by Krishna cv. (73.0 cm). The highest yield (62.10 kg/tree) was harvested from cv. Kanchan whereas it was lowest in cv. Krishna (51.40 kg/tree).Ascorbic acid content was significantly higher (485

mg/100 g of pulp) in cv. Kanchan. The performance of kanchan cv. of aonla in terms of yield (62.20 kg/tree) was significantly higher than all other varieties except NA-10 (60.30 kg/tree) which was statistically at par.

PP-2-15
Influence of foliar application of GA_3 and chemicals on growth and flowering of Gladiolus, cv. American Beauty

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Gladiolus (*Gladiolus grandiflorus* L.) is one of the most important commercial flowers of India. The average productivity of gladiolus in developed countries is more. The average production and productivity of gladiolus in the country is very less as compared to the developed countries. The present investigation was conducted to study the influence of foliar application of GA_3 and chemicals (19:19:19 and KNO_3) on growth and flowering of gladiolus cv. American beauty. The experiment was laid out in randomized block design with three replications and nine treatments of foliar application of GA_3 and chemicals with different concentrations alone and in combinations viz., GA_3 - 150 ppm, GA_3 - 200 ppm, KNO_3 - 1.5%, 19:19:19 - 1.5%, GA_3 150 ppm + KNO_3 1.5%, GA_3 150 ppm +19:19:19 1.5%, GA_3 200 ppm + KNO_3 1.5%, GA_3 200 ppm + 19:19:19 1.5% and control. It is evident from the experimental finding that, in term of growth parameter viz., maximum height of plant, maximum number of leaves per plant, maximum leaf area at 50% flowering and flowering parameters viz., minimum days to first spike emergence, minimum days to opening of first floret, minimum days to 50% flowering, maximum floret length before opening, maximum floret diameter, maximum distance between two florets were found in interaction of GA_3 at 200 ppm and 19:19:19 at 1.5% which was significantly superior over all other treatments whereas maximum longevity of floret was found in foliar application of KNO_3 at 1.5%.

PP-2-16
Effect of weed management on growth and yield parameters of rice

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An investigation was conducted on study the effect of Weed management in drilled paddy (*Oryza sativa* L.) during *kharif* season of 2014-2015. The experiment was laid down in Randomized block design having treatments viz., Control (T_1), two hand weeding at 20 and 40 DAS (T_2), Butachlor @ 1500 g a.i. ha^{-1} at 7 DAS (T_3), Pretilachlor @ 750g a.i. ha^{-1} at 7 DAS(T_4), 2, 4 D @ 1000 g a.i. ha^{-1} at 20-25 DAS(T_5), Pyrazosulfuron ethyl @ 25 g a.i. ha^{-1} at 20-25 DAS(T_6), Butachlor @ 1500 g a.i. ha^{-1} at 7 DAS + 2, 4 D @ 1000 g a.i.ha^{-1} at 20-25 DAS(T_7), Butachlor @ 1500 g a.i. ha^{-1} at 7 DAS + Pyrazosulfuron ethyl @ 25 g a.i.ha^{-1} at 20-25 DAS(T_8), Pretilachlor @ 750 g a.i. ha^{-1} at 7 DAS + 2,4 D @ 1000 g a.i. ha^{-1} at 20-25 DAS(T_9), Pretilachlor @ 750 g a.i. ha^{-1} at 7 DAS + Pyrazosulfuron ethyl @ 25 g a.i.ha^{-1} at 20-25 DAS(T_{10}) thereby making Ten treatment

combinations replicated three times. Rice variety PKV- Khamang was used as a test crop. Results showed that two hand weeding at 20 and 40 DAS (T_2) significantly influenced the growth and yield attributing characters viz., Height of plant (cm), Number of effective tillers hill^{-1}, Number of panicles hill^{-1}, Number of grains panicle^{-1}, Test weight (g), Yield of grains hill^{-1}(g), Yield of straw hill^{-1}(g), Yield of grains (q ha^{-1}), Yield of straw (q ha^{-1}), and Harvest index (%) and it was at par with treatments (T_7), (T_8), (T_9), (T_{10}).

PP-2-17
To study the effect of chemical insecticides on girdle beetle (O*bereopsis brevis*) on maus-158 variety of soybean of Marathwada region

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The importance of soybean is increasing day by day due to its high nutritive value. Soybean 'The miracle golden bean of 20th century' has revolutionized the agriculture as well as generated economy of many countries like China & Japan. The study revealed that the length tunnelled due to girdle beetle was significantly reduced in plots treated with Lambdacyhalothirin 5 EC@300 ml/ha followed by Triazophos 40 EC@800 ml/ha, which were at par with each other and the next superior treatments were Difflubenzuron 25 WP @ 400 ml/ha, Indoxacarb 14.5 SL @ 500 ml/ha and Quinalphos 25 EC @ 1000 ml/ha which were at par with each other. Highest yield was obtained from plots treated with Lambdacyhalothirin 5 EC@300 ml/ha (2500 Kg/ha) followed by Triazophos 40 EC@800 ml/ha (2451 Kg/ha), Difflubenzuron 25 WP @ 400 ml/ha (2400 Kg/ha), Indoxacarb 14.5 SL @ 500 ml/ha (1930 Kg/ha) and others.

PP-2-18
Evaluation of agronomic requirements of recently released cotton hybrids in south-western region of Punjab

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As the cotton hybrids vary with their growth habit, there was a need to work out agronomic requirement of recently released cotton hybrids. Thus, a field experiment was conducted during *kharif* 2015 at Punjab Agricultural University, Regional Research Station, Bathinda to evaluate performance of recently released cotton hybrids for optimum planting geometry and nitrogen requirement. The soil of the experimental site was loamy sand in texture, electrical conductivity of 0.15 m mhos, slightly alkaline with pH 8.1, low in available organic carbon (0.19 %), medium in available phosphorus (18.3 kg/ha) and high in available potassium (339.5 kg/ha). The experiment was laid out in a split plot design consisting three American cottonhybrids (FHH 209, HSHH 31 & LHH 144 as check) in main plot; two spacing levels (67.5 × 75 cm & 67.5 × 90 cm) in sub plot and three nitrogen levels (75%, 100% and 125 % of recommended) in the sub sub plots and were replicated thrice. The recommended dose of nitrogen (RDN) for cotton in Punjab is 150 kg N per hectare. Cotton hybrids varied significantly in seed cotton yield. Significantly higher number of

sympods per plant and bolls per unit area contributed to significantly highest seed cotton yield of hybrid FHH 209 as compared to hybrid HSHH 31 and check hybrid LHH 144. While, hybrid HSHH 31 was statistically at par with check hybrid LHH 144 with respect to number of sympods per plant, bolls per unit area, boll weight and seed cotton yield. Among the different spacing levels, significantly higher seed cotton yield was recorded at the recommended spacing of 67.5 × 75 cm because of significantly higher plant stand that led to more number of bolls per unit area than 67.5 × 90 cm. Nitrogen levels also exerted significant effect on seed cotton yield. 125% RDN resulted in maximum number of sympods per plant, bolls per unit area, boll weight and seed cotton yield which was at par with 100% RDN while statistically least number of sympods per plant, bolls per unit area, boll weight and seed cotton yield was recorded with 75% RDN. Thus it was concluded that cotton hybrid FHH209 perform significantly better over hybrid HSHH31 and check LHH144 under recommended planting geometry (67.5 × 75 cm) and recommended level of nitrogen (100% RDN: 150 kg N per hectare).

PP-2-19

Soil nutrient availability as affected by tillage, rice residue management and irrigation regimes in wheat

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Adoption of proper tillage, residue management and irrigation regime is necessary for sustaining productivity and nutrient availability. Therefore, field study was conducted during *rabi*2012-13 in an ongoing experiment initiated during 2009 in sandy loam (SL) and loamy sand (LS) soils separately at research farm, Department of Soil Science, Punjab Agricultural University, Ludhiana. The treatments included four tillage practices i.e., no-tillage with residue (NTR), no-tillage without residue (NT), roto-tillage (RT) and conventional tillage (CT) in main plots and three irrigation levels based upon IW/PAN-E ratios 1.2 (I_1), 0.9 (I_2) and 0.6 (I_3) in sub plots in split plot design. Tillage and residue management practices significantly affected available N, however the effect of irrigation levels on available N was observed to be non-significant. Numerically, among the tillage and residue management practices, the mean highest available N (kg ha^{-1}) was observed under NTR (144.0) followed by NT (139.7), RT (135.7) and the lowest under CT (132.4) for SL soil. Whereas, in LS soil, the mean highest available N (kg ha^{-1}) was observed under NTR (136.0) followed by NT (132.6), RT (129.1) and lowest under CT (122.1) practices, respectively. Irrespective of tillage and residue management practices, available N content of soil decreased with the increasing irrigation level which might be due to more leaching of nitrate. In SL soil the mean highest available N (139.0 kg ha^{-1}) was observed under I_3 followed by I_2 (138.2 kg ha^{-1}) and least under I_1 (136.6 kg ha^{-1}). In LS soil, the mean highest available N (131.5 kg ha^{-1}) was observed under I_3 followed by I_2 (130.6 kg ha^{-1}) and least under I_1 (127.8 kg ha^{-1}). Tillage, residue management practices and irrigation levels had no significant effect on available P in both textured soils. The effect of tillage and residue management practices on available K was statistically at par for both SL and LS soils. However, the effect of irrigation levels on available K was observed to be significant in SL soil. In SL soil the mean highest available K (kg ha^{-1}) was observed under I_1 (110.3) followed by I_2 (103.6) and least under I_3 (98.3). However, in LS soil the mean highest available K (kg ha^{-1}) was observed under I_1 (104.6) followed by I_2 (97.3) and least under I_3 (94.7). In both SL and LS soils, the effect of tillage and residue management practices on

wheat grain yield was observed to be non-significant whereas wheat grain yield increased significantly with increase in irrigation level.

PP-2-20

Secondary metabolites present in Pumpkin (*Cucurbita moschata* Duch. Ex Poir genotype revealing resistance against the melon fly (*Bactrocera cucurbitae*), an important biotic limiting factor

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Secondary plant metabolites play an important role in the defence against herbivores; they act as insect repellents, feeding inhibitors, and/or toxins, thus protecting plants at different phases of growth. The fruit fly, *B. cucurbitae* (Diptera: Tephritidae) attacks fruits of the crop and is one of the most important biotic limiting factors. The extent of losses caused by the pest varies from 30-100% depending on cucurbit species and season. Effective management of this dreaded pest is difficult due to its concealed feeding habit and typical life history. Conventional insecticides do not work well against the pest, rather, excessive use of pesticides cause development of resistance, resurgence, hazards to non-target organism and environmental pollution. Host plant resistance (HPR) is an important component for management of the melon fly, *Bactrocera cucurbitae* (Coquillett) owing to difficulties associated with its chemical and biological control. Various biochemical traits including total sugar, total phenols and Tannin content of fruit were studied on twenty varieties/ genotypes of Pumpkin (*Cucurbita moschata* Duch. Ex Poir in relation to resistance against *B. cucurbitae* under field conditions.Twenty pumpkin cultivars collected from different sources from all over India have been evaluated against the infestation of melon fly *Bactrocera cucurbitae* (Coq.) under teraiagro-ecological conditions of West Bengal at three different stages of fruit i.e. Early stage (0-10 DAS), Pre-maturity stage (20-25 DAS) and Maturity stage (35-40 DAS). The degree of response varies among the cultivars against melon fly infestation. Intensity of infestation significantly varied from 50 % to 100 % among the test cultivars. Maximum infestation was recorded on cultivar Eluru, followed by Gagan Sardar Para-1 and Barahmasi. Minimum percent fruit infestation was observed in cultivars Baidyabati followed by Gagan Sardar Para-2, Pasighat-1. The other local cultivars collected from West Bengal were found to be moderately resistant both the season (2015 and 2016). The variation in melon fly infestation among the cultivars might be due to this allelochemicals present in the fruit in more or less amount. Total phenol and Tannins content were highest in resistant and lowest in susceptible varieties whereas Total sugar content was lowest in resistant and highest in susceptible varieties. Total sugar content of fruit had a significant positive correlation (P=0.01), whereas Total phenol and Tannin contents had significant negative correlations with the percent fruit infestation. The traits can also be utilized for developing melon fly resistant cultivars in future breeding programme.

PP-2-21
Effect of nanoscale TiO_2 particles on the growth and yield of rice

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In recent years, TiO_2 NPs have been widely used in agricultural, industrial and consumer products due to their stronger catalytic activity when compared to TiO_2 FPs. The present experimental investigation demonstrated the effect of nanoAnatase -TiO_2 (<100 nm size) particles on rice for yield and its attributing traits with data recorded as advanced growth stage or at maturity. Rice seeds were treated with six concentrations (0, 10, 20, 50, 80 and 100 ppm) of nanoTiO_2 and treated seed of different concentration were sown in the field following RBD design with three replications for each treatment. Application of TiO_2 NPs significantly enhanced seed germination, growth and yielding traits for most of the concentrations as compared to the control. Though results of treated samples were higher in almost all the characters but it was highly effective for 20 ppm followed by 50 ppm for grain yield. The increased grain yield is associated with improve in root growth, higher in tiller number, more number of primary branches plan^{-1}, improved panicle length, more number of filled grains. The response to nano-treatment on seed germination along with yielding traits suggested optimum dose limit on these characters and decreased concentration of the performance in highest concentration could be explained as toxic effect of nanoparticle.

PP-2-22
Seed expansionuniques of Oat (*Avena sativa*) in association to specific seed treatments

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A study on seed development and maturation in Oat cv. JHO-99-2 was conducted at University Seed Farm and at departmental laboratory under Seed Science and Technology, Bidhan Chandra KrishiViswavidyalaya, Nadia, West Bengal during Rabi 2014-15 and 2015-16. In studies of seed development, flowers were tagged on a specific day of anthesis at 50% flowering and the developing pods of tagged flowers were collected at 7 days interval, starting from 7 DAA(days after anthesis) till maturity. The study parameters were restricted to length and width of seed, fresh and dry seed weight, germination linked α-amylase, soluble protein and moisture at various seed growth level under several treatments of hormones viz. NAA (100 ppm), GA3 (50 ppm) and in combination of both under single or double spray mode. Seed length and width was increased progressively with the progressing of age (DAA) with its maximum at 35DAA (8.35) for both the years, thereafter, it declined towards maturity due to drying. The fresh and dry weight of developing seeds was gradually increased during progression of seed development and attained its maximum at 35 DAA and 28 DAA respectively, though the quick accumulation was observed in every step of dry wt. considering its topmost frequency at 35 DAA irrespective of the year. The dry weight gradually increased with the stages of maturation and started decreasing after

physiological maturity at 42 DAA (0.203 or 0.198 mg). Maximum moisture content of 81.41/ per cent at 7 DAA was observed which gradually decreased to 11.63 per cent at 42 DAA. Consistent enhancement in amount of soluble protein was noted up to 35 DAA, after which it was reduced in protein or non-significant nature in alpha amylase. Therefore, it is obvious that the seed attained its physiological maturity between the stages from 28 to 35 DAA though the moisture level was higher than the extreme stage of harvest (42 DAA) indicating the seed moisture content 11.62 %.In effects of different treatments, T3(single spray, GA_3 50 ppm) followed by T5(NAA+GA3, double spray) showed significant topmost value among others though it was not properly followed in seed length and width. In action of protein and alpha amylase, the various treatments showed similar non-significant nature. The critical observations on developmental pattern in combination with hormonal treatments on Oat cv. JHO-99-2 are essential not only to detect the right schedule of physiological maturity, it also helpful to maintain research standard related to seed production programme of that specific crop.

PP-2-23

Seed bio priming: An answer to resource conservation in dry land agro ecology

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The increasing use of chemical fertilizers to increase the production of food and fibre is causing concern as soils which receive plant nutrients only through chemical fertilizers are showing declining productivity despite being supplied with sufficient nutrients particularly. The decline in productivity can be attributed to the appearance of deficiency in primary secondary and micronutrients under dry land agro ecosystem where soils are shallow in depth. Further, the physical condition of the soil is deteriorated as a result of long-term use of chemical fertilizers, especially the nitrogenous ones. It also aggravates the problem of poor fertilizer nitrogen use efficiency. Excess nitrogen use leads to groundwater and environmental pollution apart from destroying the ozone layer through N_2O production.The recent energy crisis, high fertilizer cost and low purchasing power of the farming community have made it necessary to rethink alternatives. Unlike chemical fertilizer, organic manure biofertilizer and priming intervention is available locally at cheaper rates. They enhance crop yield per unit of applied nutrients by providing a better physical, chemical and microbial environment. This ultimately improves crop yield sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. Priming is a process which seeds are pre-treated with water or bioactive molecules for enhancing their subsequent germination, growth and performance. Bio priming has the potential to avoid waste, enhance *energyefficiency* and minimize pollution, sustain productivity and have better economic return. Bio priming, a simple technique to a point of pregermination metabolisms without actual germination, is one of the most pragmatic, simple, economic and short-term approaches to combat the effects of biotic and abiotic stresses and also positive effect on seedling emergence and crop establishment mediated through nutrient use efficiency.

PP-2-24

Effect of nitrogenous fertilizer on growth and development of seedlings of S*wietenia mahagoni*.Linn.Jacq.

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The present research was carried out to evaluate response of the effect of nitrogenous fertilizers on the growth and development of seedlings of *Swietenia mahagoni* in the field experiment. As nitrogen is an essential element for plant growth and development. Therefore for the production of quality seedlings Urea (46% of nitrogen) were used as basal dose at the rate of 50kg/ha, 100kg/ha 200kg/ha, 300kg/ha and 500kg/ha respectively.Watering was done regularly with fine shower, which could not disturb the seedlings physically. After a proper establishment of seedlings, nitrogenous fertilizer treatment was applied in the form of solution in five levels i.e. 50, 100, 200, 300 and 500kg/ha with a control. A randomized complete block design is adopted with 4 replications and 25 seedlings per treatment were taken in each replication. There were altogether 600 seedlings involving six (6) treatment combinations. Seedlings were watered regularly and weeds were removed as and required. Observations on growth and biomass were recorded at 60 days interval up to 240 days. The seedlings used in the fertilizer experiment were not significantly different in their initial growth. All growth parameters were measured at four different intervals for subsequent growth prediction. Finally data of 240 days were considered for describing the result. Application of 200 kg of N/ha (T4) showed the best result in respect to collar diameter, height, root, shoot and leaf biomass at 60 days of growth. After that seedlings in T_5 (N_{300}) showed the best results in all growth parameters. SQ values for mahogany seedlings ranged from 5.43 to 5.60 among the treatments. SQ values among the application of fertilizer crossed limit 6.0 at 240 days of growth which was not advisable for quality seedlings. DQI ranged from 6.29 to 10.86 at 240 days of the growth period. The seedlings of T_3 (N_{100}) and T_1 (N_0) showed the maximum (10.86) and minimum (6.29) quality index respectively. Plants developed in the application of nitrogenous fertilizer showed the greatest values for QI up to the application of 300kg of N/ha. This suggests good potential for survival and growth in the field.

PP-2-25

Development and evaluation of native Plant Growth Promoting Rhizomicrobial consortia on growth parameters of sweet corn (*Zea mays convar. saccharata var. rugosa*)

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An attempt was made to isolate, screen, and evaluate the different Plant Growth Promoting Rhizomicrobial consortia on growth parameters of sweet corn (*Zea mays convar. saccharata var. rugosa*)". In the course of the study, as many as five *Acetobacter*, four phosphate solubilizing bacteria and four potassium solubilizing bacterial isolates were isolated from the rhizosphere soils of Malnad regions. Further all the isolates were screened under *in vitro* condition. Out of five

Acetobacter isolates, Aceto-5 fixed a maximum of 4.8mg of nitrogen/g of carbon source. Hence Aceto-5 was selected for further studies. Similarly, Out of four PSB isolates the maximum inorganic phosphorus was released by PSB-3, hence it was selected and with reference to potassium solubilization, the KSB 3 was efficient. Hence all the efficient isolates viz.,Aceto-5, PSB-3 and KSB-3 were selected. Further the effective native Plant Growth Promoting Rhizomicrobial consortia carrier based formulations was developed and evaluated on growth parameters of sweet corn. With respect to germination percentage, number of leaves, chlorophyll content and plant height, the triple inoculation treatment resulted better than other treatment imposed indicating the combined inoculation of PGPR is having an impact on sweet corn. Finally, the treatment where *Acetobacter*-5, phosphate solubilizing bacteria-3 and potassium solubilizing bacteria-3showed maximum accumulation of NPK content in leaves after 90 days and the same treatment also showed increased residual nitrogen, phosphorus and potassium level in the soil.

PP-2-26

Temporal dissection of induced sieve element 'interactome'- a new perspective for better understanding of the plant defence response to aphids

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Nearly 250 amongst ~4300 aphid species (family 'Aphididae') are identified as agriculturally 'pests'. Some crops like Mustard, Bringal, Cotton, Cowpea etc are heavily damaged by aphids' direct as well as indirect activities. Aphids have very proliferative capacity within a very short period of time to achieve the population level above the economic threshold. Characteristically, aphids are exclusively phloem sap feeders. They explore their slender stylet for tapping the sieve element sap which is rich in simple nutrients. Very interestingly, aphid stylet penetration follows intercellular route to minimize the cell damage. Two types of saliva are secreted and explored during the stylet penetration for achieving successful salivation. The gelling saliva is explored mainly during stylet penetration. This saliva becomes solidified and encased the stylet to minimize the induction of plant defense response. Finally, aphid style punctures the sieve element cells and injects aphid salivary into the sieve element cell. This gel salivary secretion reverses phloem occlusion mechanism as well as callose deposition in the host plant and assures nutrient access to tap continuously for many hours or even days from a single sieve element. The recent findings indicate that secreted effector molecules have crucial role in prolonging contact between the aphid stylet and sieve element cell. The specific interaction at sieve element develops 'induced interactome' through molecular battle between the factors present both in saliva and sieve element cell defense biology. The specific interaction with the aphid saliva in the sieve element in host plant determines sustainability the contact between aphis stylet and sieve element cell that modulates the aphid population establishment. In resistance host plant, the induced 'interactome' curtail the aphid population establishment as compared to susceptible host plant. Studies with resistant host of Green Peach Aphid indicate that the phloem sap of *Arabidopsis* wild type (Col-0) contains factor(s) that is detrimental to the insect fecundity. Petiole exudates, which are enriched in phloem sap, collected from leaves of wild type *Arabidopsis*, when added to a synthetic diet had a detrimental effect on Green Peach Aphid (GPA) population. Previous studies have also indicated that aphid infestation results in alterations in the composition of phloem sap. Indeed, petiole exudates collected from GPA-infested leaves of wild type

Arabidopsis (Col-0) showed higher inhibitory activity. So, it a new perspective to dissect the induced interactome developed at sieve element cell in temporal scale may be novel way to light on better perception of the molecular plant-aphid interaction biology for future exploitation for enhancing nutritional security through climate smart farming practices.

PP-2-27
Storage stability of flax seed based functional food

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In the vegetable kingdom, flaxseed is a good source of n-3 fatty acids (57%) dietary fiber (28%) and has been reported to have several health benefits. The functional foods based on flaxseed as well as the combination of flaxseed and ragi has been developed and evaluated for storage stability based on parameters such as peroxide value, TBA value, free fatty acids, sensory score and total quality measurement. RANCIMAT was used to measure the rancidity in terms of flaxseed and flaxseed + Ragi based sweet mixes along with control packed in trilaminate pouches were subjected to storage under 5°C and ambient (18-33°C) temperature conditions. The products were acceptable with a score of 7.2-7.6 on 9- point hedonic scale even after 4 months storage. Peroxide value increased by 1-2 meq O_2. TheTBA value ranged from 0.28-.032 mg% over 4 months storage.However free fatty acids increased 3 folds. The RANCIMAT analysis revealed the decrease in standard time from 30 to 18 h in flaxseed and ragi mix reflecting probably the slight deterioration in sample as reflected by sensory scores. The results of six months storage study with fatty acid profile will be presented.

PP-2-28
Effect of different postharvest treatments on storage life of Guava (*Psidium guajava* L.)

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Guava (*Psidium guajava* L.) is one of the important fruit crop of India, has a limited postharvest shelf life. This study explored the use of some postharvest treatments to extend the shelf life, post-harvest disease incidence and to assess the physico-chemical changes of fruits during storage of guava fruits (cv.L-49). Fully mature but green guava fruits were treated with different edible coating materials (guar gum, gum acacia, chitosan), chemicals (calcium chloride, paraffin liquid), powder formulation of bio-control agent (*Pseudomonas*), hot water, and control. Analysis of variance (one way classified data) for each parameter was performed using ProcGlm of Statistical Analysis System (SAS) software (version 9.3). Retention percent was found maximum with paraffin liquid 10%. Physiological loss in weight was least with paraffin 5% and gum acacia 10%. Regarding other horticultural traits like total soluble solids, ascorbic acid, total sugar, reducing sugar, non-reducing sugar content etc. were recorded maximum

with gum acacia10%, 20%. From this experiment, Edible coating materials showed the better results in terms of extending the shelf life of guava fruits (cv. L-49) as well as to maintain the qualities than the other chemicals.

PP-2-29

Effect of different bunch coverings on yield and quality of banana (*Musa paradiasica* L.) var. Grand Naine in West Bengal

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Bananas are important part of the smallholder farming communities, home gardens, kitchen gardens and families living in rural areas of west Bengal. Good cropping practises and post-harvest management help in producing the superior banana fruit quality. Temperatures coupled with wind blows and debris affects the delicate outer skin causing cellular damage and subsequent fruit scarring. Flea beetles (Fruit / leaf scaring beetle): scratch epicarp of the tender fruits, blemish them and render unmarketable. Technologies such as pre-harvest bunch covers have been shown to improve quality of banana fruits and reduce insect pest damage. High quality fruits that are visually acceptable, have good postharvest quality attributes are sell well in both local and international markets. This study therefore aimed at understanding the effect of bunch covers on the postharvest quality characteristics of tissue-cultured bananas. The experiment was carried out in at Instructional farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal during the year 2012 -2014, in a complete randomized design and was replicated three times. Fruits were harvested at full three quarter maturity. Parameters measured were; bunch weight, finger grade, starch, total soluble solids (TSS), sugars, chlorophyll content, physiological weight loss, green life and shelf life. Data were subjected to analysis of variance (ANOVA) using the Indostat (Version-7.1). Results showed that bunch covers significantly influenced finger grade, length and bunch weight (17.28 kg & 16.68 kg) at harvest. Chlorophyll, starch content, TSS and total sugars (18.2 and 19.0 during ripening by bunch covers. The study has shown that perforated polyethylene bunch covers at early stage of bunch development may be used in commercial banana orchards in west Bengal to produce high quality fruits especially in the cooler months.

PP-2-30

Growth and yield as influenced by Irrigation scheduling in banana (*Musa* spp., AAA group) var. Grand Naine during water deficit period in Terai zone of West Bengal

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An experiment was carried out to study the growth and yield dynamics in proportion with moisture availability regulated by method and irrigation intervals during 2012-2014 at UBKV, Pundibari. The experiment was laid out in split plot design replicated thrice having methods of irrigation (furrow and basin) as main plots and irrigation scheduling at four levels i.e. Control (No irrigation) weekly interval, biweekly interval, triweekly interval. The plant height (221.32 cm & 212.83 cm), pseudostem girth (75.25 cm& 71.65 cm), number of leaves (22.48 & 20.60), leaf area (0.93 m^2& 0.82m^2), yield (56.74 t/ha & 54.92 t/ha), water use efficiency (0.143 t/ha/cm & 0.139 t/ha/cm) was recorded highest at weekly interval in plant and ratoon crops, respectively at the time of shooting whereas in control plots the lowest plant height (206.01 cm & 197.43 cm), pseudostem girth (69.22 cm &65.52 cm), number of leaves (18.16 & 16.27), leaf area (0.76 m^2& 0.66 m^2), yield (54.92 t/ha & 43.71 t/ha), water use efficiency (0.115 t/ha/cm & 0.113 t/ha/cm) was recorded in plant and ratoon crops, respectively at the time of shooting. The moisture deficit for banana at any stage of the crop reflects the bunch yield which can be substituted by weekly or biweekly irrigation intervals to avoid moisture stress.

PP-2-31

Seed priming of field crops with different botanical extracts- a technique of enhancement of seedling vigour

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Seed priming is defined as a technique by which seeds are hydrated to a level where germination metabolism begins but radicle emergence does not initiate. Seed priming is basically a pre-sowing seed treatment. Seed priming techniques have been used to reduce the seedling emergence time, enhance synchronized emergence, improved emergence rate and better seedling stand and are known to improve the tolerance ability against biotic and abiotic stresses through enhanced seedling vigour. Rapid germination and emergence is an important factor for successful establishment. Seed priming not only improves the speed and uniformity of germination but also stimulates various biochemical changes in the seed, which are vital in breaking dormancy, the mobilization or hydrolysis of seed reserves, enzyme activation, and the emergence of embryonic tissues. There are different types of seed priming, namely, i) hydro-priming, ii) halo-priming, iii) osmo-priming, iv) growth regulator priming, v) bio-organism priming, vi) priming with botanical extract etc. Botanical extracts obtained from some crop and tree residues have been reported to play roles in crop growth and yield. Osmo-priming using extracts of Moringa (*Moringa oleifera*), papaya (*Carica papaya*), golden bush (*Haplopapus linearifolius*),

mushroom and coconut (*Cocos nucifera*) water reported to enhance seedling vigour. With respect to the different parameters measured, the extracts seem to have varying but specific effects on certain crop seeds. The root dry matter yield in field bean was enhanced by all the extracts. The extracts, specially, papaya and coconut water, have also shown a possible natural fungicidal effect as they prevented or at least reduced rotting of roots in seedlings of all the test crops. Findings of many investigators showed that the plant extracts and their compounds for control of fungal pathogens and found that plant extract significantly inhibited the radial growth of isolated fungus.

PP-2-32

Bioefficacy and phytotoxicity study of tolfenpyrad 15% EC for management of Jassid (*Amrasca biguttula biguttula* Ishida) infesting okra

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Tolfenpyrad 15% EC was evaluated at Regional Research Station(Hill Zone) of Uttar Banga Krishi Viswavidyalaya, Kalimpong, West Bengal, India at three doses (100, 125 and 150 g a.i. ha^{-1}) against jassid (*Amrasca biguttula biguttula* Ishida) infesting okra during 2014-15 and 2015-16. Seven treatments *viz.,* tolfenpyrad 15 EC @ 100,125 and 150 g a.i. ha^{-1}, Keefun (market sample of tolfenpyrad 15 EC) @ 150 g a.i. ha^{-1}, imidacloprid 17.8 SL @ 20 g a.i. ha^{-1}, acetamiprid 20SP @ 15 g a.i. ha^{-1} along with one untreated control were evaluated under field condition. All the treatments were significantly superior over untreated control. Among the treatments tolfenpyrad 15%EC@ 150 g a.i. ha^{-1} was superior and recorded the lowest mean population of jassid with maximum yield followed by Keefun (market sample of tolfenpyrad 15 EC) @ 150 g a.i. ha^{-1}. Tolfenpyrad did not produce any phytotoxicity symptoms on cabbage at higher dose of 300 g a.i. ha-^{1}.

PP-2-33

Transgenic overexpression of the *Oryza sativa* gibberellic acid insensitive *(OsGAI)* gene in the background of a tall, indigenous, aromatic rice cultivar Badshabhog reduces plant height and improves other yield attributing traits

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Food scarcity is becoming a burning problem because of increasing world population and the effect of climate change on food production. Being a major staple food crop of the world, improvement of yield attributing traits of rice has become a challenging area of research. Among the different yield attributing components, tillering ability of a plant is the important one which is directly dependent on plant height. If the plant height is reduced, tiller number will be more. In

West Bengal, an indigenous, aromatic, small grained indica rice cultivar Badshabhog is highly preferred by the consumer for its characteristic aroma present in the grains. However, the cultivation of the Badshabhog is threatened due to the extremely tall plant height of this cultivar. The tall nature of Badshabhog makes it highly susceptible to lodging due to heavy rainfall and wind leading to a massive yield loss. Furthermore, due to its short grain size, the productivity of this cultivar is lower compared to any medium grained rice cultivar. Naturally a genetic research intending for reduction of the plant height in Badshabhog cultivar is supposed to have a tremendous practical applicability. For this purpose, the present study was conducted to verify the effect of the overexpression of the *OsGAI* (*Oryza sativa* gibberellic acid insensitive) gene in the background of the Badshabhog cultivar. Agrobacterium-mediated rice transformation was carried out using a genetic construct, where the OsGAI gene is expressed under the transcriptional regulation of the rice polyubiquitin (*RuBQ*) promoter or maize polyubiquitin (*MuBQ*) promoter and nopaline synthase (NOS) terminator. The transgenic rice lines, developed using either of the constructs, were found to have significantly reduced plant height, decreased seed alpha-amylase activity, reduced early seedling growth, higher level of the anthocyanin pigmentation and reduced cell wall lignification. The leaves of the transgenic lines were more dark green than untransformed control line, owing to the increase in chlorophyll content. Different panicle characters, which contribute as yield attributing traits in rice were also analysed in these transgenic lines. Thus the present study advances our understanding on OsGAI-mediated gibberellin signal transduction in rice and advocates the utility of over expressing the *OsGAI* gene for improving the yield attributing traits in rice, which is highly pertinent in the current context of the adverse effects of climate change.

PP-2-34

A Review on Performance of Sweet Flag (*Acorus calamus* L.) as a botanical protectant against stored- grain insect pests

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In present scenario, an equal thrust is being given regarding production and protection of the food grains, particularly in storage, as one of the approaches to ensure food security. Insect pests account for about 10% loss of total food grains in stored condition. To combat them, scientists are always in search for low –cost and easily accessible protectant in small scale farmers' store as well as in commercial storage. The Sweet flag, *Acorus calamus* L. (Fam: Araceae) is one of them. This is a medicinal herb and found in abundance in the Temperate Zone of the Himalayas. The parts of this plant can be used in different forms, such as rhizome powder, seed powder, dried powder of the leaf, rhizome oil etc. Rhizome powder 1% is found to be effective for management of lesser grain borer, *Rhizopertha dominica*Fab. in sorghum during storage up to 180 days after treatment whereas rhizome powder 2% acts as ovipositional deterrent against *Callosobruchus maculatus* (F.) on seeds of black gram and shows insecticidal activity against *Sitophilus oryzae* L. infesting paddy grains. The seed powder of the plant @ 3% acts as grain protectant against *Callosobruchus maculatus* (F.) and results in minimum egg-hatching and prohibition of the development of the larvae. Higher germination percentage (87%) of wheat seed is found during treatment of the seeds with sweet flag rhizome powder @ 10g/kg of seed compared to untreated

control (77.31%) at the end of 10th month of storage. It also acts as grain protectant against groundnut bruchid, *Caryedon serratus* (Olivier) on groundnut seeds up to two months from the date of application. Dried powders of the leaf @ 20 mg/g seed of pulses and their extracts in methanol shows 91.1% mortality of adults of *Callosobruchus chinensis* L. Oil of Sweet flag at various rates have shown satisfactory mortality of *Trogoderma granarium* (Everts). This oil is evaluated as seed protectant against *Sitophilus oryzae* (Linnaeus). Fumigant toxicity of beta – asarone, extracted from sweet flag, has significant knockdown and lethal impact on four main stored-grain pests, *Sitophilus zeamais* Motsch*, Rhyzopertha dominica* Fab.*, Tribolium castaneum* Herbstand *Callosobruchus maculatus* (F.) Keeping all these in view it is quite clear that sweet flag is one of the important botanical protectants but still not a very popular one. So different effective formulations may be prepared from this herb to ensure environment – friendly management of different insect – pests in storage condition.

PP-2-35

Critical timings and method of poison bait application for rodent control in wheat crop sown with happy seeder and conventional systems

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Rodents are major vertebrate pests causing damage to wheat crop. To evaluate the frequency of baiting schedule in wheat crop sown with happy seeder having paddy residue and conventional method, the experiment was conducted at village Ladowal, district Ludhiana. In this experiment, there were five blocks, I, II, III, IV and V, each comprising one acre area having three replications. In block I, double burrow treatment 1st with Bromadialone (0.005%) and 2nd with zinc phosphide (2%) (15 days after 1st treatment) + single paper baiting with Bromadialone were practiced, in block II single burrow baiting with zinc phosphide along with paper baiting, block III only single paper baiting and in block IV single burrow baiting with Bromadialone were practiced, whereas block V was kept as control. Burrow baiting @10g/live burrow was done during vegetative stage of crop growth and paper baiting @400g/acre during reproductive stage of crop growth. Higher per cent control success (on burrow count basis) (75.06±7.37 to 82.07±7.84) was observed in fields having two burrow baitings followed by single burrow baiting and control in conventional and happy seeder fields. Similarly, after third treatment with paper baiting, higher per cent control success was observed in fields where double burrow baiting along with single paper baiting was practiced both in happy seeder and conventional fields followed by other treatments and control. Lower per cent cut tillers (0.39±0.11-0.47±0.16) and per cent damage (kg/acre) (10.52±2.81-11.23±4.07) was recorded in fields having three treatments as compared to other treatments and control in both methods of sowing. In control fields with residues of paddy the number of burrows (acre) were more as compared to conventional method of sowing and there was predominance of *Tatera indica* species followed by *Bandicota bengalensis* and *Mus booduga*. So, rodenticide treatment with double burrow baiting at vegetative phase (1st with Bromadialone and after 15 days 2nd with zinc phosphide) along with paper baiting (Bromadialone) at reproductive phase are must to control rodent pests in wheat crop sown with paddy residues in soil to increase wheat yield.

PP-2-36
Quantification of production of organic ginger in East Sikkim, India

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Ginger (*Zingiber officinale* Rosc.) is an important commercial crop grown for its aromatic rhizomes which is used both as a spice and a medicine. Ginger of commerce is the dried rhizome. It is marketed in different forms such as raw ginger, dry ginger, bleached dry ginger, ginger powder, ginger oil, ginger oleoresin, gingerale, ginger candy, ginger beer, brined ginger, ginger wine, ginger squash, ginger flakes etc. The Sikkim is the one of the major ginger producing state of country, where it is grown organically. However, the production is in declining trend due to various diseases and insect pests' problem. The study was carried out at the different Gram Panchyat Unit (GPU) of East Sikkim district, viz. Rey Mindu, Tathangchen and Syari, Lingdok and Navey, Sentam and Ringhim to quantify the area and production of ginger during the *Kharif* season in 2013 by using questioner method. The survey was carried out in each and every farmer household of the respective GPU. The total area of the study site was 1528.13 hectare under organic farming practices and within that 314.03 hectare was under ginger cultivation. The study quantified that the area under ginger at Rey Mindu block was 0.71 hectare with production level of 5.22 Mt. The area under ginger cultivation at Tathangchen-Syari, Lingdok-Navey, Sentam-Ringhim blocks were 1.71 hectare, 6.25 hectare with production level of 11.59 Mt., 2.53 Mt and 40.34 Mt respectively. The total ginger production in the East Sikkim during 2013 was 59.68 Mt. The study revealed that there is a scope for more production in future.

PP-2-37
Study the effect of boron, molybdenum and zinc and their combined treatments on growth and yield parameters of Broccoli in Terai agro-ecological region of West Bengal

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Broccoli (*Brassica oleracea* L.) is one of the main cole crops of Brassicaceae or cruciferae family. The climate of Terai region of West Bengal is highly favourable for broccoli cultivation that argued for the possibility of getting more net profit of the farmers from cultivation of this high valued crop. But due to the micronutrient deficiency in the soil of terai region broccoli not gives good return for this reason the experiment was done. The present experiment was carried out to examine the effect of boron, zinc and molybdenum on broccoli (cv-green magic) with sole doses of these three micronutrients were fixed 0.3% for borax , 0.5% and 1.0% zinc sulphate as per and 0.03% and 0.05% per ammonium molybdate solutions as sole as well as their combined treatments on the yield and growth parameters of the broccoli. Among the sole treatments, application of zinc showed significantly higher effect on leaves per plants, leaf area, total chlorophyll content of the leaf and ascorbic acid content in the head. Significantly higher plant height showed by the treatments 0.03% Mo+1%Zn (59.10cm) and 0.05% Mo + 1% Zn (59.05cm), respectively.

Irrespective of the treatments Zn had significantly positive influence in increasing the number of leaves per plant, especially at 0.5% dose. Significantly highest ascorbic acid was recorded at i.e., 61.54mg/ 100g of fresh head weight. Whereas, significantly highest leaf area were recorded at combination treatment of 0.3%, 0.03% Mo and 0.5% Zn (454.35 cm^2) and sole treatment of 0.5% Zn (452.33 cm^2).Combination of 0.3% borax, 0.03% ammonium molybdate and 0.5% zinc sulphate were recorded to be best for most of the traits.

PP-2-38

Effect of organic and inorganic amendments on the fruit quality of Darjeeling Mandarin Orange (*Citrus reticulate* Blanco)

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Citrus is one of the most important fruit crops in India. The most important citrus cultivars in India are mandarin (*Citrus reticulate* Blanco), followed by sweet orange (*Citrus sinensis* Osbeck) and acid lime (Citrus *aurantifolia* Swingle). It is also one of the important fruit crops of Darjeeling hills. Commercial citrus group like Darjeeling mandarin are grown in all the three subdivision of Darjeeling hills. Thirteen combination of organic and inorganic fertilizer along with zinc boron was applied .Treatment13 i.e. NPK (RDF), 300:250: 300g/tree along with zinc 250gm/tree ($ZNSO_4$), Boron 50gm /tree (Borax) with pig manure, vermicompost and FYM gave better result in all aspect of plant including fruit yield and quality . In this experiment different combination of organic and inorganic with micro nutrient treatment. T.S.S° (Brix) was recorded highest in T_{13} NPK+B+Zn+50% FYM +25% Vermicompost +25%Pig manure) 10.05 followed by $T_{12)}$ NPK + B + Zn + Pig manure) 10.04 T_{11}(NPK + B + Zn + Vermicompost) 9.79, T_{10} (NPK + B + Zn+ FYM) 9.79, T_4 (NPK+ B+ $ZnSO_4$) 9.67, T_3 (NPK + $ZnSO_4$ 250g) 9.64, , T_8 (50%FYM +25% Vermicompost +25%Pig manure) 9.56, T_2 (NPK +50g boron) 9.52, T_9 (75%FYM +12.5% Vermicompost +12.5% Pig manure), 9.35 ,T_7 (100% Pig manure) 9.35,T_6 (100% Vermicompost) 9.33 ,T_5 (100% FYM) 9.23 and lowest was recorded in T_1 (control) 8.95 highest total sugar % was also recorded highest in T_{13} NPK+B+Zn+50% FYM +25% Vermicompost +25%Pig manure) 8.49 followed by $T_{12)}$ NPK + B + Zn + Pig manure) 8.42, T_{11}(NPK + B + Zn + Vermicompost) 8.42, T_{10} (NPK + B + Zn+ FYM) 8.41, T_4 (NPK+ B+ $ZnSO_4$) 8.37, T_3 (NPK + $ZnSO_4$ 250g) 8.34, T_2 (NPK +50g boron) 8.15, T_8 (50%FYM +25% Vermicompost +25%Pig manure) 8.08, , T_9 (75%FYM +12.5% Vermicompost +12.5% Pig manure), 8.08 ,T_7 (100% Pig manure) 8.06, T_6 (100% Vermicompost) 7.91 ,T_5 (100% FYM) 7.88 and lowest was recorded in T_1 (control) 7.54.%. Ascorbic acid mg/100gm was recorded highest in T_{13}(NPK+B+Zn+50% FYM +25% Vermicompost +25%Pig manure 31.57 followed by $T_{12)}$ NPK + B + Zn + Pig manure) 30.74, T_{11}(NPK + B + Zn + Vermicompost) 30.71, T_{10} (NPK + B + Zn+ FYM) 29.72, T_4 (NPK+ B+ $ZnSO_4$) 29.64, T_3 (NPK + $ZnSO_4$ 250g 29.46, T_2 (NPK +50g boron) 29.40, T_8 (50%FYM +25% Vermicompost +25%Pig manure) 29.10, T_9 (75%FYM +12.5% Vermicompost +12.5% Pig manure), 29.04 ,T_7 (100% Pig manure) 28.82,T_6 (100% Vermicompost) 28.58 ,T_5 (100% FYM) 28.42 and lowest was recorded in T_1 (control) 27.04 While highest acid content % was highest in T_{13}(NPK+B+Zn+50% FYM +25% Vermicompost +25%Pig manure) 0.855 %, followed by $T_{12)}$ NPK + B + Zn + Pig manure) 0.810 T_{11}(NPK + B + Zn + Vermicompost) 0.755, T_{10} (NPK + B + Zn+ FYM) 0.755, T_4 (NPK+ B+ $ZnSO_4$) 0.725, T_3 (NPK + $ZnSO_4$ 250g 0.715, T_2 (NPK +50g boron) 0.715, T_8 (50%FYM +25% Vermicompost +25%Pig manure) 0.705, T_9 (75%FYM +12.5%

Vermicompost +12.5% Pig manure), 0.680 ,T_7 (100% Pig manure) 0.675,T_6 (100% Vermicompost) 0.675 ,T_5 (100% FYM) 0.642 by and lowest in T_1 (0.630 %). Yield No. of fruit /tree was recorded highest in T_{13} (NPK+B+Zn+50% FYM +25% Vermicompost +25%Pig manure) 653.2 fruits /tree, followed by $T_{12)}$ NPK + B + Zn + Pig manure)570, T_{11}(NPK + B + Zn + Vermicompost) 541.17,T_{10} (NPK + B + Zn+ FYM)539,T_4 (NPK+ B+ $ZnSO_4$) 496.67,T_3 (NPK + $ZnSO_4$ 250g) 478..00,T_2 (NPK +50g boron) 459.83,T_8 (50%FYM +25% Vermicompost +25%Pig manure) 440.50, T_9 (75%FYM +12.5% Vermicompost +12.5% Pig manure), 437.83 ,T_7 (100% Pig manure) 427.00,T6 (100% Vermicompost) 416.33,T (100% FYM) 415.33 and lowest was recorded in T_1 (control) 370.3 fruits/tree which was not significant with each other treatment.

POSTER PRESENTATION

Technical Session-3

Impact of climate resilient crops/horticulture for hilly agro ecosystem, socio-economic development through climate smart agriculture

PP-3-01
Yield Gap Analysis of Large Cardamom *(Amomum subulatum* Roxb.*)* through FLD in Hilly Areas of West Bengal

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A study was carried out during 2012-13 and 2013-14through front line demonstration (FLD) to analyze the yield gap of large cardamom (Amomum subulatum Roxb.) in seven villages of Gorubathan, Algarah, Mirik and Kalimpong block under Darjeeling district of West Bengal. The initial test value of soil under the study showed acidic pH (4.20) and the available N, P_2O_5 and K_2O were 260, 40 and 210 kg ha^{-1} respectively. Soil correction with $CaCO_3$@ 5 t ha^{-1}along with application of Phosphate solubilizing bacteria (P.S.B) @ 2 g $clump^{-1}$ showed decreasing technology gap as well as technology index in comparison to the normal farmers' practice and 73.25% increase in yield over the control.

PP-3-02
Prospects of growing flax as fibre crop in hilly agro ecosystem

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Flax plant supplies both industrial oil (linseed oil) and bast fibre used to produce textiles, composites and paper/pulp. Fibre is obtained from the plant called flax or linseed(*Linum usitatissimum L.*). Flax is well known to grow in a cool and moist climate. Valleys of the Himalayan ranges are the ideal geographical regions for cultivation of flax for fibre purposes where the winter simulates a European summer. Despite evolvement of good number of varieties and standardization of agronomical practices of flax crop, flax fibre production in India is negligible and domestic requirement of fibre is met by import. One of the major reasons is non-availability of suitable machine for post-harvest processing of the crop i.e. fibre extraction. Some efforts were made at CRIJAF, Barrackpore to develop machine for extraction of flax fibre. The capacity of developed machine is 5-6 kg fibre/h and can deal 140 kg of retted and dried straw in a day and produce 30-35 kg fibre. To extract fibre of a hectare area it needs about 22 working days i.e. 44 man-days for its operation. The fibre extraction with the machine reduces drudgery and as well labour requirement from 665 man-days/ha by manual to 109 man-day/ha. Flax fibre

extraction with this machine was found economical and feasible. This paper discusses details of production and post-harvest processing of flax fibre including value addition in hilly agro ecosystem.

PP-3-03
Exploring the contribution of large cardamom enterprise towards the socio-economic development of large cardamom growers in Sikkim

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In Sikkim, large cardamom is a major cash crop which contributes largely to ensure sustainable livelihood for many farmers of this area. But, recently, under the climate change scenario, almost all the agro-based enterprises are more or less facing serious threats to their production and productivity. Consequently, large cardamom cultivation in Sikkim is also exposed to this changing climate. But, before analysing how this change is affecting large cardamom farming as well as its contribution to the livelihood of the large cardamom growers, it is of utmost importance to identify the existing situation related to the matter. With this background, the present study has been carried out to explore the present situation about the contribution of large cardamom farming towards the socio-economic status of the farmers. The study was conducted at six gram panchayat wards under Regu block of East Sikkim district in Sikkim. Purposive, multi-stage and simple random sampling procedures were followed in the present study to select hundred numbers of respondents. In the present study, impact of the large cardamom cultivation on socio-economic condition of the farmers has been considered as the dependent variable and eighteen other attributes of the respondents were considered as the independent variables. Personal interview method with the help of structured interview schedule was followed for data collection. Major statistical tools used were descriptive statistics, Pearson correlation and multiple regressions. Majority of the respondents agreed that large cardamom farming has medium level socio-economic impact. Correlation coefficient revealed that the variables like education, family education status, mass media exposure, management orientation, risk orientation and innovativeness are significantly and positively associated with the dependent variable, socio-economic impact of large cardamom cultivation but, livestock possession is the only variable which has negative and significant association with the dependent variable. Again, in the multiple regression analyses, it is found that the variables namely family annual income, management orientation, risk orientation and innovativeness of the farmers are positively and significantly contributing towards characterizing the dependent variable, soio-economic impact of large cardamom cultivation but, other three variables namely annual expenditure, livestock possession and social possession have contributed significantly but negatively in case of characterizing the dependent variable that is the socio-economic impact of large cardamom cultivation and the entire explicability is 0.625. Another important finding of the study showed a sharp increase in the investment pattern of the large cardamom growers in different aspects of their day-to-day life which ultimately reflects improvement of their socio-economic condition after cultivating large cardamom successfully.

PP-3-04
Characterizing Sub-Himalayan family farms with special reference to socio-economic aspects

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Family farms are those which include agriculture, animal husbandry, fisheries, sericulture and forestry in their production system and are operated and controlled by a family; cultivates an area of land below the upper limit decided for the region; and the family members should work directly on farm and the ratio between family and hired labour would not be less than one. Family farms are important in the sense that these grow a wide variety of cultivars, many of which are indigenous landraces and are genetically more heterogeneous than modern varieties, and thus would offer greater resilience against vulnerability and enhance harvest security. The contribution of small farmers to total farm output in India exceeds 50%, while they cultivate only 44% of land. Realizing the important contributions that family farming is making towards food security and eradicating poverty, the year 2014 has been declared as the 'International Year of Family Farming' (IYFF) at the 66th Session of the United Nations General Assembly and aims to upscale family farming by technological intervention, entrepreneurial skill development and business ownership. In this backdrop, the present study was undertaken in sub-Himalayan region to know their socio-economic characteristics. The present study presented baseline information on land ownership, land characteristics, personal characteristics of farm owners and information on land-water-animal and tree based enterprises adopted in family farming. The paper presented a comprehensive database on sub-Himalayan family farms which may be utilised by the researchers and policy makers to upscale these farms.

PP-3-05
Community level vulnerability due to climate change: a comparative study between selected Naga tribes in India

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The inhabitants of Nagaland, India are almost entirely tribal with distinctive dialects and cultural features. In Nagaland state there are 16 major Naga tribes, among these *Angami* and *Ao* are the most dominating. The developmental experience of Nagaland has been full of challenges. Apart from its late start, geographical remoteness and inaccessibility, hilly terrain, lack of infrastructure, population composition, and scarce resource base, the state also had to face continuous insurgency, spending much of its resources on administration and related costs at the expense of development. With this background the present study was undertaken to assess comparative vulnerability at community level due to climate change. Vulnerability is a derivative of exposure, sensitivity and adaptive capacity. The study was conducted in Mokokchung and Kohima district of the North-Eastern State of Nagaland. Two villages under each district, each dominated by one of the said tribes were purposively selected. The study reveals that both the communities fall under subsistence level of vulnerability class, which means any minor change in strength of exposure or sensitivity or weakness in adaptive capacity may force the community to be vulnerable. Although both the societies fall under same vulnerability class but t-test value concludes that the *Ao* communities of Naga tribes are more vulnerable than the *Angami* tribes. Based on the findings of the present case study, it can be tentatively said that efforts to reduce livelihood vulnerability in Naga tribal communities should be multifaceted so as to simultaneously tackle exposure, sensitivity, and adaptive capacity.

PP-3-06
Attitude towards Watershed Development Project in Cooch Behar District of West Bengal, India

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Watershed is a natural hydrological entity that covers a specific area expanded on land surface, within whose boundaries the entire rainfall run-off ultimately passes through a specifically defined stream. In many countries watershed approaches have increasingly becoming a holistic approach to natural resource management and rural development instead of focusing only on 'water' through improved land management and rain fed crop production. Recognising the importance of watershed development programme in the state, Cooch Behar district also implemented 6 nos. of micro watershed project during XI- five year plan (2007-08 to 2011-12) of which *Rangamati* watershed project has executed at Mathabhanga-II Block. A positive attitude towards any phenomena or activity is an indirect means of efficacy of it. Positive attitude towards any activity or programme creates a higher probability for its success. The present study analyses the attitude towards watershed development project and traced the impact of positive attitude towards the success of the watershed project. The study revealed that the farmers of the watershed area had developed a positive attitude towards the project; and the farmers with positive attitude reaped higher benefits from it. So, it is suggested that with the introduction of watershed project, government should campaign about the project for development of positive attitude towards watershed development projects which can reap the highest benefit from the scheme.

PP-3-07
Economic analysis of different rice based cropping system in new alluvial zone of West Bengal

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The experiment was carried out for find out the best cropping system in the New Alluvial Zone of based on field data from at Central Research Farm, Gayeshpur, Nadia, BCKV on 2011-12 reveals that the highest Rice Equivalent Yield (REY) was observe in Rice-Potato-Jute (CS2) (15427 kg ha^{-1}) cropping system followed by Rice-Potato-Maize (CS3) (11785 kg ha^{-1}) and Rice-Rice (CS1) (9188 kg ha^{-1}) respectively. A significant increase in REY (kg ha^{-1}) was found with mulching (M2) than non mulching (M1). The significantly more Net Return found in CS2 (Rice-Potato-Jute) followed by CS1 (Rice-Rice) and CS3 (Rice-Potato-Maize) respectively. The effect of Rice-Potato-Jute cropping system over tillage, mulch and fertilizer on system rice equivalent yield on was lowest (6853 kg ha^{-1}) in conventional tillage with 75% Recommended Dose of Fertilizer +25% Nitrogen through Vermicompost interaction and highest value found in 16972 kg ha^{-1} in minimum tillage with 100% RDF interaction. The Cost-benefit ratio was found significantly more in CS2 (Rice-Potato-Jute) followed by CS1 (Rice-Rice) and CS3 (Rice-Potato-Maize).

PP-3-08
Financial support to small and marginal farmers in the event of climate change- a study on status and roles of weather-based crop insurance scheme

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The paper analyses the present status and roles of Weather-based Crop Insurance Scheme (WBCIS) as a critical component of climate smart agriculture (CSA) in the event of climate change in India with the help of a unique set of data derived from different secondary sources for the period of 2007 to 2014. The paper is a review type of work. The study shows that impact of WBCIS has remained far from expectations. In spite of its various economic benefits, participation in the scheme is very poor. Smallholders can implement a range of CSA practices and technologies to minimize the adverse effect of climate change but their adoption largely depends on economic benefits of CSA practices. The estimates of CAGR for the period 2007-08 to 2013-14 show that no. of farmers insured and no. of farmers benefitted have registered more than 50 per cent growth. In fact, this growth rate is still not adequate to cover majority of the farmers. Further, only 4 per cent of the household had insured their crop at the all India level. According to National Sample Survey Organization (NSSO), only 10 per cent farmers are aware of crop insurance policy and only about 30 per cent of the farmers in India receive institutional credit while about 20 per cent is covered under agriculture insurance scheme. Reasons/factors affecting for low adoption of WBCIS and feasible recommendation have also been analyzed. Inadequate information (technical, social and economic), procedural lacunae and apathy from the banking officials have created lot of contained in its performance. Thus, farmer's social and economic parameters need to be considered while implementing the scheme. Govt. financial institutions in collaboration with private agencies have to adopt a holistic approach to review the scheme and take appropriate action for effective implementation of WBCIS in India which, in turn, will act as a critical component CSA for sustainable agriculture.

PP-3-09
Role of dry flower technology in employment generation- a review

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Floriculture has become a profitable industry in many parts of the globe. Cut flower is one of the major components of floriculture trade but the shelf life of cut flower is very limited .considering the problem of shelf life there is an urgent need of supplying the farmers with appropriate technology, for preservation of flower and floral crafts. Dehydration is one potential technology. Drying and preserving flowers and plant materials is a form of artistic expression that was very popular during the Victorian age and has once again gained popularity. Dried or Dehydrated Flowers or Plant part or Botanicals (Roots, leaves, Stem, Bark or Whole plant) can be used for ornamental purposes. Dried flowers and other plant parts is a Rs. 100 crore industry in India and such dry decorative materials are globally accepted as natural, eco-friendly, long lasting and inexpensive.Major dry flower industries units are located in Tuticorin (TN), Kolkata, Maharashtra, Karnataka and A.P in India. India is one of the major exporters of dried flowers to the tune of 5% world trade in dry flowers. This industry shows a growth rate of 15% annually. Potpourris are a major segment of dry flower industry valued at Rs. 55 crore in India alone. Easy availability of products from forests, possibility of manpower available for labour intensive craft making and availability of wide range of products throughout the year are the reasons for development of dry flower industry in India. This industry provides direct employment to around 15,000 persons and

indirect employment to around 60,000 persons.Dehydration techniques have been standardized under room temperature, sun drying, press drying, hot air oven drying, microwave oven and solar cooker. Dried flowers and foliage have multipurpose use. A cottage-scale industry based on floral craft can come up for self-employment of unemployed youths and for earning money to the housewives as well as rural women through this creative occupation. Dehydration technology can also be exploited for dehydration of promising colourful cut flowers in its original colour and shape for long term enjoyment and for commercial utilization of unutilized/underutilized plant species. Dry flowers that are near natural, dried and preserved, have an everlasting value that can be cherished for longer periods and require little care. Dry flower market has grown exponentially as consumers become “eco-conscious” and chooses dried flowers as the environmentally friendly and biodegradable alternative to fresh flowers. There is large potential to develop the dry flower industry in our country with great potential of employment generation.

PP-3-10
Adoption of scientific farm innovations towards enhancing nutritional security in selected areas of Kalimpong, West Bengal

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Among the four pillars of nutritional security viz. food availability, access, utilization, and stability, first one is the most important pillar. Agricultural technologies have a special role in developing countries, boosting the growth of the agricultural sector, hence driving the overall growth and lowering food prices. Agricultural technologies can also directly contribute to alleviate food insecurity: they can improve crops productivity allowing for higher production quantities both for self-consumption and for increased household income, and they can reduce risks of crop failure in case of physical shocks, such as drought or floods. In this backdrop, the present study was undertaken in Kalimpong Hills of West Bengal to assess the adoption level of agricultural technologies (scientific farm innovations). Education being the most dominating factor towards adoption of farm innovations, the present study also analysed the association of education with adoption of innovation. The study revealed that the farmers of Kalimpong hills adopted different production technologies with varied levels. It is also clear from the study that literacy level has profound effect on adoption of different scientific farm innovations. So, it is suggested that to enhance household nutritional securities, farmers should be encouraged to adopt new agricultural technology; and which can automatically be achieved by increasing education level of the farmers.

PP-3-11
Perception of forest fringe communities on impact of climate change

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One of the greatest challenges to livelihoods in the 21stcentury, particularly in developing countries, is the threat from climate change that could potentially reverse decades of development gains, such as those focused on achieving the Millennium Development Goals. The forest dwellers, adjacent farmers and even considerable proportion of underprivileged population are particularly at risk due to climate change. Climate change is projected to adversely impact rural livelihoods especially forest communities dependent on climate sensitive natural resources. The present study documented perception of forest fringe community of Chilapatta Reserve Forest during 2013-2015 on climate change with its associated risk. A total of 100 respondents through random sampling were selected for personal in-depth interview through close ended questionnaire. Majority of the respondents were male, literates and subsistently growing crops in

their marginal land.Forest fringe community of Chilapatta Reserve Forest have considerable awareness and consistence on climate change and its effects on the weather, ecosystems, biodiversity and agriculture. They perceived climate change and believed it as worldwide phenomena. Majority of them perceived increase in temperature as increase in day and night temperature, mildness in winter and warming of winds. Similarly they believed that monsoon is becoming unpredictable day by day with changed intensity and pattern but generally arriving late and withdrawing early over the past few decades along with decrease in cloudy and rainy days. Majority of these people also perceived negative impact of climate change on forest biotic and a biotic environment along with risk on their livelihood through increased misery, decreased income, increase susceptibility to serious diseases and decreased availability of food and water. The study also revealed a need for scientists, government and non-government agents and other stakeholders to support efforts by farmers to adapt to effects of climate change through technological, policy and financial interventions with an aim of improving livelihoods and food security.

PP-3-12
Impact of climate change on India's food security

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Global climate change is a change in the long-term weather patterns that characterize the regions of the world. The term "weather" refers to the short-term (daily) changes in temperature, wind, and/or precipitation of a region. In the long run, the climatic change could affect agriculture in several ways such as quantity and quality of crops in terms of productivity, growth rates. Climate change has added to the enormity of India's food-security challenges. While the relationship between climate change and food security is complex. This study provides a view of the impact of climate change on India's food security by concentrating on issues like availability, access and absorption. It finds that ensuring food security in the face of climate change will be a formidable challenge and recommends, among others, the adoption of sustainable agricultural practices, greater emphasis on urban food security and public health, provision of livelihood security, and long-term relief measures in the event of natural disasters.

PP-3-13
Impact on farmer's awareness programme on Gramin Krishi Mousam Sewa

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Thisstudyevaluatedtheexecutionandknowledgegainedbyfarmerswhoattended thefarmer's awareness programmeorganizedbyGramin Krishi Mousam Sewa (GKMS) in Uttar Dinajpur district of West Bengal. From a total of 80 participants, a sample of40 farmers, representing about 50% of the invited farmers from different villages was randomly selected for evaluating the planning and execution of the farmers awareness programme out of which 34 farmers (about 25% of invited farmers) was also randomly selected for the measurement of the farmers awareness programme impact based on gain in knowledge. Data were collected for the evaluation of planning, characteristics of booth leaders and farmers and the training impact on the participating farmers. Thet- test (paired observation formula) was used to determine any significant difference between the pre and post exposure knowledge scores of the participating farmers. The results showed that most of the farmers at the awareness programmewere middleage, between 30-50 years with about 60% of them being literate. Certain aspects of

the organization of the farmers training rated as satisfactory include the selection of the participants, time of they earthe training came up and transportation. However, food and publicity aspects were ratedun satisfactory. This study also showed that there was significant difference in the knowledge scores on Gramin Krishi Mousam Sewa of farmers before and after participation in the awareness programme.

PP-3-14
Socio-economic characteristics of selected Naga tribes – A comparative study between Angami and Ao

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The Naga people are an ethnic group conglomerating of several tribes native to the North Eastern part of India and north-western Burma. As of 2012, the state of Nagaland officially recognizes 17 Naga tribes. Among them, Aos and the Angamis are the major tribes as per the statistics and characteristics. Most of the tribal communities are devoted to avocation like hunting, fishing etc., along with farming. So, the broad objective of this study was to study different Personal and Socio-economic characteristics of the selected population as well as to make a comparison between them. Specifically, the Study described the Personal and Socio-economic characteristics of these tribes and required intervention to sustain and enhance their livelihood. Accordingly, the study was conducted for these two communities namely Angami and Ao. The area of study was Kohima and Mokokchung districts of Nagaland. The data was collected by interview method with the help of structured and pre tested interview schedule. It was found that the Ao tribe accounts for low level of able population in the families compared to Angami families. Further, the study confirmed that the Ao tribes possess better level of education and organisational participation compared to Angami tribes but possess low land holding compared to Angami tribes. However, interestingly both tribes are very much inclined towards rituals and social networks. It was also observed that the Angami and Ao tribes face different levels of livelihood vulnerability which can be well explained through their Personal and Socio-economic characteristics. Hence, the study provides a ground for conducting further research on vulnerability of their livelihood system and different livelihood threatening factors in relation with their different characteristics. As of now, to sustain and enhance the livelihoods, the policymakers need to study these characteristics in order to identify and facilitate appropriate interventions that foster their asset building, improve institutional capacity as well as build social capital. It is also recommended that government should invest more funds in agriculture as these tribes are very much involved with farming in order to develop the sector and make it attractive to graduates of agriculture.

PP-3-15
Status of NTFPs from buffer zone of the Kanchandzonga Biosphere Reserve, Sikkim, India

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Non-Timber Forest Products (NTFP's) have always been and will continue to be an important element of the forests resources for uplifting economic conditions of the dependent communities. Like other Himalayan regions, Sikkim Himalayas is also having significant diversity of flora and

comprising of different life forms like herbs, shrubs, trees and other micro flora which provide diverse types of NTFPs. The present study reports some of the NTFPs from buffer zone of Kanchandzonga biosphere reserve Sikkim. The data was collected in the year 2016 by taking personal interview using questioner method. The present study recorded 96 numbers of NTFPs from the study area. NTFPs like wild vegetables, fodder, fuel wood, medicinal, mushroom and fruits. Among all the reported NTFPs, utilization the medicinal plants was found highest with 20 species followed by fodder 18 species, fuel-wood 15, wild vegetables 12, mushroom 11, wild fruits 10 and bamboo/canes 10 respectively. The study revealed that villagers are well aware of collecting seasons and use of specific products of many NTFP species. However, the knowledge and conservation practices of these NTFPs need to document for future generations and sustainable development.

PP-3-16
Low Glycemic index rice-an alternative for people with Type 2 diabetes

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Rice is a staple food for millions of people and having great importance in food and nutritional security. In Indian food and livelihood security system, rice occupies a pivotal role providing about 75 percent of calories and 55 percent of the protein in average daily diet of the Indians. But in cultures that consume a lot of rice, it is also a contributor to excess carbohydrate in the diet causing our modern day health woes, of obesity and decision associated with ageing.India is at the top of the diabetes projections list with a massive 87 million people to be effected by 2030. The glycemic index (GI) is a ranking of carbohydrate foods from 0 to 100 based on how quickly they raise our blood sugar levels compared to a reference food. Generally food with GI of 55 or less are considered low (good), while values of 56 to 69 are medium and those 70 or higher (bad). Low GI rice could help to “keep diabetes at bay” by slow digestion and absorption rates in the body, causing a gradual and sustained release of sugar in the blood. 235 varieties of rice were evaluated by investigators from the International Rice Research Institute (IRRI) and Australia ‘s Commonwealth Scientific and Industrial research Organization (CSIRO) Food Future Flagship and discovered that the GI values ranged from 48 to 92 which indicate people with diabetic have healthful options when it comes to choosing rice as part of their diet. India’s most widely grown rice variety Swarna have low GI and varieties like Doongara from Australia and Basmati have medium GI. Indian Institute of Rice Research under the aegis of Indian Council of Agricultural Research has identified three rice varieties with low GI values-Lalat , BPT 5204 and Sampada GI - 51 It is a high time to develop more varieties of rice with low GI values and thus expand the options for people with type 2 diabetes.

PP-3-17

Residual fate of glufosinate ammonium 13.5 % SL on physico-chemical properties and microbial populations of soil in tea (*Camellia sinensis* L.) plantation

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Tea is one of the most popular, low cost beverages in the world and in India it has witnessed a many fold increase in production, which is mainly attributed to efficient and integrated agricultural practices including efficient weed management practices. Residual fates of glufosinate ammonium 13.5 % SL on soil physico-chemical properties and microbial populations in tea (*Camellia sinensis* L.) plantation was conducted at Cooch Behar Tea estate, West Bengal during kharif season of 2015.The experiment was investigated through a randomized block design (RBD) with three treatments and seven replication. Imposed treatments were T_1: glufosinate ammonium 13.5 % SL @500 g a.i./ha, T_2: glufosinate ammonium 13.5 % SL @1 kg a.i./ha and T_3: Weedy check (Untreated). Experiment showed that none of the treatments have any adverse effect on soil physico- chemical properties like bulk density (BD), water holding capacity (WHC), pH, Electrical conductivity (EC), Organic Carbon (OC) available N, P and K. But there was slight reduction in available N, P and K which was actually due to crop removal or uptake. Again, the effect of herbicidal treatments on post emergence application to control weeds in Tea plantation did not have any harmful effects on microbial population (i.e. bacteria, fungi and actinomycetes) of soil.

PP-3-18

Bio-efficacy of Bispyribac acid 40 % SC against weed flora in Rice (*Oryza sativa L*)

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The experiment was conducted at Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India to study the bio-efficacy of bispyribac acid 40 % EC against weed flora in Rice (*Oryza sativa*) during 2014-15 to 2015-16. The experiment was laid out in Randomized block design with seven treatments and replicated thrice. Treatments comprises T_1=Bispyribac acid 40% SC @ 17.5 g ai/ha, T_2= Bispyribac acid 40% SC @ 35 g ai/ha T_3= Bispyribac acid 40% SC @ 52.5 g ai/ha T_4= Bispyribac acid 40% SC @ 20 g ai/ha T_5= Azimsulfuron sodium 10% SC @35.0g ai/ha T_6= Untreated control and T_7= Bispyribac acid 40% SC@70gai/ha. The result from the experimental trial revealed that the weeds flora in rice were controlled effectively by applying Bispyribac acid 40 % SC at dosages ranges from @ 17.5 to 52.5 g a.i./ha, which were statistically superior to the standard checks Bispyribac sodium 10% SC@ 20 g a.i./ha and Azimsulfuron sodium 10% SC @ 35 g a.i./ha. Significant increase in grain yield and straw yield was obtained by application of Bispyribac acid 40 % SC at the tested

dosages ranges from @ 17.5 to 52.5 g a.i./ha in comparison to the untreated control & standard check.

No phyto-toxicity symptoms were observed in any of the doses of Bispyribac acid 40 % SC including double the recommended dose and hence, it can be used safely at the recommended rate in rice for effective weed management. Economic analysis revealed that Bispyribac acid 40 % SC @ 52.5 g a.i./ha (T_3) fetched highest net return and benefit cost ratio during both the years of experimentation.

PP-3-19

Standardization of organic practices of *Acorus calamus* in Hill region of West Bengal

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The increasing demand for medicinal crops cultivation in the recent-past focuses on evaluation, identification and large-scale cultivation of some promising medicinal plants in hilly region of West Bengal. *Acorus calamus* is a medicinal plant grown for its several medicinal uses in ayurveda. Calamus is used as reliever of toothache or headache, as disinfect for teeth etc. Its demand is increasing day by day. Thus, a field experiment was conducted to study the best source of treatments for greater yield potentiality, insect pest resistance and better soil health for *Acorus calamus* cultivation at Reigional Research Station (Hill Zone), UBKV, Kalimpong during 2015-16. Eight sources of nutrient treatment (Control, FYM, Vermicompost, Neem cake and RDF as inorganic) were taken for the study. Fully Inorganic source of nutrient showed more yield in terms of leaf (0.78 t/ha), rhizome (0.85 t/ha) and root (0.59 t/ha) dry weight than organic sources. Among organic treatments Neem cake (2.5 t/ha) and Vermicompost (7.5 t/ha) showed at par rhizome yield (0.83 and 0 .63 t/ha respectively). Percent increase or decrease of N, P_2O_5 and K_2O in soil was noted and it showed that neem cake (2.5 t/ha) treatment increases the N availability and Vermi compost (7.5 t/ha) increase the P_2O_5 availability in the soil after one year of cultivation. No incidence of insect pest was observed during the period of study.