

## KEY NOTE AND SPECIAL ADDRESS

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### KN-01

#### **Doubling Farmer's Income: Is It a Paradox or Possibility**

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India today is not only self-sufficient in respect of demand for food, but is also a net exporter of agri-products occupying seventh position globally. It is one of the top producers of cereals (wheat & rice), pulses, fruits, vegetables, milk, meat and marine fish. India's agriculture production accelerated post 2000. During last decade, horticulture and livestock segments have become the drivers of growth. India stands 1<sup>st</sup> and 2<sup>nd</sup> in terms of milk and fish production, respectively. Since mid-1960s India witnessed almost doubled population growth with the food production multiplied to a tune of 3.7 times. However, about 22.50 per cent of the farmers live below official poverty line. The average income of an agricultural household during July 2012 to June 2013 was as low as Rs. 6,426, as against its average monthly consumption expenditure of Rs.6,223. Farmers own land. Land is a powerful asset. And, that such an asset owing class of citizens has remained poor is a paradox. They face the twin vulnerabilities of risks & uncertainties of production environment and unpredictability of market forces. Agriculture when defined as an enterprise comprises two segments – production and post-production. The success of production as of now amounts to half success, and is therefore not sustainable. Farmers' income also remained low in relation to income of those working in non-farm sector. Low income of farmers and its fluctuations has been a major source of agrarian distress. A sharp acceleration in present growth rate is needed in order to achieve a rate of 10.41 per cent annual growth rate by year 2022-23 and this can be done by harnessing every possible source of farmer's growth. For doubling farmers' income five major sources of growth can be identified within agriculture sector viz. improvement in crop productivity, improvement in livestock productivity, resource use efficiency or saving in cost of production, increase in cropping intensity, and diversification into high value crops. Drastic shift in dietary demand is seen at present due to higher per capita consumption, urbanization and Indian diet has evolved to be "lacto-vegan" because of accelerated dairy products, vegetables, fruits, eggs, vegetable oils, sugars, fish and meat while it has decelerated for staple food grains. Emerging game changers are found from farm sector where consumer expenditure comprises of cereals with 21% and from non-farm sector comprising dairy products & eggs (21%), fruits & vegetables (34%). This indicates that more than 50% of food production is from non-farm sector. So policy level planning should consider this preference of consumer expenditure on food to

enhance farmer's income. The sources of growth in output and income can be put in four categories – development initiatives including infrastructure, technology and innovations, policies and institutional mechanisms. In order to double farmer's income from agriculture by 2022, agricultural production has to be consumption driven focusing on marketing. Adequate attention needs to be given to increasing the income of the half of India's population to improve the livelihood of those who feed the nation. Enhancing farmers' income would bridge the gap between farm and non-farm income and alleviate agrarian distress.

**Key Words:** Farmer, Income; Doubling; Paradox; Farm; Productivity; Economy

## **KN-02**

### **Doubling farmer's income vis-à-vis Achieving Food and Nutritional Security: are they mutually inclusive– the Indian Experience**

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Sustainable agriculture focuses on a production system with low energy inputs having minimal effects on the environment thus conserving the natural resource base and promoting biodiversity. Indian soils are versatile with varying soil nutrients. Future of agriculture will depend on judicious use of natural resources. Diversification of agriculture by different farming enterprises will boost the farmers to achieve the food and nutritional security while simultaneously doubling the farm income. Scientific crop husbandry involves appropriate crop rotation involving cereals, legumes and other crops. Those crops and varieties along with package of practices that require low inputs are less risky and resilient to climate change with high water use efficiency should be given priority. The crops which fix atmospheric nitrogen and improve soil fertility should be given preference. Package of practice should rely on bio fertilizer, vermi compost, organic manure, bio-waste and bio-pesticide. Crop diversity will not only contribute towards food security but also nutritional security by diversification of the food sources like cereals, pulses, nutri - cereals, oilseeds, fruits and vegetable along with livestock and fish. Areas which using less fertilizer particularly hilly and tribal areas could be easily converted into organic mode of farming which will add value to the produce with better returns to the farmers for doubling farmers' income. Regarding this, an Inter-ministerial committee has recommended seven source of income through growth like improvement in productivity of crops, livestock and increase in cropping intensity, diversification towards high value crops and improvement in real prices received by farmers, shift from farm to non-farm occupation during off season.

**Key words:** Sustainable agriculture, Food security, Farm diversification, Farmer income

## LEAD LECTURE AND ORAL PRESENTATION

### Technical Session-1

## Climate Change Resilient Smart Farming for Doubling Farmer's Income and Environmental Impact with Socio-Economic Issues

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### TS1LL1

#### Year Round Production Technology of Tropical and Subtropical Orchids

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The orchids have taken a significant position in cut flower industry due to its attractiveness, long shelf life, high productivity, right season of bloom, easy in packing and transportation. Orchid accounts for a large share of global floriculture trade both as cut flowers and as potted plants and is estimated around 10% of international fresh cut flower trade. The value of fresh cut orchids and buds trade during 2007-2012 with the average trade value was US \$ 483 million. In 2012, there are more than 40 exporting orchid countries and 60 importing orchid countries around the world, and the total size of the global trade is US \$ 504 million. The Netherlands is the top most orchid exporting country (39.67%) followed by Thailand (28.41%), Taiwan (10%), Singapore (10%) and New Zealand (6%), respectively. Importing countries are mainly Japan (30%), UK (12%), Italy (10%), France (7%) and the USA (6%), respectively. The total orchid cut flower trade of the world mostly consists of 85% *Dendrobium* species and 15% *Phalaenopsis* and *Cymbidium* species and Asia is the main source of orchid to enter the world. In India, some of native genera like *Cymbidium*, *Paphiopedilum*, *Vanda*, *Arachnis* and *Dendrobium* are cultivated on a large scale for cut flower production. The *Cymbidium* is mainly grown in cool summer and heavy rainfall areas of Sikkim, Darjeeling hills and Arunachal Pradesh. Tropical orchids are cultivated in Kerala and some parts of Tamil Nadu, Karnataka and Maharashtra. In Himalayan region, tropical and subtropical orchids can be grown round the year with selection of suitable species and hybrids.

**Key words:** Orchids, Tropics, Cut flowers

## **TS1LL2**

### **Doubling the Farmers Income through Horticultural Innovations**

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The horticulture sector is considered as the most dynamic and sustainable segment of agriculture in India. It covers pre- and postharvest management of a wide spectrum of crops, including fruits and nuts, vegetables (including potatoes), flowering and aromatic plants, tuber crops, mushrooms, spices, plantation crops, edible bamboos etc. A consistent, high quality and quantity of production is needed using the natural assets available; innovations and technologies that make horticultural production smarter and more efficient are essential. Technical knowledge shared about amongst others integrated soil fertility and pest management, vegetable breeding, nursery raising, bee pollination and greenhouse technology. Reducing post-harvest losses and enabling profitable trade in fresh produce requires good practices and strategies for processing, aggregation, transport and storage. Nonetheless, innovation research has been marginalized by horticultural and agricultural scientists in Germany in the past. Recently, changes in agricultural and horticultural knowledge and innovation systems have been reported worldwide. Yet, it is unclear, if and how these changes have influenced the way innovations are being brought about in the sector and among actors. When conditions are not suitable for storage or immediate marketing of fresh produce, many horticultural crops can be processed using simple technologies, for the innovations in processing fruits and vegetables into marketable juices, jams and other products.

**Key Words:** Horticulture, Innovations, Processing, Value-Add, Food

## **TS1LL3**

### **Approaches towards Doubling Farmers' Income with special attention to Bridging Yield Gap and Resilience to Recent Climate Changes**

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The Indian economy is largely agrarian, with around 55% of the population dependent for their livelihoods on agriculture and allied sectors that generate 15% Gross Value Added (GVA). Unfortunately, farming in India turned non-profitable over time due to rising costs and uneconomical holdings. Therefore, keeping in view these facts, the Union Budget 2016-17 stated

to double the income of farmers by the year 2022. The growth rates in income of farm households across major states of the country varied from 6.71 per cent in West Bengal to 17.48 per cent in Haryana in the period between 2002-2003 and 2012-2013. Income doubling time is 8 to 11 years for states like Assam, Bihar, J&K, Jharkhand and West Bengal. Several approaches have been proposed that can surely double farmers' income within the given time period if maintained properly. Some major approaches include (i) Increasing crop yield- that can be obtained by (a) bridging yield gap through reducing water shortage, proper supply and use of inputs and by (b) biotechnological approaches that involve crop and livestock production by enhancing yields, nutritional profile, stress tolerance and crop protection and also GM crops; (ii) Water Resource Management for enhancing farm incomes through irrigation schemes like Integrated Watershed Management Programme (IWMP) (iii) Giving special focus on dryland areas- adopting rainwater harvesting and storage; (iv) Reduction in Cost through (a) Smart nutrient management by implementing soil health card programme to all parts of India, (b) Low input agriculture- possible through organic farming, sustainable agriculture and precision farming, (c) Integrated Farming System, (d) Stabilizing Income and Risk Management through mixed farming, sharecropping etc. Recent climate changes will have severe negative impacts on crop and milk production by 2050. Climate change resilience can be possible through developing drought- and high temperature stress tolerant crops with the help of biotechnology and giving concern towards more cultivation of millets that can assure higher income by producing additional amount of 48 million tonnes of millets within (3-4) years only.

**Keywords:** Doubling farmers' income, Integrated Farming System, Resilience

## TS101

### **Production of Quality Jute (*Corchorus olitorius* L) Fibre through Deployment of Improved Microbial Retting Method by the Farmers of Dakshin Dinajpur**

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Dakshin Dinajpur is a smaller rural district (86% village population) of West Bengal and economically backward due to fragmented land holdings and over dependence on age-old agricultural practice (as no major industry prevailing) leading to lower productivity. The farmers of the important jute growing three blocks namely Tapan (big), Kumarganj (medium) and Hili (small) blocks of Dakshin Dinajpur follow traditional jute retting practice characterized by use of mud and banana pseudo stem as weighing material which results low quality jute fibre even after following somewhat good agronomic practices. Such low quality jute fibre fetches fewer prices in the market and thereby farmers get lower return from jute cultivation even with medium fibre yield. With an aim to get better quality jute fibre, improved microbial retting technology using 'CRIJAF Sona' was introduced among the jute farmers of the studied three blocks of Dakshin Dinajpur. In this technology, an improved microbial formulation (popularly known as CRIJAF Sona) which is a consortium of three different strains of *Bacillus pumilus* bacteria was used. This improved retting technology could able to complete the jute retting within 11-13 days, which was about 6-8 days less than the conventional jute retting method. The resultant jute fibre was tested for fibre strength, fineness and other quality parameters following standard procedure. The jute fibre so obtained was at least 1-2 grade higher and the farmers earned additional amount of Rs. 1350 per bigha (i.e., Rs 10,090/ha) by selling the quality fibre in the local market over conventional method of retting. Analysis of the farmers' feedback data revealed that about 90% of the farmers were satisfied with the efficiency and ease of the improved retting technology.

**Key words:** Jute, Microbial retting, *Bacillus pumilus*

## **TS102**

### **Estimation Potential Evapotranspiration using Temperature and Radiations based Methods in Agro-climatic Zones of Chhattisgarh**

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Precise estimation of potential evapotranspiration (PET) is essential for the judicious use of available water resources for agricultural purpose. In order to choose a proper method for the estimation of PET under different climatic condition it is required to evaluate the performance of different PET estimation methods with the available climate data. In the present study PET values were estimated using temperature and radiations based methods in the three agro-climatic zones viz, Chhattisgarh plains, Baster plateau and northern hills spreading over a geographical area of 13.6 million hectares of Chhattisgarh. Daily weather data on temperature, humidity, wind speed, sunshine and evaporation was collected from Raipur, Jagdalpur and Ambikapur and used for the analysis. Computer software PET Calculator V3.0, developed by AICRPAM, CRIDA, and Hyderabad was used for this study to estimate PET on daily, weekly and monthly basis. Analysis showed that the pattern of weekly and monthly PET is different for the methods of computation. This is because of the changes in the weather pattern in three different Agro-climatic zones. Highest annual PET was observed for Raipur followed by the Ambikapur and Jagdalpur in Chhattisgarh. It was also observed that the computed values of PET by both the methods were at higher side when compared to the pan evaporation data. Although the estimated values by the Thornthwaite method found to be at higher at Jagdalpur and Ambikapur as compared to Hargreaves method under investigation.

**Key words:** Potential evapotranspiration, PET Estimation Methods, PET Calculator V3.0

## **TS103**

### **Livestock Based Integrated Farming System for Sustainable Development**

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Farmers maintain different enterprises of complimentary and supplementary nature to ensure sustainable livelihood. Integrated Farming System (IFS) is a farming practice meant for all-round development of agriculture with animal husbandry and other occupations related to core agricultural practices. Since land holdings of farmers are declining due to population growth, the IFS can enhance farmers' income through a well-designed system. IFS is a type of mixed farming

system that combines crop and livestock enterprises in a supplementary and/or complementary manner. Integration generally occurs when outputs (usually by-products) of one enterprise are used as inputs by another in the farming system. The basic difference between mixed farming and integrated farming is that enterprises in the integrated farming system are mutually supportive and dependent on each other. The concept of integrated farming in India is as old as human civilization. There are several objectives of IFS approach viz., sustainability, food security, farmer security and poverty reduction. IFS play a vital role for sustainable development of farmers and farming community in Indian conditions. Several workers have reported that IFS mainly focusses at enhancing the income of small and marginal farmers by combining many enterprises. The advantages of IFS involves enabling farmers to increase economic yield per unit area and per unit time, utilization of waste material from one enterprise as input for other enterprise, source of balanced food for farmers, provides income round the year, employment to farmers' families and increased input efficiency. Earlier integrated farming system was limited to the crop-livestock farming system but with the advancement of time for sustainable farming system, more enterprises like poultry, fishery, bee keeping, horticulture, silviculture were incorporated. It could be integration of crop-fish or livestock-fish or crop-fish-livestock or any combinations of crops, livestock, fish and other enterprises. Studies have indicated that agriculture and livestock based farming systems (dairy, poultry and sheep rearing) generated more employment over arable farming. Net income was found to be higher in agriculture-dairy farming followed by agriculture-poultry farming and agriculture-sheep farming. The present paper discusses the importance of Integrated Farming System and its applicability for sustainable development in agriculture.

**Key words:** Livestock, Integrated Farming System, Sustainable Development

#### **TS104**

### **Sugarcane Bud Chips for Seed Multiplication and Seed Crop Management through Seed Certification Standard for Production of Quality Seed Cane in West Bengal– An Overview**

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Sugarcane (*Saccharum sp.* hybrid complex) is a tropical plant and the juice extracted from sugarcane is used for making white sugar, brown sugar (*Khandsari*) and Jaggery (Gur). In West Bengal, Sugarcane is mainly produced to make Gur (Jaggery). In addition to that Sugarcane has high demand for Juice and other purposes. Sugarcane is cultivated conventionally through 3-budded setts in different districts of West Bengal. Sugarcane bud

chip technology is relatively less expensive, labour, 6-8 weeks time saving and reliable method for seed cane multiplication. Sugarcane Bud Chips Methods and seed crop management as per seed certification standard can produce high quality seed cane which ultimately harness the varietal potential and ultimately achieve the sustainable sugarcane production in West Bengal.

**Key words:** Sugarcane Bud Chips, Seed Crop Management, Certification, Quality Seed Cane

## **TS105**

### **Economics Analysis of Rice Seed Production in Terai Zone of West Bengal**

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The study attempted to analyse the economics of rice seed production and evaluated the financial viability with the primary data collected purposively from 28 sample seed growers distributed over two most promising blocks viz. Cooch Behar – II and Sitalkuchi of Cooch Behar district and Maynaguri block of Jalpaiguri district of Terai zone of West Bengal during 2016-17. Tabular analysis was extensively used and standard concepts of 'cost' and 'return' were employed to judge the economic viability of the cropping venture. Different farm efficiency measures were also used. Simple statistical tools like mean, geometric mean, regression etc. were also used. From the socio-economic study of sample seed growers it was observed that average age of them was below 45 years with average family size of 4.93. About 68% of the seed growers were belong to SC and ST community and around 50% farmers had the education of secondary onwards. 78.57% seed growers practiced seed production to their own land and 46.42% seed growers generate income solely from farming activities. The seed growers had about 5 years of seed production experience mainly provided by the Agril. University and KVK. The major varieties used for seed production were MTU-1153, MTU-1075, SS-1, MTU-1121, MTU-1210, J.B-1, and J.B-3. The average Net Cropped Area of the seed growers was 4.28 acre of which 47.83% used for seed production purpose. From cost and return analysis, it was examined that the average total variable cost of cultivation (Rs/acre) was Rs 22074.83 and Rs 20953.37 respectively for seed and general production and the share labour cost revealed 45 - 50%. The net income (GI-Cost C3) in Rs/acre revealed Rs 8556.73 and Rs 5161.77 for seed and general production. Although the cost of cultivation was found higher in seed production than general production process but the cost production was lower in seed production (Rs 1417.65/ql) than general production process (Rs 1452.22/ql). The evaluated input-output ratio (based on Cost C3) for seed production of rice found 1:1.29. The overall contribution of different resources to

the variation of income found 53% ( $R^2= 53.28$ ) for seed production. The factors viz. seed, chemical and irrigation revealed significant at 5% level each. The calculated Marginal Value Product (MVP) and Resource Use Efficiency (RUE) were found positive for all resources viz. seed, organic fertilizer, Inorganic fertilizer, agrochemical and irrigation except human labour for seed production. In respect of marketing of seed, two types marketing channel were identified. Garret's ranking showed that low price of output, shortage of labour, high price of input, disease and pest attack and availability of credit were the important constraints for seed production. Though seed production is flourishing in India, but to meet the demand of food grains particularly rice for growing population of the country as well as the to increase surplus production to export, to increase the availability of proper quality seed, the production potential of seed at the farmers level is to be enhanced through different governmental agency and schemes with proper infrastructure, guidance and training facility.

**Key words:** Economic analysis, Rice seed production, Terai Zone, West Bengal

## TS106

### **Evaluation of some Indigenous Technical Knowledge (ITK) Practices against *Scirtothrips dorsalis* Hood and *Myzuspersicae* Sulz in Chilli under West Bengal**

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An experiment was conducted to evaluate the efficacy of different Indigenous Technical Knowledge (ITK) practices along with one insecticidal treatment against *Scirtothrips dorsalis* Hood and *Myzus persicae* Sulz infesting chilli during rabi season of 2012-2013 at A/B block farm, Kalyani. All the treatments were effective in reducing the population of *Myzus persicae* Sulz and *Scirtothrips dorsalis* Hood at 3 and 7 days after application (DAA) except the untreated control (UTC) plots. Imidacloprid 17.8% SL @ 0.3 ml/ litre of water performed the best in comparison to ITK practices and recorded lowest number of aphids/leaf (0.31) which was followed by 3 % NSKE (0.44) and 3 % Panchagavya solution (0.53) which were statistically on par with each other. Likewise, 100% mortality of thrips was observed in imidacloprid 17.8% SL at 7 DAA which was followed 3 % NSKE (0.35) and 3 % Panchagavya solution (0.57).

**Keywords:** Indigenous Technical Knowledge, Chilli, *Scirtothrips dorsalis*, , *Myzus persicae*, NSKE, Panchagavya

## **TS107**

### **Validation of Targeted Yield Equation of Lentil in Farmers' Field of Gangetic Alluvium Soil of West Bengal**

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A study was conducted in farm of ICAR-CRIJAF, Barrackpore of West Bengal for developing targeted yield equation of lentil. A fertility gradient was created by growing exhaust crop maize using different doses of fertilizer and different seed rates. After harvest of fodder maize soil samples were tested which clearly showed the creation of fertility gradient. After creation of fertility gradient, lentil was grown as test crop in all the three strips. Lentil grain yield and pre lentil soil test values were recorded. Nitrogen, phosphorus and potassium uptake by lentil was estimated. From lentil grain yield, soil test values and nutrient uptake by lentil, nutrient requirement (NR) to produce one quintal of lentil, percent contribution from soil (% CS), per cent contribution from fertilizer (% CF) & percent contribution of nutrients from organic matter (% COM) were estimated. Targeted yield equation of lentil was derived on the basis of these parameters. The targeted yield equation for lentil was verified at farmers' field. Verification trials were conducted in the farmers' field of Nadia district, West Bengal. Result showed that targeted yield equation of lentil was achieved with some yield deviation. Grain yield of lentil targeted yield based fertilizer application was higher than the farmers' practice. Higher net return and improved B: C ratio was observed under STCR approach.

**Keywords:** Validation, STCR, Targeted yield equation, Lentil

## **TS108**

### **Krishi Kalyan Abhiyan - Boosting Farmers for Doubling Income**

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A new scheme "Krishi Kalyan Abhiyan" is an initiative by Govt. of India for doubling the farmer's income by 2022 and also fulfills the needs of farmers in saturation mode. Among the various activities undertaken in 25 villages, the standard deviation values and mean values recorded in 100 % eradication in sheep's (PPR) (2144.92 & 2452.76), distribution of Mini kits Greengram var. IPM-2-14 (411.28 and 504.00), Soil health cards (276.88 & 451.28) and artificial insemination saturation (5.19 & 150.80) and 100% bovine vaccination (FMD) (375.25 and 640.44),

respectively. Moreover, there are no statistical differences were observed in case of horticulture plants distributed, training programmes organized on Bee keeping, Mushroom cultivation, Kitchen gardening, making of NADEP compost pits and demonstrations on micro-irrigation and integrated cropping practices. Therefore it could be concluded that deviations rose with respective to the individual components doesn't required considering while ranking the performance of this scheme in a holistic manner.

**Key Works:** Krishi Kalyan Abhiyan, Doubling farmer's income

## **TS109**

### **Agricultural Planning through Prediction of Rainfall Characteristics for Bilaspur Region of Chhattisgarh Plain in India**

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The knowledge of total rainfall and its distribution pattern round the year of a place is very important for better crop planning, determining irrigation and drainage requirement of crops, design and construction of soil and water conservation structures. In rain-fed agriculture, the total amount of rainfall as well as its distribution affects the plant growth. In view of this, an attempt has been made to evaluate rainfall distribution patterns i.e. weekly, seasonal and annual rainfall, based on 12 years (2001-2012) data of Bilaspur, Chhattisgarh in the year of 2014 at BRSM College of Agricultural Engineering and Technology, Indira Gandhi Krishi Vishwa Vidyalaya, Mungeli, Chhattisgarh. The analysis showed that amongst various weeks of monsoon season, the 26th week received highest rainfall amount equal to 362.8 mm. However, average rainfall as 102.7 mm was found to be highest for 26th week. From the monthly rainfall analysis, it was found that maximum value of average monthly rainfall (340.4 mm) and minimum value (2.2 mm) were recorded in the months of July and December, respectively amounting to 28.26 % and 0.18 % of the average annual rainfall with CV of 50 % and 251 %, respectively. The annual average rainfall was computed as 1204.6 mm.

**Keywords:** Rainfall, Rainfall distribution pattern Crop planning, Irrigation, Rainfed agriculture

### **TS1010**

#### **Effect of Seasonality of Non-Timber Forest Products on the income of indigenous communities of a protected forest area in West Bengal, India**

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Non-timber forest products (NTFPs) contribute significantly to the income of the local communities living adjacent to the forest areas in India. However, the seasonal pattern of NTFPs collection and its effect on income have seldom been studied in sub-Himalayan region of West Bengal. This study examines the income from NTFPs and its dependency on the time spent on NTFPs collection in different seasons of protected forests of sub-Himalayan region of West Bengal, India. We conducted a survey by interviewing 107 households of forest dependent communities of Jaldapara National Park, West Bengal, India by following a structured questionnaire. Our analysis found that NTFPs significantly contributes to the household income of the local communities at the study area. However, majority of the households (65%) use NTFPs as subsistence (1-20% of their total income). In rainy season, although majority of the respondents (75%) spend 1 to 10 days for NTFPs collection, the time spent significantly influenced their household income. Although no significant effect on household income, majority of the respondents (75.7%) spent more time (11-30 days) on NTFPs collection in the winter season. These findings suggest that NTFPs are significant source of income but their effect on income and time spent in collection varies according to the season.

**Keyword:** NTFPs, Protected area, Livelihood, Traditional uses

### **TS1011**

#### **Response of Bedding Medium on Production of Flowering Anthurium (*Anthurium Andraeanum* Lind)**

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Eleven different growing media namely Sugarcane Bagasse, Charcoal, Coconut Husk, Sand, Wood Chips, Saw Dust, Cinder, Soil, Soil (½) + Sand (¼) + Charcoal (¼), Equal parts of Soil + Sand + Wood Chips + Charcoal + Sugarcane Bagasse + Cinder and Equal parts of Soil + Sand +

Coconut Husk + Charcoal + Wood Chips were tried on flowering anthurium (*Anthurium andraeanum* Lind.) and their effect on growth, development and flowering were studied. Bedding medium containing equal parts of soil, sand, wood chips, charcoal, sugarcane bagasse and cinder produced highest number of side-shoots per plant (4.33) and sugarcane bagasse alone produced lowest number of side-shoots (1.70) per plant. Plants grown on sand reached the Flower Bud Initiation (FBI) stage earliest (273.33 days) whereas, soil culture showed the most delayed FBI (328.33 days). Spadix visible (SV) stage from FBI was found earliest in sand culture (26.33 days) and the plants grown on cinder reached the SV stage last of all (41.83 days). Earliest blooming from SV stage was recorded with plants grown on sand (5.83 days) and the delayed effect was noticed with saw dust (8.50 days). Maximum *in-situ* longevity of flowers was recorded with plants cultured on sand (33.33 days). Field-life was found lowest with the plants cultured on cinder (23.50 days). Highest number of flowers per plant (3.33) was derived from sand culture but plants cultured on sugarcane bagasse and wood chips produced lowest number of flowers per plant (1.67). Longest stalks were obtained from the plants raised on equal parts of soil, sand, coconut husk, charcoal and wood chips (15.23 cm) but the shortest stalks were obtained from the plants grown on saw dust (10.68 cm). Longest spathes were noticed with the plants cultured on sand (6.46 cm) and the shortest spathes were noticed with cinder (4.92 cm). Sand as a bedding medium produced widest spathes of Anthurium (6.17 cm) and narrowest spathes were obtained from coconut husk grown plants (3.73 cm). Longest spadix was observed with the plants grown on equal parts of soil, sand, coconut husk, charcoal and wood chips (4.13 cm), on the other hand shortest spadix was seen in the plants grown on charcoal (2.83 cm). Spadix circumference was found highest with sand (1.28cm) and lowest with plants grown on coconut husk (0.83 cm). Post-harvest life of cut inflorescence was found highest (11.50 days) with the flowers grown on sand. Monthly leaf number, leaf length, leaf width and petiole lengths were fluctuated greatly with season and stage of crop growth. Sand and a mixture of equal parts of Soil, Sand, Coconut Husk, Charcoal and Wood Chips were found as better growing media for successful growing of anthurium in the plains of West Bengal.

**Key Words:** Anthurium, *Anthurium andraeanum*, Bedding medium

## **TS1012**

### **Biomass and Quality of Bajra Napier Hybrid Grass as Influenced by Irrigation and Nutrients under Light Textured Soils**

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The fodder crops are highly negligible crops for water and nutrients; hence the main objective of the study was to investigate the impact of irrigation water and nutrients on the performance of bajra Napier hybrid grass grown under light textured soil. The study was carried out at university Research Farm, Tamil Nadu Veterinary and Animal Sciences University, under light textured soils. The treatments consisted of irrigation treatments I1: drip irrigation at 100% potential evapotranspiration (PE), I2: drip irrigation at 75% PE and I3: surface irrigation, Nutrients: F1: Farm Yard Manure 25 t/ha + 50% RDF, F2: FYM 25t/ha + 100% RDF and F3:100% RDF alone. Cumulative irrigation water was calculated and applied as per the treatment schedule. Plant samples were analyzed macro nutrients and uptake of nutrients by plants were calculated. Chlorophyll content was estimated periodically. Plant vegetative growth and biomass contributing characteristics were measured to relate with irrigation frequency and nutrients. The leaf indicators like N, P and K had more influence on growth and biomass of plants. Irrigation through drip at 100 % PE maintained the moisture availability throughout the crop growth period. Highest leaf chlorophyll content (38.8 and 25.7) was obtained with application of 25 t Farm yard manure/ ha + 100 % recommended dose of nutrients and drip irrigation at 100% PE. The biomass was found higher with the application of 25 t Farm yard manure/ ha + 100 % recommended dose of nutrients and drip irrigation at 100% PE. Crude protein content had significant influence with nutrient and irrigation water application.

**Key words:** Bajra Napier hybrid grass, Irrigation, Nutrient, Biomass Soil

## **TS1013**

### **Impact of Agri-clinics and Agri-business Centers Scheme (ACABC) on Increasing Farmer's Income in Andhra Pradesh**

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Agriculture is the way of life and tradition of Indian economy and provides the underpinning for our food, livelihood security for the economic growth and social transformation of the country and

about 75 percent of population is dependent directly or indirectly on agricultural and allied sector. In the post-green revolution era, public extension found itself unable to meet changing demands of farming community. In view of this, the finance minister Government of India on February 28, 2001 announced a scheme for Agri-clinic and Agri-business Centers. Then NABARD has formulated a model scheme for financing agriclincs and agribusiness centers in consultation with ministry of agriculture and selected banks. While MANAGE identified 66 training institutes throughout the country for importing training to agri-graduates. The scheme of Agri-clinics and Agri-business Centers were launched on 9th April, 2002 to strengthen the transfer of technology and quality of paid extension services to farmers in India and also provide self-employment opportunities to technically trained persons. This study has evaluated the extent to which the scheme in Andhra Pradesh has been successful in augmenting farmers' income through crop and allied activities. The study has found a positive impact of ACABC Scheme in Andhra Pradesh as the significant reason which made beneficiaries in order to know high value per annual crops with respect to higher area allocation intern significance higher income, however some aspects like good cultural practices, better productivity, good quality and high value output, profitable price for output and consequently high number of returns that can be obtained from animal output. In the above study it has been proclaimed that the outreach of ACABC Scheme have to be increased so that farmers in huge number may access to their service and benefits in getting higher income and production management.

**Key words:** Agriclincs and Agri Business Centers, Farmers income, NABARD, MANAGE

#### **TS1014**

### **Feasibility Windows for Doubling Farmers Income and Relevance of DFS and SLA**

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The Prime Minister's dream declared on 28.02.2016 of doubling farmers' income by 2022 has become a farmer-centric agriculture policy-matter for the Govt. of India, and the **DFI** Committee and other government bodies, authorities, institutions, and experts are searching for and suggesting many prospective avenues or windows as probable enhancing tools and factors for attaining this target. The deliberations often comes out with suggestions of critical technical and economic concepts, eg, diversified farming systems (**DFS**) and Sustainable livelihood approach (SLA), which may not be readily comprehensible to the non-technical non-economist individuals. So, the basic matters, and the major recommended ways and approaches for DFI have been

accounted, with interpretations of the concepts DFS and SLA, in a manner intelligible to the commons.

**Key words:** Doubling farmers' income, Diversified farming systems, Sustainable livelihood

## **TS1015 Clean India Mission -An Overview**

L.C. De

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Clean India Mission-a biggest behaviour changecampaign ever with 30 states, 677 districts, 650,000 villages, 1.25 billion people, 550 million practiced open defecation at the start of Swachh Bharat Mission. On October 2, 2014, the Hon'ble Prime Minister launched the Swachh Bharat Abhiyan upon the idea of "A clean India would be the best tribute the country could pay to Mahatma Gandhi on his150th birth anniversary in 2019." With the primary objective to reduce open defecation through the construction of individual, cluster and community toilets, the mission aims to achieve an Open-Defecation Free (ODF) India by 2<sup>nd</sup> October 2019 by constructing 12 million toilets in rural India, at a projected cost of Rs 1.96 lakh crore. Swachh Bharat Mission is a demand driven and community cantered programme emphasizing behavioural change of people. This requires community process as well as collective action by people,. However, the Ministry is endeavouring to achieve the objectives of Swachh Bharat by 2nd October, 2019 in coordination with State Governments. Sanitation Coverage as on 2.10.2014 was 38.7%. This has increased to 84.13 % as on 24.05.2018. 386 Districts, 3,578 Blocks, 1,62,688 GPs and 3,66,774 Villages have been declared Open Defecation Free (ODF) as on 24.05.2018. As on 24.05.2018, 17 States/UTs namely Arunachal Pradesh, Sikkim, Himachal Pradesh, Kerala, Gujarat, Rajasthan, Punjab, Uttarakhand, Haryana, Mizoram, Chandigarh, Chhattisgarh, Meghalaya, Dadar & Nagar Haveli, Daman & Diu, Maharashtra & A & N Islands have been declared ODF. There are around 3 crore households pending as on 1.4.2018, which are likely to be benefitted from this scheme in 2018-19. Mission is well on track to achieve an ODF India by 2<sup>nd</sup> October 2019.

**Key words:** India, Clean, Mission

## **TS1016**

### **Social and economic empowerment of farm men and women in strawberry based entrepreneurship for sustainable and doubling farmers income**

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Horticulture has emerged as an indispensable part of agriculture, offering a wide range of choices to the farmer for crop diversification. It also provides ample opportunities for sustaining large number of agro-industries which generate substantial employment opportunities; India is the second largest fruit producer of fruits in the world after China crop diversification towards high value crops with efficient recourses use practices offers a great scope for improvement in income of the farmers. Strawberries are good source of natural antioxidant and medicinal properties. Awareness about the production of the crop during Rabi season in subtropical conditions with planting material and production technology can make strawberry a successful crop in subtropical conditions. Strawberry varieties like Camarosa, Festival, Winter dawn, Sweet Charlie, Florina and Navila are performing well in Aurangabad district when planted in mid of September. On an average Sri Brij Kishor Mehta farmer of Aurangabad district earn net profit Rs 10,82,960 per annum during the year 2017-18 from 6 acre of cultivable land. He has expand his area up to 11 ha and also motivated other farmers and generated income for other farm men and women.

## **TS1017**

### **Role of Women Run Micro-enterprises in Increasing Farm Household Income and Empowerment**

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Rural women make substantive contributions to all the agricultural activities encompassing crop production, dairying, animal husbandry and fisheries. Their engagements are visible across the value chain. It must be appreciated, that they do this along with their responsibilities as home makers. Human labour is the most important resource in total cost of production in which women contributes nearly half of the total human labour. Women comprise 37 per cent of the agricultural labour force in India. Agriculture has been unsustainable particularly for small and marginal farmers in recent years. And, rural women's contribution in agriculture & farm household, and

their potential and prospects are overlooked. In this context, women can play very important role to make the agriculture more remunerative by opting the micro-enterprises. Women can become exemplary micro-entrepreneurs, only if their innate talents are made professional by training to link up with markets and credits, and meet the laid down standards. To make the rural women of farmers' households interested and ready to take up micro-enterprises, primary necessity is to motivate them with information on benefits including self income & family income rise and development of empowerment, us types of microenterprises to chose from; scopes of credit availability; Bank, Government and NGOs' programmes of assistance with loan, training, etc.

**Key words:** Rural women, Empowerment, Micro-enterprise, Entrepreneur, Farm Household income

## LEAD LECTURE AND ORAL PRESENTATION

### Technical Session-2

## Conservation, Sustainable Development, Crop Improvement and Management for Doubling Farmers Income

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### TS2LL1

#### Improved Seed for Ensuring Farmers' Doubled Income

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Occurrence of two consecutive drought situations in several zones leading to widespread distress among farmers necessitated a round table meet at India International Centre, New Delhi on April 30, 2016 to address the issues related to sustainable agriculture in context to changing climate, market and technological developments. Following that Indian Council of Food and Agriculture (ICFA) organized a national consultation involving top experts from different corners chaired by Dr. M. S. Swaminathan and co-chaired by the Secretary- Agriculture, Govt. of India, wherein it was stressed to double the farmers' income by 2022 through restructuring agricultural processes and policy interventions. It was felt that farmers' net income can be doubled well surely within the period of next six years. To double the farmers' income by 2022, it would require 15% compounded income growth rate, which is a marginal increase over the achieved one (13.7%). Relating to that Dr. Swaminathan stated that "If agriculture goes wrong, nothing else goes right" and "Younger people will join agriculture, if it is technologically driven". A total of 40 recommendations were made for such enhancement in farmers' income, which was classified into five groups, 'Increasing income by improving productivity' was the first and foremost one. Diversification in crop cultivation and use of improved seed play the vital role in enhancing farmers' income through improvement in productivity in conjunction with the advanced technological knowhow. Diversification towards high value crops can be handled smoothly through shifting of a portion of area under staple crops to that under high value crops (HVC). It is estimated that if the past trend in diversification is continued, 5% enhancement in farmers' income can be made possible by 2022-23. Use of improved seeds, both duly certified better class and enhanced quality through modern technologies viz., seed pelleting, coating, priming or production of synthetic seed, even through seed tape and seed mat, have been proved to enhance yield significantly and thereby directed to enhance farmers' income.

**Key word:** Improved Seed, Farmer, Doubled Income

## **TS2LL2**

### **Assessment of Small Scale Tea Cultivation as a Potential Component for Doubling Farmers' Income**

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Small tea growing system (STGS) is gradually emerging as a promising substitute for traditional crop production in North-Bengal areas of West Bengal. High return compared to other traditional crops and less risk of crop failure makes it more popular among the youth and small and marginal farmers. Limited works has been done on STGS in North-Bengal perspective. Present study was undertaken in Jalpaiguri and Uttar-Dinajpur as the most concentrated small tea growing districts in West Bengal. It was seen from the study that majority of small tea growers had shifted from food and other cash crops to tea for their livelihood. The higher profitability and prospects of setting a steady income with minimum efforts contributed to the growth of small tea growers. Youth could find a new avenue for good income in tea cultivation which incidentally suited their fancy and status consciousness. This study analysed the system from an agro-economic view point. It is seen from the study that maximum small tea growing farmers in North-Bengal were in a poor condition due to un-organized nature, low economics of scale, low bargaining strength, un-even distribution of bought leaf factories (BLFs) and absence of specified business linkage between bought leaf factories and small tea growers. The situation lead to low price realization for green leaf and unfair trade practices. The way to extract better livelihood from small tea is to raise collective voice and organized bargaining power which can only be achieved by establishing Self Help Groups.

**Key words:** Tea, Self Help Groups, Alternative farming, Integrated Farming System

## **TS2LL3**

### **Impact of Microcredit on Farmers Income**

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Timely and adequate availability of required farm inputs is must for agricultural development but investment capacity of majority of our farmers' is very low. So, lack of finance and its accessibility are one of the main reasons for low productivity and hence income of the farmers. Microcredit can thus play an important role in agricultural development. As per RBI master circular, 2008,

Microcredit is defined as provision of thrift, credit and other financial services and products of very small amount to the poor in rural, semi-urban and urban areas for enabling them to raise their income levels and improve living standards. Microcredit Institutions are those, which provide these facilities. In India, the concept of microcredit is as old as 3,000 years but it was in 70s that microcredit got popularity and became a “modern” phenomenon. Muhammad Yunus, a well-known Noble laureate gave it the most required international attention. Today we know microfinance is an economic development approach that involves providing financial services, through institutions, to low-income clients, where the market fails to provide appropriate services. The services provided by the Microfinance Institutions (MFIs) include credit, saving and insurance services. Many microfinance institutions also provide social intermediation services such as training and education, organizational support, health and skills in line with their development objectives. India has also channelized a huge fund to rural capital market as well as financial sectors to improve the accessibility of timely funds. Hence, there should not be any doubt that access to agricultural credit can definitely help to improve farmers' productivity and income. Report says still only a meager percentage of farmers avail credit from formal institutions and rest depend on informal sources. It may therefore be suggested that our policy makers should put more emphasis on educating farmers, designing better systems and create more financial outlets to encourage timely and adequate disbursement.

**Key Words:** Micro credit, Micro finance, RBI, NABARD, Farmers' income

## **TS201**

### **Agronomic Interventions for Enhancement of Productivity of Jute Based Cropping System in Dakshin Dinajpur District**

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Dakshin Dinajpur is a smaller district having only 2.5% of area and 1.83% of population of West Bengal. The district is economically backward; as there is no big industry and people's economy solely depend on agriculture and other smaller endeavours. Out of the total working population, 27.5% are direct cultivator and 39.8% are agricultural labourers, so more than 67% of the work force depends on agriculture for their livelihood. Jute (and kenaf) based cropping systems are the important agricultural element of the district. However, the productivity of most of the component crops is quite low as compared to state's average except in cases of paddy. This is due to practice of age-old cultivation procedure arising out of lack of awareness about the scientific agriculture. So to increase productivity of the jute based cropping system, 3 blocks of Dakshin

Dinajpur were considered based on their respective size, big (Tapan), medium (Kumarganj) and small (Hili) having 20.2%, 12.9% and 4.1% area of the district, respectively. Improved agronomic interventions for jute-paddy-mustard and jute-paddy-lentil system were implemented during the last four years (2014 to 2017) to enhance productivity of the crops. In jute, technologies like improved *tossa* variety (cv. JRO 204 or 'Suren'), line sowing deploying multi row jute seed drill, mechanical weeding by CRIJAF nail weeder, balanced nutrition (along with micronutrients especially Zn and B) and use of microbial retting formulation (CRIJAF Sona) were introduced. As a result, the jute fibre yield obtained were  $\pm$  50% higher (33.6 q/ha) in the farmers' participatory mode as compared to the farmers' own practice (22.4 q/ha). Profit from improved practice of jute was Rs 66,300/ha which was much higher than farmers' practice (Rs 8,028/ha). Unlike pre-intervened period, the jute crop totally escaped stem rot disease (*Macrophomina phaseolina*), might be due to application of Zn and B, generally deficient in the soils of Dakshin Dinajpur district. As the paddy productivity of the district (2.8 t in *Aus*, 4.2 t in *Aman* and 4.9 t in *Boro*) is very close to state's average (3.5 t for *Aus*, 3.9 t for *Aman* and 5.1 t for *Boro*) and the majority farmers are following at least partially improved technologies for paddy, so more improved technology was not added for paddy. After harvest of jute and paddy, farmers prefer to grow mustard in *rabi* season. To get higher productivity, improved production technology for mustard/ yellow sarson (*Brassica rapa* var. *trilocularis*) viz. certified seed cv. B 9, balanced fertilizer use - N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O @ 60:40:40 kg/ha and one irrigation at pre-flowering stage were deployed. By following the improved method, the farmer got at least 30.5% higher yield (1423 kg/ha) as compared to districts average yield (1091 kg/ha). In the other crop rotation (jute-paddy-lentil), during the *rabi* season improved cultivation practices for lentil (*Lens culinaris*) such as variety (cv. WBL-77 or Moitree), balanced fertilizer (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O @ 20:40:20 kg/ha) use produced about 1265 kg/ha and in economic term (NRPRI) it was even marginally better (1.33) than jute because of lentil's lower input requirement.

**Key words:** Jute, Cropping system, Agronomic Interventions, Productivity

## TS202

### System Productivity, Resource and Radiation Use Efficiency under Conservation Agriculture in Jute Based Cropping Systems

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Improving livelihood security and environmental conservation are the prime targets for innovative farming systems under present context of climate change scenario. Conservation agriculture

(CA), based on no or minimum tillage, crop residue retention and crop rotations has been proposed for climate smart agricultural practice so as to sustain agricultural productivity and resource conservation. Jute, being one of the most important fibre crops in Indo-Gangetic plains has tremendous scope for CA practice. It is eco-friendly, biodegradable and has much higher CO<sub>2</sub> assimilation rate which is creating an opportunity for the survival and growth of jute industry in the era of environmental concern. Study conducted to evaluate the effect of tillage systems i.e. conventional tillage and no tillage with or without crop residue retention (+R/-R) on system productivity, crop physiology, resource and radiation use efficiency and under most predominant jute based cropping systems (jute-rice-wheat, jute-rice-lentil and jute-rice-mustard). Tillage practices and crop residues alter the surface properties of soil affecting both shortwave albedo and long wave emissivity. Results after 3<sup>rd</sup> year of crop cycles showed that radiation use efficiency in terms of photosynthetically active radiation (PAR) was higher in no tillage in association with crop residue than conventional tillage. Similarly, the relative water contents (RWC; range: 73.9-88.3 %) and chlorophyll contents (SPAD; range: 7.8-16.2) are significantly higher in no tillage + residue treatment than conventional tillage in all crop rotations. Crop yields after 3<sup>rd</sup> year of crop cycle showed the jute equivalent yield (JEI) and system productivity, both under no tillage with residue are comparable than that under conventional tillage. The JEI among the cropping systems were in the order: Jute-rice-lentil (7.32 t/ha) > jute-rice-wheat (7.19 t/ha) > jute-rice mustard (6.75 t/ha). However, the production efficiency and land use efficiency among the cropping systems varied in between 0.028 to 0.034 kg/ha/day and 76.99 to 83.01 %, respectively, highest being in Jute-rice-wheat cropping system. Thus, tillage and residue management put forth a notable improvement in radiation interception, crop growth, yields and system productivity by modifying soil physical environment.

**Key words:** Jute, Cropping system, Productivity, Resource and Radiation Use Efficiency, Conservation Agriculture

### **TS203**

#### **Genetic Variability, Heritability and Genetic Advance for Yield and Yield Related Traits in Bread Wheat (*Triticum Aestivum L.*) Genotypes**

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Evaluated for genetic variability, heritability and genetic advance for yield attributing traits. Agronomically important traits are a requirement to design a suitable plant breeding method and for information on the extent of genetic variability, heritability and genetic advance. Analysis of

variance revealed that there was a significant difference among the genotypes for all the characters studied. Thus, there is enormous opportunity in the improvement wheat genotypes. Therefore, the information generated from this study needs to be used by breeders who are interested in different traits. Significant differences were observed among the genotypes for the traits namely, spikelet fertility, number of grains per spike, number of effective tillers per plant and pollen sterility. The PCV and GCV was found to be high for spikelet fertility, number of grains per spike and pollen sterility while, moderate for number of effective tillers per plant and spikelet fertility (field). Higher value of PCV was obtained in all the cases than the GCV for all the characters. The heritability for all the characters was found to be high with high GAM (Genetic advance over mean). Characters with a high genetic advance as a percent of mean allow the improvement of this character through selection. Hence, these yield attributing traits could be considered as suitable selection criteria for the development of high yielding wheat cultivars in the breeding programs.

**Key words:** Wheat, Genetic Variability, Heritability, Genetic Advance, Yield

## **TS204**

### **Effect of Postharvest Treatment of Chemicals on Storage Behaviour of Sapota Fruits**

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Sapota (*Achras zapota* L.) is one of the tropical climacteric fruits preferred by the consumers due to its sweet taste and aroma. Fruits become ripe very quickly after harvesting due to sudden climacteric rise with high respiration rate and ethylene production. Quick ripening loosens the texture of fruit which leads to softening of and spoilage. The short shelf life of the fruit is a marketing problem which is a major cause of huge postharvest loss of this fruit. Postharvest treatment of fruits with suitable non-hazardous chemical can extend the shelf life of this fruit by reducing the respiration rate and ethylene production. In the present experiment postharvest treatments of sapota fruits has been tried with solutions of different chemicals like  $\text{KMnO}_4$  (2.5% and 5.0%),  $\text{GA}_3$  (100ppm and 200ppm),  $\text{CaCl}_2$  (0.5g/l and 1.0g/l) etc. Fruits were dipped in the solutions for 15 minutes and stored at ambient conditions. Significant lowest PLW (18.7%), highest fruit hardness (1.66kg), maximum consumable life (10.12 days) were observed in the fruits treated with 5.0%  $\text{KMnO}_4$  solution. However, the lowest infections were observed in the fruits treated with  $\text{GA}_3$  @ 100ppm. Maximum total soluble solids, total sugar and reducing sugar were obtained under  $\text{GA}_3$  @ 100ppm treatment.

**Key words:** Sapota, Postharvest treatments, Shelf life, Quality

## TS205

### Modeling of Occurrence of Neonatal Diarrhea in Young Goats through Distribution Approach

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Goat is a key domestic animal in most of the developing countries. It is one of the most resourceful and efficient ruminants. Coccidiosis is caused by microscopic protozoan parasites called coccidian (*Eimeria spp.*). Coccidia go through a complex "life cycle" in the intestinal cells of goats. In the process, they produce large numbers of eggs (technically called oocysts) that are passed in the feces. In the process of growth and multiplication in the goat intestinal epithelial cells, the coccidia may destroy many intestinal cells. This may cause diarrhea and other signs of the disease coccidiosis. Coccidiosis is the most common cause of diarrhea in goats and is very severe particularly in young goats (commonly known as neonatal diarrhea) where it can generally arise between three weeks to three months age of kids. Clinical signs include anorexia, weakness, and diarrhea with or without mucus or blood, dehydration, emaciation, stunted growth along with intestinal lesions at necropsy. Neonatal diarrhea, if not treated properly, may even leads to death of the kids. Literature revealed that, neonatal mortality among goats due to diarrhea may vary from 20-50% and in some cases even 60 %. Thus, modeling the occurrence time of neonatal diarrhea and hence predicting the peak occurrence are of great importance for time bound actions. Here, exponentiated exponential distribution (which is one of the commonly used distributions in the field of survival theory) was used to model the neonatal diarrhea disease infestation time in Goats based on 128 observations collected from ICAR-Central Institute for Research on Goats (CIRG), Makhdum, Uttar Pradesh. The goodness of fit of the distribution has also been assessed using different tests like Kolmogorov-Smirnov, chi-square and other goodness of fit tests. All tests reveal that the distribution fits well for the data under consideration. The summary statistics of the data have also been calculated along with different occurrence probabilities.

**Key words:** Goats; Modeling, Distribution approach, Neonatal Diarrhea

## **TS206**

### **Jackfruit: A Review of Its Medicinal Uses and Health Benefits**

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*Artocarpus heterophyllus* Lam., commonly known as “Jackfruit” is an important fruit plant in India. The fruit can be consumed as alternative nutritional food used raw as vegetable and ripe as fruit in different region. Its significantly contributes to the nutrition as a source of vitamins, minerals and calories. It is treated number of diseases like cure ulcers, lowering of blood pressure, protect against viral and bacterial infections diseases, maintain a healthy eye and skin, control asthma, bone strengthens and Cancer. The present review has been primed to describe the existing data on the information on functional and medicinal use.

**Keywords:** Jackfruit, Medicinal value, Health benefits

## **TS207**

### **Doubling Farmers' Income by Quality Improvement of Jackfruit Leather with Natural Products**

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Jackfruit is one of the most widely grown fruit crop which is found in almost all part of India. Jackfruit has a huge market demand when unripe. But there is a steady decline in the preference of jackfruit as a fruit. This can be attributed to the fact that jackfruit have a typical flavour which is considered be an off flavour, particularly with city dwellers. This is another reason why processed product made out of jackfruit is not available. The processed products like dehydrated flakes, leather, puree, paste, etc are not that much demanding. The main culprit is the strong odour. The circumstance is thus that ripe jackfruit which is enormously nutritious gets rotten over and is thrown to decompose. Million tonnes of ripe jackfruit are thrown off here and there without utilization. Hence an attempt has been made to value add jackfruit in the form of leather and mask the off-flavour using natural products like lemon juice, aamada, mint. There were 12 treatments including control. The other treatments were varying doses of these natural products. It has been observed that all these treatments have a positive effect when question comes to masking the off flavour. However, organoleptically the best treatment was T<sub>7</sub>–Jackfruit pulp +

Citric Acid 0.3 % + Aamada 5 %. Total sugar and reducing sugar was highest in T<sub>1</sub>-control. Titratable acidity was highest in T<sub>4</sub>- Jackfruit pulp + Citric Acid 0.3 % + Lemon juice 5 %. Ascorbic acid (vitamin C) was highest in T<sub>5</sub>- Jackfruit pulp + Citric Acid 0.3 % + Lemon juice 10 %. Vitamin A was highest in T<sub>0</sub>- control. The most microbiologically safe product (lowest TPC) at 12 month storage was T<sub>12</sub>- Jackfruit pulp + Citric Acid 0.3 % + Aamada 5 % + Mint 2 %. So, it can be concluded that blending normal jackfruit leather with herbs can mask the odour and can prove out to be an excellent processed product and the farmers can double their income.

**Keywords:** Leather, Jackfruit blended product, Odour masking

## **TS208**

### **A study on Q/I Relationship for the Prediction of Potassium Status in Tropical Soils**

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The potassium (K) supplying capacity of some selected agricultural soil was investigated by employing the quantity-intensity (Q/I) approach. The values of potential buffering capacity (PBC<sup>K</sup>), labile K (K<sub>L</sub>), specific K (K<sub>0</sub>), specific K sites (K<sub>X</sub>), equilibrium activity ratio (AR<sup>K</sup>) and free energy change (-ΔG) were estimated from the quantity-intensity curve. Higher cation exchange capacity and lower organic carbon favours labile K pool. All Q/I parameters has a direct relationship with chemical composition and clay mineralogy of the soil. The changes of Q/I parameters is associated with contents of clay, organic matter and clay mineralogy of the soil. High exchangeable cation in the soil matrix and higher CEC favours labile K, specific K and specific K sites. Equilibrium activity ratio of potassium increases with decreasing free energy change as well as increasing CEC and exchangeable cations.

**Key words:** Labile K, K sites, Free energy change, Equilibrium activity ratio, Q/I relationship

## TS209

### Genetic Screening of Adaptable Clones of *Eucalyptus tereticornis* Sm.

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In India the trees outside forest (TOF) constitutes about 77.06% of the total geographical area of the country, in which *Eucalyptus* covers over 8.0 million hectare area with an average productivity of about 5-7 m<sup>3</sup>ha<sup>-1</sup>yr<sup>-1</sup>. Comparatively, in Brazil 3.0 million hectare plantations of *Eucalyptus* have an average productivity of 45–60 m<sup>3</sup>ha<sup>-1</sup>year<sup>-1</sup>. The natural high phenotypic variation in *Eucalyptus tereticornis* Sm. (69.20 million hectare or 21.05% of the total geographical area) offers wide scope for selection of desired trees in its natural range. The presence of Genotypex Environment (GxE) interaction for specific traits implies that different set of gene loci are operating in different environment. The present GxE study focused on estimation of quantitative variations in selected genotypes of *E. tereticornis* Sm. The phenotypic measurement of selected genotypes planted in randomized, replicated experiments in different test environment was analyzed. The analysis of variance (ANOVA) was carried out for 6 morphological traits in twenty four clones. For each traits measured, the variation among genotypes is portioned into variation due to difference among genotypes and variation due to GxE interaction. There was a significant variation in genotypes recorded for all six traits studied, at 0.01% level of significance.

**Key words:** Provenance, Correlation, Phenotypic variation, Plus tree`

## TS2010

### Biodiversity of Ornamental Plants in Siang District of Arunachal Pradesh

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The floristic diversity of North East India is considered to be one of the Biodiversity Hot Spots in the world. About 56.6 percent of the total flowering species in India is dominant alone in the N.E. region. The entire North East region possesses the vast potential of new ornamentals from wild sources. Among North East region, the state of Arunachal Pradesh is considered to be luxuriant in floral diversity and has been recognized as the 25th biodiversity hotspots in the world. The floral diversity comprises well over 4000 species of economically important, interesting and

biologically diverse plant species. Among them, orchids belonging to the family of Orchidaceae form a dominant group of plants in the state. Nonetheless, it alone accounts for 601 species (12 species - endangered, 16- vulnerable, and 31 – threatened), almost 52% of the total species known in India, thus making Arunachal an 'orchid paradise' of our country. The Siang District is a wild mountainous area and presents a remarkable topographical variety and lies approximately between N 27° 43' and E 94° 42'. The Siang district is one of the botanically very little known areas of Arunachal Pradesh. With the advent of 20th Century, plant explorations in this region gained momentum. The ground vegetation comprises of ephemeral, annual, and perennial species of grasses, sedges, legumes and non-legume forbs. These include many trees, shrubs and climbers such as *Bauhinia purpurea*, *Bischofia javanica*, *Bombax ceiba*, *Brassiopsis aculeata*, *Carallia brachiata*, *Duabanga grandiflora*, *Engelhardtia spicata*, *Mucunani gricans*, *Musa balbisiana*, *Oroxylum indicum*, *Trevesia palmata*, etc. This survey in Siang District is an attempt to initiate the further intensive and exhaustive exploratory studies so as to have better utilization of our floral wealth for the betterment of humanity. In the race for urbanization, we are somewhere losing our natural flora.

**Keywords:** Siang, Arunachal Pradesh, Floral diversity, Wild

## **TS2011**

### **Regeneration and Distribution of Flora along an Altitudinal Gradient in a Protected Area of Western Himalaya**

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The Indian Himalayan region occupies a special place in the mountain ecosystems of the world. This region is not only important from the standpoint of climate and as a provider of life, giving water to a large part of the Indian subcontinent; but it also harbors a rich variety of flora, fauna, human communities, and cultural diversity. There are several ecological studies on plant communities in Western Himalayas but the studies pertaining to high altitudinal zones of protected areas are meagre. Thus, the present study focused on distribution pattern of flora, natural regeneration potential and anthropogenic pressure along altitudinal gradient using the stratified random sampling design in Madhmeshwar area of Kedarnath Wildlife Sanctuary. The study revealed that a total of 324 plant species (33 trees, 48 shrubs and 243 herbs) with dominant families-Ericaceae, Rosaceae, Asteraceae and mostly contagious distribution was found across all the altitudinal zones. The distribution of density was found highest in 0-15 GBH class and anthropogenic pressure was observed in areas near the human settlement. The study concludes that the regeneration pattern or the growth of seedlings and saplings decreases with

increase in altitudinal gradient and anthropogenic disturbance increases with decrease in distance from human settlements. Plant species like *Pyropsashia*, *Quercus semicarpifolia* and *Rhododendron barbatum* growing as seedling/sapling in the upper altitudes without having any presence of adult form is the indication of vegetation shift.

**Keywords:** Himalaya, Species, Regeneration, Anthropogenic disturbance, Distribution

## TS2012

### **Contribution of Wild Medicinal Plants to Rural Household Income in the Remote Villages of Govind Pashuvihar Wildlife Sanctuary in Uttarkashi District of Uttarakhand**

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The present study was conducted to understand status of resources utilization pattern with special reference to medicinal plants by the rural folk living in remote villages of Govindpashuvihar wildlife sanctuary. The study area is rich repository of wild medicinal plants and forms the habitat of important medicinal plants that has recently been categorized as RETs. The disconnect and thereby the poor infrastructure of the region makes local folk completely dependent on the nature for their sustenance as majority of them have sedentary life style composed with nature calamities. The data were collected through social science methods such as questionnaire survey, semi-structured interview, focus group discussion and participatory rural appraisal tools to assess the utilization by the local people regarding the plant species in their area. A total of 290 respondents were sampled to assess the socio-economic status of the local community and identify the economically important plants used for Medicare and sale. Results of the study showed that the economically important medicinal plants include *Aconitum heterophyllum* Wall. Ex Royle, *Aconitum balfourii* (Bruhl) Muk, *Angelica glauca* Edgew., *Dactylorhiza hatagirea*, *Picrorhiza kurrooa* Royle ex Benth, *Paris polyphylla*, *Saussurea costus* (Falc) Lipsch, *Jurinea macrocephala* Benth. (S), *Allium spp*, *Juglans regia* and the sale of these plants generate Rs. 3593331 annually. The total contribution of medicinal plants to annual household income was found to be 10.89 % of the total income and contribution to the annual employment being 5250 man days. The medicinal plant sale constitutes the third important economic activity following agriculture and livestock. Thus the present study revealed that the medicinal plant cultivation could be promoted to diversify the economic activity and that will be important precursor in the conservation of these scarce medicinally important resources by diverting the pressure from available wild resources.

**Key words:** Rural, Income, Community, Genetic Resources

## TS2013

### **Doubling Farmers' Income by Identifying Constraints in Production and Marketing of Selected Pulses Farmers in Mahabubnagar District of Telangana State**

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Development of India cannot be conceived without the development of villages. Pulses are one of the important food crops globally due to higher protein content enjoys a largest producer of pulses in the world, both in quantity and variety, once a net exporter and presently turned into one of the largest importers of pulses. to achieve the target of doubling farmers income, the study has suggested a practical measures of increasing focus on production of pulses in the country. Using primary data, this study has identified constraints in production and marketing of selected pulses. The study has revealed that labour scarcity during peak time, erratic electric supply, high labour cost, distance of input supply centre, non availability and high costs of inputs, lack of knowledge of scientific crop production, low quality seed, biotic and abiotic stress, low yield and inadequate credit supply by financial institution are the major production constraints. Among the marketing constraints faced by selected pulses growing farmers, frequent price fluctuations first major among all the constraint faced by them, high transportation, lack of storage facilities, lack of support prices, the farmers faced was distress sale/forced sale due to burden of repayment of loan, lack of availability of market information at farm level, weighing loss during storage, lack of proper infrastructure and facilities in market, lack of cooperatives in marketing societies, poor transportation and road, lack of awareness of new technology and scientific training, high commission charges and delay in cash payment. The study has concluded that for increasing the productivity of pulses and to raise/ doubling the farmers' income proper community, information centers should be established, road and transport connectivity should be developed to link farmers with regulated markets and the cost of cultivation of pulses could be reduced by adoption of recommended package of practices and increase resource use efficiency and technology upgradation.

**Key words:** Production constraints, Marketing constraints, Farmers's income

## **TS2014**

### **Manifestation of Heterosis for Earliness, Fruit Yield and Yield Attributing Characters in Sweet Pepper**

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The field experiments were carried out at Central Research Farm, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, West Bengal during autumn-winter season of 2017-18 under side ventilated low cost poly house to evaluate Seven diverse Inbred lines (variety and breeding lines) of sweet pepper and their five F1 hybrids for characterization through various morphological, growth, yield and quality characters and for identification of best cross combination through analysis of heterosis for different characters. From the study, mean sum of squares clearly suggested significant difference of the genotypes (parental genotypes and hybrids) for all the 18 characters excepting total chlorophyll content of fruit at matured green stage even at one per cent level of significance which clearly endorsed the presence of wide genetic variability for the character concerned both among the parental genotypes and resultant hybrids. All the hybrids manifested negative heterosis over mid-parental value for days to first flowering. Four hybrids registered marked positive heterosis ranging between 28.91 and 46.50 % over mid parent and between 2.99 and 38.67 % over better parent for fruit yield per plant. Highest yielding hybrid, Baby Bell x C/4 did not register highest heterosis over neither mid-parent nor the better parent which suggested that both per se performance and manifestation of heterosis should be considered for the selection of promising hybrids. Two hybrids, Baby Bell x Ayesha and 8/4 x Royal Wonder manifested marked positive heterosis over the mid-parental value in case total chlorophyll content. Most of the hybrids registered marked positive heterosis in total sugar content ranging from 9.04 to 55.33 % over mid parental value and from 7.02 to 64.65 % over better parent. All the hybrids had fruits with higher reducing sugar content compared to the parental genotypes indicating dominance for the conditioning of this character. Three hybrids registered positive heterosis over mid-parent however; none manifested positive heterosis over the better parent in the case of Ascorbic acid content of fruit.

**Key words:** Inbred lines, Hybrids, Variety, Heterosis, Yield, Sweet Pepper

## **TS2015**

### **Distribution of rare earth elements in the sediment of Sundarban mangrove estuary**

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The distribution of rare earth elements (REEs) in surface and core sediments were measured on samples collected from two stations Lothian and Jharkhali in Sundarban mangrove. Performance of mangroves in sequestering trace metals within the sediment and plant is well studied. However, less is known about the chemistry of rare earth elements (REE) in the coastal systems, especially in the world's largest mangrove province, the Sundarban. Here the concentration of REE in the sediment and plant organs of eight dominant mangrove species (mainly dominated by *Avicennia sp.*) in the Indian Sundarban were measured to assess their sources, distribution and bioaccumulation state. Results revealed that lighter REE (LREE) were more enriched than the heavy REE (HREE) (128-144 mg kg<sup>-1</sup> and 12-15 mg kg<sup>-1</sup>, respectively) in the mangrove sediments, with a relatively weak negative europium anomaly (Eu/Eu\* = -0.01 to -0.03) with respect to North American shale composite. The primary source of REE was most likely linked to aluminosilicate weathering of crustal materials, and the resultant increase in LREE in the detritus. Vertical distribution of REE in one of the long cores from Lothian Island was altered by mangrove root activity and dependent on various physico-chemical properties in the sediment (e.g. redox, pH, organic carbon and phosphate).

**Keywords:** Rare earth elements (REE), Mangrove, Sundarban

## **TS2016**

### **Socio-psychological Constraints in Diversified Farming System and Sustainable Livelihood in West Bengal**

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Diversified farming system and sustainable agriculture are deeply interrelated with social and psychological adaptation easily acceptable to the farmers. The constraints ingrained in social strata and status in psychological manner trended and traditionally carried generation to generation year after year in human history are few reasons for the great failure till date in

modern agrarian civilization. Social structure, political motive, modern day lifestyle with super comfort facilities, illiterate that's why farmer and educated not for cultivation like social thoughts engulfing the entire agriculture system including diversified farming system and sustainable livelihood. The various earning options in various sectors with high annual turnover and comfort in compared to farming is one of the major reason for farming decay now a day in West Bengal. The districts where various natural limitations existed with landscape, rainfall, soil fertility and poverty to access the least required infrastructure are questioned and diversified answers observed in farmer and non-farmer sections. The main reasons found are psychological behavior of farmers, political influence and caste based social interactions have great concern in farmer adaptation, acceptance and practical utilization with modern days agriculture. Changes in psychological and social behavior in urgent with modern thoughts may lead us for far more excellent agricultural position.

**Keywords:** Agriculture, Diversified farming, Sustainable livelihood, West Bengal

## **TS2017**

### **Potential Prospective of Integrated Farming System for Enhancing Tribal Farmers' Income under Hill Farming Situation in West Bengal**

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With the aim of doubling farmers' income, identification of suitable farming system is the need of the hour. Higher the benefit obtained from the introduced enterprise combinations, easier it will be to persuade the farmers to adopt them in their farms. Keeping this in mind, a study was undertaken to find out the potential prospective of integrated farming system for enhancing tribal farmers' income in sub-Himalayan region of West Bengal. Integrated farming system (IFS) models was evaluated in hill farming situation to identify a superior model for attaining maximum net returns, benefit cost ratio and economic contributions of different components in IFS. In all, 100 respondents engaged in different integrated farming were randomly selected for data collection. Data were collected on recall basis from the respondents through personal interview for last three years. The result shows that the model comprising horticulture crops + piggery + goatery + poultry was the most superior model for tribal farmers in sub-Himalayan agro-climatic region with highest B C ratio. Piggery, poultry and goatery were the three main components which was having highest contribution in IFS. The study further shows that tribal farmers with

more animal husbandry components had significantly higher income generation in IFS. Thus, it can be concluded that the model comprising horticulture crops with more animal husbandry components can be promoted in larger extent among tribal farmers of these region and other regions with similar agro-climatic conditions and farming situations for higher income generation and employment generation.

**Keywords:** IFS, Income generation, Tribal farmers, Hill farming situation

## POSTER PRESENTATION

### Technical Session-1

## Climate Change Resilient Smart Farming for Doubling Farmer's Income and Environmental Impact with Socio-Economic Issues

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### TS1P1

### Constraints Faced in Accessing Information and Communication Technology (ICT) as a Tool for Doubling Farmers' Income

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Availability of timely and accurate information is crucial for mitigating pest and disease prevalence, drought management and also for getting proper price of their produce through identifying proper market place. ICT has now become a reliable instrument to achieve this goal in India. ICT can play a crucial role in doubling farmers' income by 2022. Although ICT have escalated the living standard of Indian farmers and made them ICT-friendly, which has resulted in increased penetration of useful information about crops, soils, climate and cultivation processes, but rural India has yet to achieve full swing towards usage of ICT by the common farmers. The present study is an attempt to identify the constraints faced by the farmers in accessing ICT-based service. 100 farmers were interviewed from selected villages of Cooch Behar district of West Bengal, India through a structured interview schedule. The study revealed that the farmers have limited access to the ICT tools because there are many constraints faced by them. It is seen that Low internet access, Lack of training and skill development facilities, lesser access to computers & other ICT tools and Poor connectivity of network are the most crucial constraints towards extracting benefit from it. The study suggests overcoming these constraints to use ICT tools for their farming benefits.

**Key Words:** Information and Communication Technology, Internet, Connectivity

## **TS1P2**

### **Effect of Lime and Boron on Growth and Yield of Sprouting Broccoli**

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Broccoli (*Brassica oleracea* L.) is an important crop under the cole group. The climatic condition of Terai region of West Bengal is highly suitable 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 experiment was to determine the suitable combination of lime and boron during winter season months under terai region of West Bengal. The experiments were carried out at Instructional Farm, UBKV, Pundibari, Cooch Behar during 2015-16. The experiment consisted of two levels of lime (0 and 450 kg/ha) and six levels of Boron (0 kg/ha, 7.5 kg/ha, 15 kg/ha, 22.5 kg/ha, 30 kg/ha and 37.5 kg/ha). Each experiment were conducted in Asymmetrical Factorial Randomized Block Design with 3 replications by using lime, boron and lime-boron interaction significantly that resulted increase in plant growth and yield as compared to the experiments conducted without lime, boron, and their interaction that is in control with the applicable dose of NPK. Similarly, the use of lime and boron significantly increased plant height and number of leaves by 18.04 % and 34.00 % respectively over the control. It was found that use of lime and boron @ 450 kg/ha and 7.5 kg/ha gave highest number of leaves (23), and use of lime and boron @ 450 kg/ha and 30 kg/ha gives maximum fresh weight (674.32 g) and head diameter (17.57 cm) in F1 hybrid Green Magic variety of sprouting broccoli. Combined use of lime (450 kg/ha) and boron (30 kg/ha) recorded 56.09 % higher yield (16.16 t/ha) over the control (5.93 t/ha).

**Key words:** Boron, Lime, Sprouting Broccoli

## **TS1P3**

### **Pomato: Double Harvest from a Single Plant**

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Pomato is a grafted plant developed by grafting tomato and potato with an objective to achieve both potato and tomato yield from a single plant. The vegetable grafting is an

alternative strategy to overcome some important hindrance related to vegetable production such as bacterial wilt, fusarium wilt, nematodes, high and low temperature, flood, site specific adaptability, fruits durability etc. At first vegetable grafting was adapted by Japan and Korea and later by many countries in Europe, Northern Africa, Central America and other parts of Asia. In India, vegetable grafting has been started in different states of India. In the present study grafting between tomato and potato was done during November, 2017 at the research field of DDKVK Majhian. 30 days old tomato seedlings were cleft grafted in a 20 days old potato seedling. Successful graft union was achieved after 15 days of grafting. The grafted plants produced profuse branches and flowers. Mature fruits were ready to start harvest in about 110 days after grafting and harvesting was continuing up to 150 days. The result also showed that average fruit per plant in tomato was 35, fruit weight 78 gram and an individual plant produce about 2550 gram fruits. Edible potato tubers were ready to harvest at 120 days after grafting and yielding about 4-5 number of potato around 211 gram tuber from each plant. Though the experiment was conducted just as aesthetic interest to show whether the graft would be success or not but after completion of the programme it may suggested that any home gardener can practice this technique as an amazing satisfaction which may fulfill home requirement to some extent for both tomato and potato however, it requires further study for commercialization of the technique in large scale.

**Key words:** Grafting, Pomato, Potato, Tomato, Yield

#### **TS1P4**

### **Potassium Quantity/Intensity Relationship in some Soils of Cooch Behar, West Bengal**

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Exchangeable potassium determined by routine  $\text{NH}_4\text{OAc}$  may not always be a reliable indicator of soil potassium (K) available to crops in all soil. In that case potassium quantity/intensity (Q/I) relationship can be used to predict potassium availability in soil. This relationship was used to estimate the potassium supplying capacity in six surface (0-20 cm) and subsurface (20-40 cm) soils of Entisols of six different blocks of Cooch Behar district, India situated at Himalayan floodplain. The soils were mostly sandy loam in texture and acidic in pH (5.20 to 6.49). The organic carbon, CEC, clay and available K were lower in the sub-surface layers. The plant available K was significantly positively correlated with organic carbon ( $r = 0.764^{**}$ ), clay ( $r=0.824^{**}$ ) and CEC ( $r= 0.742^{**}$ ). The activity ratio at equilibrium ( $\text{AR}^{\text{K}_e}$ ) values in soils varied from  $5.3 \times 10^4$  to  $15.2 \times 10^4$  in surface and  $3.3 \times 10^4$  to  $9.2 \times 10^4$  in sub-surface soil. The  $\text{AR}^{\text{K}_e}$  value

was positively correlated with exchangeable K. The total labile pool of K varied with the variation in exchangeable potassium ( $r=0.586$ ), CEC ( $r=0.745^{**}$ ) and clay content ( $r=0.866^{**}$ ) of soil. The potential buffering capacity ( $PBC^K$ ) was also much dependent on clay ( $r=0.702^*$ ), organic carbon ( $r=0.853^{**}$ ), CEC ( $r=0.773^{**}$ ) of soil. The lower  $PBC^K$  values suggest the frequent requirement of K-fertilization for better crop yield.

**Key Words:** Available and labile K, Free energy change, Quantity/intensity of potassium

## TS1P5

### Morphological and Biochemical Characterization of Bael in West Garo Hills

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The present study entitled, "Morphological and Biochemical Characterization of Bael (*Aegle marmelos* Correa.) in West Garo Hills, Meghalaya" was carried out in Garo Hills of Meghalaya, India during 2017-2018 at Department of Horticulture, North Eastern Hill University, Chasingre, Tura campus, in West Garo Hills Districts, Meghalaya. Thirty different accessions of bael fruit were collected from different locations of West Garo Hills and the analysis of variance was carried out in a Completely Randomized Design with three replications. The result revealed that significant variation in respect of their morphological and biochemical characters. The morphological characters such as tree height varied from (8.67-5.67 m), trunk girth (132.03-66.13 cm), tree spread {N-S (7.20-4.83 m); E-W (6.81-3.57 m)}, fruit length (16.21-11.50 cm), fruit width (16.94-9.34 cm), fruit weight (0.57-0.15 kg), pulp weight (62.11-31.66 g), fruit skull thickness (3.64-2.19 mm) number of seeds per fruit (52.71-31.57), number of fruits/ tree (36.67-14.33) and fruit length to width ratio (1.24-0.87). The biochemical character viz., TSS ranged from (35.47-24.80 °Brix), titrable acidity (0.45-0.23 %), total sugar (25.38-14.34 %), reducing sugar (8.84-4.69%), non-reducing sugar (17.64-6.67%), TSS: acid ratio (108.21-57.11) and sugar: acid ratio (114.43- 37.59). Based on the organoleptic characters viz., pulp colour varied from (3.34-2.90), pulp aroma (3.61-2.98), pulp taste (3.92-2.20) and pulp acidity (1.35-0.96). Based on the quantitative, biochemical and organoleptic characters, accessions collected from location-3 i.e., Cherangre, location-5 i.e., Sampalgre and location-6 i.e., Babupara were found to be the best and promising accessions. Both a significantly positive and negative correlation was observed amongst the quantitative and biochemical characters of bael fruit accessions.

**Key words:** Morphology, Biochemical, Organoleptic, *Aegle marmelos*, Variability

### **TS1P6**

## **Soil Charge, Base Saturation and Fertility Decreases down along Soil Fertility**

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The aim of the present study was to acknowledge the charge characteristics of some surface and sub-surface soils in relation to soil fertility. Eight surface and subsurface soils were collected from different states of India. Charge characterization was made by the experiments through selective ion exchange of Cs<sup>+</sup> by Li<sup>+</sup> and Cs<sup>+</sup> by NH<sub>4</sub><sup>+</sup> respectively. Results reveal that the variable and total charge ratio of 0-15 cm layer exhibited maximum proportion of electric charges with respect to 15-30 cm layer profile. With increasing organic matter, CEC and surface charge increases, % base saturation is higher in upper profile compare to lower profile. Numerical data supported by statistical interpretation by 0.5% level of significance in relation with cation exchange capacity ( $p < 0.05$ ; 0.99942). The total surface electric charges vary with several depths that have direct relation with cation exchange capacity and organic matter content and directly proportional to base saturation and soil fertility.

**Key words:** Organic matter, CEC, Variable charge, Base saturation.

### **TS1P7**

## **Carbon, Litter and Nutrient Status in Teak Stands of a Foothill Forest in Indian Eastern Himalayas**

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A study was conducted in teak stands of sub-humid foothill forest to estimate carbon storage, NPK status, litter production and decomposition. The litter production was 5.61 Mg/ha with turnover rate of litter decomposition in teak stands was only 12 months. The highest NPK and C availability was during September (269.54, 1118.68 & 163.09 Mg/ha and 1.86 %, respectively). Carbon stock is intricately linked with site quality, nature of land use, choice of species and other silvicultural practices adopted. These factors ultimately influence plant growth which is reflected into its biomass (1938.28 Mg/ha). Total carbon accumulated including soil, litter and biomass

estimated was 911.27 Mg/ha. The site quality factors of the stands like tropical moist deciduous with soil having high organic carbon and available nitrogen and heavy precipitation, high mean monthly relative humidity and optimum temperature supported luxuriant growth supporting biomass production and carbon storage. Drawing CO<sub>2</sub> out of air and sequestering it into biomass is the only known practical way to remove large volume of greenhouse gases from atmosphere and thus indicates the importance commercially planted timber species like teak towards maintenance of atmospheric CO<sub>2</sub> efficiently which is permanently stored in its biomass for a longer period of 20-100 years or even more.

**Keywords:** Biomass, Carbon sequestration, eastern Himalaya, Litter NPK, Teak

### **TS1P8**

#### **Uses and Ecosystem Services of Tree Outside Forests- A Case Study from Uttar Banga Krishi Viswavidyalaya, West Bengal, India**

Nazir A Pala, Bisleshna Tamang, Trishala Gurung, Kiran Yonzon, Roman Chettri, Pema Kiden Sherpa, Avinash Giri, Rufash Singh, Mendup Tamang, Kamal Ghising, Manish Roy and Biplov C Sarkar

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Trees outside forests (TOFs) play a critical role in conservation of floristic diversity apart from being reservoirs of other ecosystem services. TOF includes all the trees, attained 10cm or more diameters at breast height, available on lands, which is not notified as forests. The present study was therefore conducted in the Pundibari campus of Uttar Banga Krishi Viswavidyalaya to document the available tree diversity and their potential uses and ecosystem services. A total of 1816 numbers of individuals with dbh  $\geq$  10cm of 95 woody perennials species were inventoried belonging to 79 genera and 38 families. The contribution among number of individuals was dominated by *Mangifera indica* with (9.19%). The overall dominant family was Fabaceae represented by 11 species followed by Arecaceae and Meliaceae. The contribution of inventoried 95 species was dominated by forestry tree species followed by road side plantation, fruit crops and plantation crops respectively. The highest number of individuals among forestry plantation was for *Terminalia arjuna* (121) followed by *Gmelina arborea* (114) and *Tectona grandis* (95). The reported species were dominated by endemic flora with (66.31%) and (33.68%) of exotic flora. Majority of the species (54) were of timber value, followed by food (50), fodder (36) and ethno-medicine (39). Based on the contribution to ecosystem services all the 95 species have the potential to sequest carbon followed by 46 species to provide beautification in the form of avenue/ornamental/roadside. The tree species richness and their potential ecosystem services

documented in the present study can be a baseline study for further assessment of such landscapes and their significance under threatening environmental conditions.

**Keywords:** Trees outside forests, Ecosystem services, Biodiversity

### **TS1P9**

#### **Effect of Different Levels of Single Super Phosphate on the Growth of Poplar under Nursery Conditions**

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Agroforestry systems based on poplar (*Populus deltoides*) are becoming popular in eastern and northern parts of India. Therefore studies on the structure and function of the systems are very important. Present study was conducted to explore the growth performance of *Populus deltoides* (G-48 variety) under nursery condition to check the effect of Single Super Phosphate (SSP) on plant height, root length and other growth attributes. Application of SSP showed significant better result as compared with control. However, all the growth factors and productivity rate increased drastically between days 75 to 90 from the date of application.

**Keywords:** Single Super Phosphate, Poplar, Nursery, Growth

### **TS1P10**

#### **Influence of Postharvest Treatments on Fresh Cut Pineapple Cubes**

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Pineapple is one of the most important fruit crop of India tends to have high perishability coupled with poor transport networks and a long term chain for marketing intermediaries, that have failed to turn into profitable venture for farmers. The bulk of the world production of pineapple is used by canning industry and the trade in fresh fruits is limited. But, demand of fresh cut pineapple is highest though the recommendation of experimental finding is very few for marketing of fresh cut pineapple with proper postharvest treatments for better shelf life. Keeping this in view an investigation was made to find out the best effect of postharvest treatments on fresh cut

pineapple cubes with 12 treatments which includes the combination of sugar @ 100 and 200 gram/litre, citric acid @ 500, 750 and 1000 ppm and Na- benzoate @ 500 and 1000 ppm and one control. Changes in TSS, ascorbic acid, acidity, reducing sugar, non-reducing sugar, and total sugar were recorded at every 5 days of interval. Results indicate that the self life and quality of fresh cut pineapple cubes can be extended upto 20 days with treatment combination T8(sugar 200g/l + citric acid @500ppm + Na-benzoate@1000pp).

**Key words:** Pineapple, Cubes, Quality, Postharvest

### **TS1P11**

#### **Bioefficacy and Phyto-toxicity of Cyhalofop Butyle 10 % EC in Direct Seeded Rice**

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An experiment was conducted at Terai Zone, Pundibari, Cooch Behar and Old of Alluvial Zone, Majhian, Dakshin Dinajpur of Uttar Banga Krishi Viswavidyalaya,, West Bengal, during kharif and Boro season of 2016 & 2017 to evaluate the bio- efficacy and phyto-toxicity of Cyhalofop Butyle 10 % EC in Direct Seeded Rice. The result from the experimental trial revealed that the weeds flora in direct seed rice were controlled effectively by applying Cyhalofop-butyl 10 % EC at dosages ranges from @ 75 to 100 g ai ha<sup>-1</sup>, which were statistically superior to the standard checks Cyhalofop-butyl 10 % EC@ 75 g ai ha<sup>-1</sup> (Manufactured by DOW), Pendimethalin 30 % EC@1000g ai ha<sup>-1</sup> and Oxyfluorfen 23.5 % EC @150g ai ha<sup>-1</sup>. Significant increase in yield attributes and grain yield was obtained by application of Cyhalofop-butyl 10 % EC at the tested dosages ranges from @ 75 to 100 g a.i./ha in comparison to the untreated control & standard check. No phyto-toxicity symptoms were observed in any of the doses of Cyhalofop-butyl 10 % EC and hence, it can be used safely @ 75 to 100 g ai ha<sup>-1</sup> in direct seeded rice for effective weed management. No adverse residual effect of Cyhalofop-butyl 10 % EC has been found on the succeeding lentil and black gram.

**Keywords:** Cyhalofop Butyl, Direct seeded rice, Weed control efficiency, Yield

## TS1P12

### Improving Floret opening, Carotene Retention and Post-Harvest Life of Cut Inflorescences of different Heliconia Species using 8-Hqc Based Vase-Solutions

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A study was conducted at the Department of Horticulture, Institute of Agricultural Science, University of Calcutta, Kolkata, West Bengal during April-June of 2016 to evaluate the effect of eight different 8-HQC based vase-solutions on the post-harvest life of cut inflorescence of four *Heliconia* germplasm namely – *Heliconia rostrata*, *Heliconia psittacorumspathocircinata* cv. Golden Torch, *Heliconia psittacorum* var. Choconiana and *Heliconia humilis*. Eight different 8-HQC based formulations viz., 8-HQC alone (500mg/l), 8-HQC (500mg/l) + Sucrose (2%), 8-HQC (500mg/l) + AgNO<sub>3</sub> (1500ppm) + Sucrose (2%), 8-HQC (500mg/l) + CaCl<sub>2</sub> (750mg/l) + Sucrose (2%), 8-HQC (500mg/l) + GA<sub>3</sub> (80µM) + Sucrose (2%), 8-HQC (500mg/l) + NAA (100ppm) + Sucrose (2%), 8-HQC (500mg/l) + Citric Acid (200mg/l) + Sucrose (2%) and 8-HQC (500mg/l) + BAP (50µM) + Sucrose (2%) were used as vase-solutions for cut inflorescence of four *Heliconia* germplasm and the effects were compared to control (distilled water) and standard preservative solution consisted of 10 ml fresh lemon juice + 10 g table sugar + 5g household bleach per litre of water. Results indicated that use of CaCl<sub>2</sub> along with 8-HQC and Sucrose exhibited best for *Heliconia psittacorumspathocircinata* cv. 'Golden Torch' (36%) in respect of flower opening (percent in bracts) followed by BAP (33%) and NAA (31.66%) respectively. It was also revealed that GA<sub>3</sub> and Citric Acid along with same combination resulted optimal opening in case of *Heliconia rostrata* (25%), *Heliconia psittacorum* var. 'Choconiana' (24.66%) and *Heliconia humilis* (35.00%). Retention of pigment content i.e. carotene of bract and flower of *Heliconia* inflorescences exhibited that *Heliconia psittacorumspathocircinata* cv. 'Golden Torch' was at its best under addition of AgNO<sub>3</sub> with 8-HQC and sucrose maintaining 47.51 and 40.67 µg/ml carotene pigment for both bract and flower on 7<sup>th</sup> and 9<sup>th</sup> day respectively, however deterioration was observed on the 11<sup>th</sup> day. In *Heliconia rostrata* and *Heliconia humilis*, approximately all combinations unveiled consequential results except control and standard preservative till the 7<sup>th</sup> day and thereafter pigmentation got reduced. Concerning carotene pigment recovery, 8-HQC alone and added with sucrose divulged satisfactory effect from both bracts and flowers for all three durations in *Heliconia psittacorum* var. 'Choconiana'. Use of GA<sub>3</sub> along with 8-HQC and Sucrose improved the vase-live of cut inflorescences of *Heliconia rostrata* (16 days) whereas addition of Silver nitrate did good in *Heliconia psittacorumspathocircinata* cv. 'Golden Torch' (15.33 days) and *Heliconia psittacorum* var. 'Choconiana' (16 days), but addition of Calcium

chloride and Silver nitrate were found suitable in *Heliconia humilis* (15.33 days) along with 500ppm 8-HQC and Sucrose (2%) in respect of vase-life of cut *Heliconia* inflorescences.

**Key words:** Heliconia, Floret opening, Carotene Retention, Postharvest Life

### **TS1P13**

#### **Standardization of Level of Nitrogen Management for Maize using Leaf Color Chart in Hill Zone of West Bengal**

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Need based nitrogen (N) fertilizer application in maize (*Zea mays* L) is beneficial over blanket recommendation, which restrict productivity due field to field variability. Therefore, a field experiment was conducted during the *pre-kharif* season of 2017-18 at the Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong to standardize the level of nitrogen application for maize cultivation using leaf color chart in Hill Zone of West Bengal. The analyzed data revealed that the grain yield and yield attributing characters shows better result over recommend dose of N. Significantly maximum plant height (242 cm), cob length (23.64 cm), cob diameter (6.1 cm), cob fresh weight (434.1 g), 100 grain weight (42.4) and grain N content (1.58%) were achieved when N was applied @ 40 kg/ha at basal and 30 kg/ha when LCC falls below five. LCC based N application obtained a maximum (7.78 t/ha) maize yield, which much better than our national average as well as it saved 20 kg N/ha. LCC based N application would be the most promising technology to overcome farmers' perception of N over-application.

**Keywords:** Leaf color chart, Maize, Nitrogen level, Yield attributing parameters

### **TS1P14**

#### **Socio-Economic Characteristics of the Adopters of Organic Production Technology in Terai Region of West Bengal**

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Socio-economic characteristics are the one which triggers respondent's collective behavior in his/her society and financial position. And, study of socio-economic profile is important as

because these factors may directly or indirectly influence farmers to adopt new perceived technology such as organic production technology, as, we know in rural society there is a close association and more likely to share ideas, facts and values among individuals. This study revealed that majority of the organic respondents of Terai region were from Schedule Caste community, a vast majority of the adopted farmers believed in Hinduism, nearly half of the adopted farmers had 4 to 6 members in their family, majority of the respondents indicated that at least 2 members from their family engaged in organic farming, one third each of the respondents had active participation in different social organizations like Gram-Panchayat, organic groups etc. either as member or office bearer. Majority of the respondents were from middle age group and mostly up to primary level of education. Majority of the adopted farmers had lower level of outside contact. Farming was the primary occupation of majority organic farmers and had cultivated land holding up to 3 bighas (one acre). Most of the adopted farmers had medium level of agricultural asset possession. More than half of the respondents had medium level of personal media contact and low level of group and mass media contact. More than three fifth of the responding farmers had only attended up to three trainings regarding organic production technology of mostly one day long duration. It is seen that age, family size, cultivated land, agricultural asset possession, outside contact had no significant difference between adopter farmers and non-adopter farmers from the selected districts of Terai region of West Bengal. Family members engaged in farming have highly significant relationship among adopter farmers and non-adopter farmers. Personal media contact and Number of training receives can influence/persuade/motivate the individual farmer to adopt organic farming technologies which might be the probable reason for a highly significant relationship among adopter farmers and non-adopter farmers. Also, receipt & duration of training and social participation had highly significant relationship among adopter farmers and non-adopter farmers. Duration of training has positively significant relationship between adopter farmers and non-adopter farmers from the selected districts of Terai region of West Bengal.

**Keywords:** Adopters, Non-adopters, Farmers, Organic production, Socio-economic factors

## **TS1P15**

### **Detection and Identification of different Ornamental Plant Diseases in Landscape under Arunachal Pradesh**

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Ornamental plants like Anthurium, Orchid, Chrysanthemum, Zinnia, Gerbera, Tuberose, Marigold, Chinese evergreen are commonly grown and Duranta, Kufiya, Croton used as hedge plant in

Arunachal Pradesh. In recent years, many fungal and bacterial diseases were observed and greatly affect the beautification of landscape. Hence, a thorough study was conducted at to know the occurrence and severity of diseases. The infected plant samples were identified based on its symptoms and etiology. The bacterial blight of Anthurium caused by *Xanthomonas spp.* is very common, highly devastating, causing economic losses and reduces market value and its disease severity is recorded 20-75 %. Disease severity of *Cercospora* leaf spot of Zinnia is range from 30-45 %, bacterial leaf spot of orchid is recorded 55-60%. *Fusarium* wilts (70 %) disease observed in marigold. In Peperomia plant, bacterial blight and *Colletotrichum* leaf spot incidence is recorded upto 35% and 60-80% respectively. Duranta plant also was found to be infested with leaf spot caused by *Colletrochium spp* with disease severity of 25%. It is found that both bacterial blight and *Colletotrichum* are serious threat to ornamental plants particularly in Arunachal Pradesh region. Constant research may be initiated to explore newer and newer strategies to manage these diseases for better cultivation of ornamental plants in North Eastern region.

**Key words:** Ornamental plants, Disease, Identification, Detection

## **TS1P16**

### **Nanoparticle Induced Metabolic Alterations in Waterlogging Stress and Associated Gene Expression in the Root Periphery to Address Hypoxia Tolerant Mung Bean (*Vigna radiata* L.)**

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Mung bean (*Vigna radiata* L.), which is one of the imperative pulse crops enriched with digestible protein (approximately 25-28%), is extensively grown in tropics and subtropics and fitted well in multi-cropping systems, because of its rapid growth and early maturity, results in the increase of small landholders' income and enhancement of soil fertility. However, its large-scale adoption is constrained by low yield potential due to waterlogging stress. Waterlogging blocks the oxygen supply to the roots, this creates hypoxic and subsequently anoxic conditions and thus inhibiting root respiration, resulting in a severe decline in energy status of root cells affecting important metabolic and physiological processes of plants. Oxygen deprivation decreases relative water content (RWC), membrane stability index (MSI) in root and leaf tissues, and chlorophyll (Chl) content in leaves, total, reducing and non-reducing sugars which subsequently affect activity of sucrose synthase (SS), alcohol dehydrogenase (ADH) and nitrate reductase (NR) in root periphery. To address the hypoxic effect, nanoparticles (NPs) with unique physicochemical properties, i.e., high surface area, high reactivity, tunable pore size, and particle morphology

could serve as 'magic bullets', which target specific cellular organelles in plant for better growth and development related to photosynthesis and improvement of crop yield and quality in hypoxic situation. The work could be planned with pre-characterized NPs, viz. ZnONPs, TiO<sub>2</sub>NPs, AgNPs to target the hypoxia tolerance mechanism of mung bean particularly nitrogen and carbohydrate metabolism at root periphery with boosted SS, ADH and NR activities for continued glycolysis and to validate the expression of candidate genes like *ss*, *adh*, *cNA* (cytosolic nitrate reductase) using  $\beta$ -Tubulin as housekeeping gene.

**Keywords:** Mungbean, nanoparticles, gene expression, hypoxia tolerance

### **TS1P17**

#### **Evaluation of Bioefficacy of Fungicides against Sheath Blight, Blast and Brown Spot of Rice**

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A field experiment to evaluate the bioefficacy of fungicides against sheath blight, blast and brown spot of rice was laid out in RBD with seven treatments and three replications during Kharif, 2016 and 2017 in the experimental field of Regional Research (Old Alluvial Zone), UBKV, Majhian, Dakshin Dinajpur. Disease index (DI) was recorded in per cent from the experimental plot based on different symptoms produced by different pathogens. The result revealed that all the treatments were superior over control and treatment T3 (Tebuconazole 15 % + Zineb 57 % WG) @ 1500 g/ha showed lowest DI with better yield against sheath blight and blast followed by T2 (Tebuconazole 15 % + Zineb 57 % WG) @ 1250 g/ha, T6 (Hexaconazole 4 % + Zineb 68 % WP) @ 1250 g/ha, T1 (Tebuconazole 15 % + Zineb 57 % WG) @ 1000 g/ha, T4 (Tebuconazole 25.9 % EC) @ 750 ml/ha, T5 (Zineb 75 % W. P) @ 2000 g/ha and T7 (control). Similarly, lowest PDI with better yield against brown spot was found in treatment T3 (UPF-115) @ 1500 g/ha followed by T2 (Tebuconazole 15 % + Zineb 57 % WG) @ 1250 g/ha, T6 (Hexaconazole 4 % + Zineb 68 % WP) @ 1250 g/ha, T4 (Tebuconazole 25.9 % EC) @ 750 ml/ha, T1 (Tebuconazole 15 % + Zineb 57 % WG) @ 1000 g/ha, T5 (Zineb 75 % W. P) @ 2000 g/ha and T7 (control). Considering the two parameters PDI and yield, T3 (Tebuconazole 15 % + Zineb 57 % WG) @ 1500 g/ha was the most effective treatment.

**Key words:** Rice, Sheath blight, Blast, Brown spot, PDI, Bioefficacy, Fungicide, Yield

### **TS1P18**

#### **Provisioning Ecosystem Services in Homegarden of the North Bengal, West Bengal, India**

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Ecosystem services (ES) are the conditions and processes by which natural ecosystems and the species that they comprise, sustain and fulfill human life. Home gardens are traditional farming systems, presumably the oldest land use system and allow its owner to produce a wide variety of products and ecosystem services. It is an agroforestry system having micro-environment with multi-species arranged into different vertical strata for multi-purpose use close to the homestead. The present study was conducted in 2017 in Cooch Behar district of West Bengal. Purposive, multi-stage and random sampling procedures are followed in the present study. The present study reported seven types of prominent provisioning services by different species viz. food, fuel wood, fodder, construction, implements, timber, fibre. The 80 plant species provided food followed by fodder with (59) species, fuel wood (48), timber (41), construction and implements (4), fibre (1) respectively. In the Cooch Behar district, prominent higher numbers of plant species were present to provide provisioning services. The home garden provides a bridge between the social and biological, linking cultivated species and natural ecosystems, combining, and conserving biodiversity.

**Key words:** Ecosystem Services, Homegarden of the North Bengal, West Bengal, India

### **TS1P19**

#### **Response of split application of nitrogen on the performance of maize (*Zea mays L*)**

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Maize (*Zea mays L.*) is one of the most vital cereal crops of the world and adds in mitigating food security in most of the developing countries. Its importance lies in the fact that it is not only used for human food and animal feed but at the same time it is also widely used for corn starch industry, corn oil production, baby corns, ethanol industry etc. which makes it one of the fastest growing cash crops in the world. Nitrogen is a major yield-determining factor required for maize

production. Its availability in sufficient quantity throughout the growing season is essential for optimum maize growth. Lack of sufficient soil nitrogen leads to reduced leaf area, lessening the rate of photosynthesis and delayed growth and development which resulted into lower yield. Therefore, to obtain good yield and improve the use efficiency of applied nitrogenous fertilizer real time application of nitrogen is utmost necessary. Keeping the above facts in mind present experiment had been conceptualized to find out optimum splitting of nitrogen for better yields and use efficiencies. The field experiment was laid in randomized block design with four Replication and comprises of six treatments namely T<sub>1</sub>: Control (no fertilizer) T<sub>2</sub>: 90 kg N ha<sup>-1</sup> at sowing + 30 kg N ha<sup>-1</sup> at 35 DAS, T<sub>3</sub>: 60kg N ha<sup>-1</sup> at sowing + 60 kg N ha<sup>-1</sup> at 35 DAS, T<sub>4</sub>: 60 kg N ha<sup>-1</sup> at sowing + 30 kg N ha<sup>-1</sup> at 35 DAS + 30 kg N ha<sup>-1</sup> at 55 DAS, T<sub>5</sub>= 40 kg N ha<sup>-1</sup> at sowing + 40 kg N ha<sup>-1</sup> at 35 DAS + 40 kg N ha<sup>-1</sup> at 55 DAS and T<sub>6</sub>: 120 kg N ha<sup>-1</sup> at sowing. The experimental plot sizes was 5.2 m x 4 m, and DKC-9081 variety was used. Except control plot, maize was fertilized with an N: P: K rates of 120: 60:60 kg ha<sup>-1</sup>. Results of the experiment revealed that whenever nitrogen was applied in three equal splits at sowing, 35 and 55 days after sowing (T<sub>5</sub>) recorded tallest plant, higher dry matter (17.49 t ha<sup>-1</sup>), longest cob (18.13 cm), higher number of kernel rows cob<sup>-1</sup> (16.59), more number of grains cob<sup>-1</sup> (528.51), 1000 grain weight (307.60 g) which intern helped in producing 202 % and 24.19 % more grain yield over absolute control(T<sub>1</sub>) and single application of nitrogen(T<sub>6</sub>) might be due to synchronized supply of nitrogen with plant demand. Split application also registered higher values of ARN, PFP<sub>N</sub> and nitrogen uptake efficiency (NUE) over single application of nitrogen (T<sub>6</sub>) might be due to reduced losses of applied nitrogen. Whenever nitrogen was applied in three equal splits at sowing, 35 and 55 days after sowing (T<sub>5</sub>) recorded highest values of ARN (111.70%), PFP<sub>N</sub> (86.75%) and NUE (150.52%) as compared to other treatments. The highest net monetary return to the tune of Rs. 57157 ha<sup>-1</sup> was recorded in T<sub>5</sub> while control plot give negative return.

**Key words:** Economics, Grain yield, Maize and Nitrogen,

## TS1P20

### Impact of TiO<sub>2</sub> Nanomaterials on Germination and Seedling Growth of Spinach

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The present experimental investigation was carried out on impact of biosynthesis TiO<sub>2</sub> (<100nm size) nanoparticles on germination and seedling growth of Spinach. Using the variety All Green of

Spinach beet seeds were treated with different concentrations of nanoscale TiO<sub>2</sub> (0, 10, 20, 30, 40, 50 ppm), including control. The experiment was conducted on CBD with 3 replications. The biosynthesis TiO<sub>2</sub> nanoparticles (Asparagus leaf extracted) characterized using different techniques such as DLS, TEM and HR-TEM, XRD, SEM, AFM, EDS were employed for confirmation of size, shape, surface structure, crystalline nature, and elemental proportion. Based on biomass assay, it was found that the nanoparticle-treated seedlings displayed better growth than the control, demonstrating a positive effect of the treatment. Application of TiO<sub>2</sub> nanoparticles at 40 ppm showed the maximum germination percentage and better seedling growth such as root length (18.81%), shoot length (48.98%), total seedling weight (20%) and vigour index (41%) of spinach beet. The increase in seed germination along with seedling growth in specific concentration of TiO<sub>2</sub> nano particles suggested optimum dose limit for growth of spinach beet seedlings and that reduction in lower concentration may be suggested as least sensitiveness on such treatment or detrimental interaction effect of nanoparticles and seedling growth.

**Keywords:** Nanoparticles, Spinach, TiO<sub>2</sub>, Germination

## **TS1P21**

### **Effect of Temperature on the Flowering Response to Photoperiod in Farmers' Varieties of Rice (*Oryza sativa* L)**

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A study on the photoperiodic control of flower in rice is advancing and rice has become an example of short day plant. Rice is sensitive to photoperiod — long-day treatments can prevent or considerably delay its flowering. Rice cultivars exhibit a wide range of variation in their degree of sensitivity to photoperiod. Flowering date, act as the most considerable aspect of agricultural trait of rice. The flowering of the rice plant is mainly controlled by two ecological factors- day length and temperature, which are often interrelated. The plant may respond to temperature and photoperiod simultaneously, but the degree would vary according to the cultivar. Temperature affects both the photoperiod-sensitive and photoperiod- insensitive cultivars. Generally, high temperature accelerates and low temperature delays heading. Some reports, however, have also shown that high temperature delays flowering. The optimum temperature for photo-induction may vary depending upon the photoperiod being used. The optimum temperature tended to be higher under a longer photoperiod and vice versa Putting it another way, at a certain temperature each cultivar has its own optimum day length under which it flowers at the earliest date. A total of 40

Farmers Varieties' collected from different parts of West Bengal, Assam and Manipur districts of India formed the subject of the present study. In all the cultivars, photoperiod induction commenced on the 21st day after germination, and continued till panicle emergence. Forty Farmers' Variety of rice was sown at an interval of 15 days for one year in the Research Farm of U.B.K.V., Pundibari. The dates of heading recorded in this experiment made possible the selection of 40 varieties on the basis of their differences in photoperiodic behavior. The varieties may, broadly speaking, be classed into 5 groups, viz. (1) varieties with a very low sensitivity to the photoperiod and a short juvenile phase, (2) varieties with a very low sensitivity to the photoperiod and a long juvenile phase (3), moderate (4), high (5) or very high sensitivity to the photoperiod. . Inflorescence initiation was determined by examining with a microscope.

**Key words:** Photoperiod, Flowering, Rice, Sensitive, Insensitive

## POSTER PRESENTATION

### Technical Session-2

## Conservation, Sustainable Development, Crop Improvement and Management for Doubling Farmers Income

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### TS2P1

#### Effect of Seed Pretreatment on Seed Germination of Papaya

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Papaya is one of the delicious tropical fruit. It is favoured due to its yellowish orange coloured soft sweet ripe fruit as table purpose as well as green fruit as culinary purpose. Fruit juice, milk shake, candy, jelly, jam etc are also commonly prepared value added products of papaya. The plant is commonly propagated by seeds and the seed germination is greatly effected by seed treatment to overcome barrier of germination from sarcotesta as well as the inhibitors present beneath the seed coat. Moreover seedling growth is also effected by seed treatment in papaya. In the present experiment seeds of Ranchi variety were soaked for 24 hours in the solutions of coconut water @ 50%, tomato juice @ 20%, cow urine @ 10%, GA<sub>3</sub> @ 200ppm, NAA @ 200ppm, KNO<sub>3</sub> @ 0.5% and normal water (control). 100 seeds replicated thrice for each treatment under Completely Randomized Design. Treated seeds were then sown in polythene bags having growing media comprising garden soil, sand, FYM and vermin-compost (2:2:1:1). Maximum seed germination was obtained under GA<sub>3</sub> @ 200ppm. Higher rate of seed germination was also observed in the seeds treated with 50% coconut water. Speed of germination was recorded highest in the seeds treated with GA<sub>3</sub> @ 200ppm. Seedling growth was highest under the same treatment. Germination was inhibited by KNO<sub>3</sub> and tomato juice treatment where rate of seed germination was observed lower than the control.

**Key words:** Seed, Pretreatment, Germination, Papaya

## TS2P2

### Effect of Organic Amendments for Sustainable Production of Broccoli (*Brassica oleracea* var. *italica*) under New Alluvial Plains of West Bengal

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A field experiment was conducted at Horticulture Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal from November 2017 to February 2018. The design of experiment was RBD replicated thrice. The variety used was Sadhana (F1 hybrid). From the experimental result, it was observed that application of the recommended dose of fertilizers recorded higher values for both the vegetative growth parameters like plant height (44.07 cm), plant spread (68.60 cm), stem girth (19.49 mm) etc. and reproductive parameters like curd diameter (10.42 cm), curd weight (153 g) and yield (17.32 t/ha). The treatment T3 (Vermicompost + Azotobacter + PSB) was found next best treatment after T1 (recommended dose of fertilizers). But as per economics and sustainability was concerned, T3 recorded the maximum values like B:C ratio (3.50) and net return (Rs 235150) followed by T4 (Neem cake + Azotobacter + PSB) with B:C ratio (3.18) and net return (Rs 189650). In quality parameters, the maximum Beta-carotene (2.71mg/100g) and ascorbic acid (132.10mg/100g) content was found in T3. From the experiment, it may be concluded that application of vermicompost + Azotobacter + PSB may be viable and sustainable for cultivation of broccoli for new alluvial plains of West Bengal.

**Key words:** Broccoli, Organic amendments, Sustainable production

## TS2P3

### Genetic Divergence in Babul

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Genetic divergence of Babul (*Acacia nilotica* L) was assessed using Mahalanobis D statistic. They were grouped into eight clusters. Maximum genetic distance was recorded between III & VIII clusters indicating greater distance between two clusters that showed maximum diversity amount the genotype and helps in hybridization programme.

**Key words:** Genetic divergence, D<sup>2</sup> statistic, Hybridization, Provenance

## **TS2P4**

### **Soil Surface Charge is an Index of Soil Productivity**

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Surface charge properties of four representative kaolinitic soils from humid tropics of India were investigated by a methodology involving independent measurement of net total permanent and variable charge components. Permanent structural charge was determined by Cs<sup>+</sup> adsorption; where as variable charge was quantified by simultaneous proton titration and background electrolyte (LiCl) adsorption measurement. The results show the zero point charge varies with soil according to the variation of organic matter and sesquioxide content. Net charge also varies with organic carbon, composition of clay and chemical component of soil. Variability in the magnitude of this charge was attributed to the effect of Al or Fe blocked exchange sites or contribution from dissociated organic functional groups. Organic carbon strongly affects the variation of negative charge with pH, but sesquioxide/allophone is responsible for positive charge variation. The  $\Delta$ pH value is presented as a measure of pedogenic development. The decrease in this  $\Delta$ pH value is interpreted as indicating that the soils are approaching a steady- state with time. These soils exhibited similar surface charge behavior, with no pronounced effect of differences in either organic carbon or Fe and aluminium oxide content. These characteristics of surface charges changes with changing the chemical content of the soil and directly proportional to soil fertility.

**Key words:** Soil surface charge, Index, Soil productivity

## **TS2P5**

### **Morphological and Biochemical Characterization of Indian Wild Orange in Nokrek Biosphere Reserve, Meghalaya**

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The study was carried out in Garo Hills region of Meghalaya, India during 2016-18 in the Department of Horticulture, North Eastern Hill University, Tura Campus, West Garo Hills, Meghalaya. Different 30 accessions of *Citrus indica* [R.C Woodford (2008)] were collected from different locations of Nokrek Biosphere Reserve which has shown enormous variability. The analysis of variance for one way classification was observed for physical and biochemical

characters namely; Tree height(m), trunk girth(cm), tree spread(m), leaf length (cm), leaf width (cm), fruit length (cm), fruit width (cm), fruit weight (g), number of fruit segment, juice content (%), rind thickness (mm), seed length (mm), seed width (mm), seed weight (g) number of seeds per fruit, TSS (°Brix), total sugar (%), reducing sugar (%), non-reducing sugar (%), acidity (%), pH and ascorbic acid (mg/100g). The analysis of variance was significant for all the traits which indicate that there was sufficient variability for each trait among accessions selected for study. The accessions of *Citrus indica* revealed that there is significant and positive correlation for some characters whereas there was high significant negative correlation for other few characters. Based on fruit length and fruit weight, accessions from Sasatgre was best, whereas on the basis of TSS and ascorbic acid, accessions from Mandalgre and Bandigre respectively was best and can be used for conservation, domestication, multiplication and for breeding programs. There was significant variable observed among the accessions for the characters studied.

**Key Words:** Morphology, Biochemical, *Citrus indica*, Variability, Correlation

## **TS2P6**

### **Analysis of Litter Fall Pattern, Nutrient Return, Decomposition and Budgeting Ecosystem Carbon under *Swietenia Macrophylla* King (Indian Mahogany) Plantation**

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The study was conducted in Mahogany plantation, U.B.K.V Campus, Pundibari. Quadrats size 1 X 1 m<sup>2</sup> was laid down randomly for litter fall study. The total litter production was 6920.2 kg ha<sup>-1</sup> yr<sup>-1</sup> and 8387 kg ha<sup>-1</sup> yr<sup>-1</sup> in 2016-17 and 2017-18 respectively. The increase in annual total litter production in 2017-18 was 17% higher than the year 2016-17. It was observed that leaf litter showed higher nutrients than that of rachis litter. The leaf fraction had the highest amount of nutrient in the decreasing order of N> K> P whereas the same trend was followed in rachis litter. The average weight remained in leaf litter after one year decomposition was 4.33 g (21.64%) and 5.01 g (25.05%) in rachis litter. In leaf litter decomposition after 3 months T<sub>0.50</sub> was observed in order of decreasing trend, whereas in rachis litter T<sub>0.50</sub> was observed after the four month. The nitrogen release of 127.78 kg ha<sup>-1</sup> and 31.46 kg ha<sup>-1</sup> was recorded in leaf and rachis respectively. Whereas in phosphorous it was observed release of 8.93 kg ha<sup>-1</sup> and 1.46 kg ha<sup>-1</sup> from leaf and rachis individually. The potassium nutrient release was 88.64 kg ha<sup>-1</sup> and 11.82 kg ha<sup>-1</sup> in leaf and rachis respectively. The total above ground biomass of the plantation was of order of 179.73 t ha<sup>-1</sup> of which 52.83 percent (95.02 t ha<sup>-1</sup>) was contributed by stem and the branch contributed 30.81

percent (55.37 t ha<sup>-1</sup>) and the remaining 16.32 percent (29.34 t ha<sup>-1</sup>) showed by leaves. Calculated below ground (root) biomass is 59.55 t ha<sup>-1</sup>. The specific gravity varied from 0.682 to 0.762. The total soil organic carbon 40.36 t ha<sup>-1</sup> comprising 25.30 t ha<sup>-1</sup>(0-20 cm), 10.46 t ha<sup>-1</sup>(20-40 cm) and 4.6 t ha<sup>-1</sup>(40-60 cm) depth wise respectively was recorded. The biosphere part recorded carbon was 109.82 t ha<sup>-1</sup>, comprise the total carbon of above and below ground biomass of 84.47 t ha<sup>-1</sup> and 25.34 t ha<sup>-1</sup> respectively. The recorded carbon storage of plantation was 150.18 t ha<sup>-1</sup>, the litter carbon stock of 3.48 t ha<sup>-1</sup>, was excluded from the ecosystem budgeting.

**Key words:** Ecosystem budgeting, Carbon stock, Biomass, Nutrient release

## **TS2P7**

### **Documentation, Utilization Pattern and Economics of Non Timber Forest Products of Fringe Villages in Jaldapara National Park**

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The present study was carried out at the fringe villages in and around Jaldapara Wildlife sanctuary of North Bengal. The study was delineated to explore the plant use pattern and the relationship of the same with the socio-economic attributes through a structure methodology. The research design followed in the study was survey research method and data were collected by random sampling technique through questionnaire based personal interviews. Almost all the respondents inhabiting in and around the forest fringe are indigenous tribes and dependent upon NTFP species for self consumption or to gain cash value. In the present study the households were living as far as 2.5 km away or close to the forest. The respondents were of age between 25 and 81 years with mean age of about 46 years. The respondents spent 1-6 hours daily to collect NTFP from the forest. Time spent for collection was more during winter than other seasons. Overall in the year the households were engaged in collection of NTFPs for 9-85 days. The total income of the household from NTFP ranged from Rs.1000 to 30,000. Medium sized families were generating more income from NTFP as compared to smaller and large ones. A total of 43 economically important species were recorded. A total number of 146 NTFPs species represented by 126 genera and 77 families were documented. Out of these documented NTFPs, 127 species of plant 7 species of fungus and 14 species of animal resources were present. Among the plants, trees were dominated with 72 species, shrubs 15 species, herbs 29 species and 5 species of climbers. The documented NTFPs were used to treat 49 types of diseases. Leaves were the most dominant plant part used and harvested from maximum of (70) plant

species, followed by fruits of 35 plant species. More than 60 % of the species collected or harvested is throughout the year and mostly were the fuelwood. The highest use of NTFPs species was done by Nepali communities (16 %) and lowest by Machey & Dhanwer 2% species each. The communities should be encouraged for sustainable harvesting species through capacity building, timely policy intervention along with strong market linkage to ensure their income, livelihood improvement and ultimately conservation of these species.

**Key words:** Jaldapara National Park, Utilization pattern, Non timber forest products

## **TS2P8**

### **Emerging Need of Iron Enrichment in Vegetable Crops for Children and Women**

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Iron is one of the most important micronutrients essential for human subsistence which is available in our diet through different vegetables and especially the leafy vegetables. Iron deficiency anaemia is a worldwide health problem, more specifically for women and children. Iron is the main constituent of blood haemoglobin which transfers oxygen in our blood from lungs to tissues. Iron is also needed for proper immune function. Globally more than 2 billion people are suffering from iron deficiency anaemia. Besides consumption of iron rich traditional vegetables, a new concept of biofortified vegetables (iron enriched) may be adopted to reduce the problem of iron deficiency and malnutrition in the developing countries. The ways of biofortification can be achieved through agronomic practices, conventional breeding process and genetic engineering. An increase in iron content of up to 3 mg/100 g was obtained in some biofortified leafy vegetable. This was about 40 times higher than the traditional leafy vegetables. The present review intends to reflect the recent advances on iron enrichment of different vegetable crops through agronomic practices, conventional breeding process and genetic engineering in order to promote iron fortified vegetables as an effective mean of strategy to combat the iron deficiency in women and children. Finally, the review suggests several future research areas relevant to iron fortification to exploit and improve the iron content of different vegetable crops.

**Key words:** Iron enrichment, Biofortified vegetable, Human health

## **TS2P9**

### **Ethno Botanical Edible Plant Biodiversity of Lepcha Tribes**

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Dzongu area of North Sikkim is one of the most biologically diverse habitats reserved for the Lepcha tribe in Sikkim. Surveys were conducted among the community during January to December 2009-10 to document the edible plants wealth of the area. Edible resources were categorized into four types on the basis of their uses. The paper highlights the edible resources commonly used by these tribes for life saving purposes in a very remote part of the country. Among vegetables, spices, fruits and underutilized plants, 38 plants belonging to 11 families under 24 genera are used as vegetables, nine plants from five families and seven genera are used as spices, 10 plants from seven families and nine genera are used as fruits and 19 plants from 17 families and 18 genera are underutilized for different purposes.

**Key words:** Edible, Lepchas, Plant diversity, Sikkim Himalaya

## **TS2P10**

### **Fern Diversity and Biomass in Urban Forest Ecosystem of Cooch Behar, West Bengal**

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Present study documented the status of fern diversity, biomass and carbon accumulation at in urban forest ecosystem of Cooch Behar, West Bengal. Stratified random nested quadrat sampling was adopted for analyzing the qualitative and quantitative characters. Nineteen fern species were recorded, of which two are yet to be identified. Identified species were of eight families and nine genera. Highest and lowest frequency recorded were 25.44 and 0.19 while relative frequency varied from 3.16 to 12.25. Fern density ranged from 93 to 13,403 individuals ·ha<sup>-1</sup>. Most of the species were widely distributed. IVI values ranged from 7.54 to 37.45. The above ground portion of ferns accumulated the major portion of biomass and carbon.

**Key words:** Chilapatta forest, Fern diversity, Biomass

## **TS2P11**

### **Ethno Medicinal Plants in Naxalbari Area of West Bengal, India**

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The present study was an effort to document the medicinal plants traditionally utilized by the local communities to cure various day to day prevailing ailments. The information on plants parts used, mode of administration, doses and uses in different ailments and disease was gathered from the tribal medicine men including the elders of the community using a well structured questionnaire. The study reported 35 plant species of ethno medicinal importance belonging to 31 genera and 26 families. The species comprised of 16 trees, 10 herbs, 8 shrubs and 1 climber. Of all these collected medicinal plant specimens, fruit was the most important and widely used. Fruits of (15) species were used in medicinal purpose followed by leaves (11), bark (9) and whole plant (5). The plants were used in various ailments in the form of powder, paste and raw form etc. These available plants are used to treat different diseases like body ache, heart problem, stomach disorder, cuts, fracture, gastric, tooth pain, headache, etc. in the localities of the existing communities. The transformation of existing traditional knowledge has kept intact the socio-cultural heritage, spiritual and medicinal arena of the people in the region.

**Key words:** Indigenous community, Ethnomedicine, Diseases

## **TS2P12**

### **Sacred Groves for Biodiversity Conservation**

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The sacred groves are patches of forests or woody thickets dedicated to deities and/or ancestral spirits used for worshipping by the indigenous communities. Sacred groves are important for conservation of biological diversity. The groves are an important means of expression and transmission of culture, necessitating recognition and support for the rights of their traditional caretakers and local communities. The conservation value of these sacred sites is recognized because they harbour higher species richness including endemics, biodiversity and biomass than the surrounding land uses. The paper discusses in detail the conservation value of the sacred groves and need to conserve it.

**Keywords:** Sacred Groves, Biodiversity, Conservation

## TS2P13

### Effect of Seed Inoculation Treatments on Seed Yield and Quality of Green Gram

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In addition to the prevalent practice of seed inoculation with nitrogen fixing bacteria, several other biological control agents are also applied to green gram for management of diseases affecting the crop in the form of seed treatment particularly for organic cultivation of green gram. To study the effect of such seed inoculation treatments with biological agents on seed germination, field emergence and its effect on seed yield and component characters, a field experiment was conducted during summer season, 2015 at the organic plot of the Instructional Cum Research (ICR) Farm of Assam Agricultural University (AAU), Jorhat. Seeds of green gram variety Pratap (SG-1) were treated with microbial formulations of *Rhizobium*, *Bacillus megaterium*, *Trichoderma harzianum*, *Trichoderma viride* and their combinations. The seven treatments consisted of *Rhizobium* (T<sub>1</sub>), *Trichoderma harzianum* (T<sub>2</sub>), *Trichoderma viride* (T<sub>3</sub>), *Bacillus megaterium* (T<sub>4</sub>), *Trichoderma harzianum* + *Trichoderma viride* + *Bacillus megaterium* (T<sub>5</sub>), *Rhizobium* + *Trichoderma harzianum* + *Trichoderma viride* + *Bacillus megaterium* (T<sub>6</sub>) and Control (T<sub>7</sub>). The experiment was laid out in Randomised Block Design with four replications. The unit plot size was 1.5 m x 3 m with a row to row spacing of 30 cm and 10 cm between plants. After 20 days of sowing, shoot length, root length and seedling dry weight were recorded and observations on nodulation, yield and yield contributing characters were recorded at maturity. In addition, germination characteristics of the seeds treated with various inoculants were studied in the laboratory. Analysis of variance revealed significant variations among the treatments for all the characters except root length and number of seeds pod<sup>-1</sup>. Seeds treated with combined inoculation of *Rhizobium* @ 4 g + *Bacillus megaterium* @ 5ml/1000 ml of water + *Trichoderma harzianum* @ 5ml/1000 ml of water + *Trichoderma viride* @ 5ml/1000 ml of water (T<sub>6</sub>) recorded significantly higher field emergence (91%), speed of emergence (42), seedling dry weight (1.67mg), shoot length (25.48 cm), seed yield (992 kg ha<sup>-1</sup>), Stover yield (1870 kg ha<sup>-1</sup>), number of pods plant<sup>-1</sup> (37), number of seeds pod<sup>-1</sup> (13.25), 100 seed weight (3.63g) root length (9.22 cm), nodulation (15) except disease incidence (3.95%) which was the lowest. The same treatment (T<sub>6</sub>) showed best performance under laboratory conditions for germination characteristics such as germination percentage, speed of germination and hard seeds percentage. These results, thus, indicated that the combined inoculation treatment of *Rhizobium* with other biological agents improves vigour characteristics and seed yield in green gram.

**Keywords:** Green gram, Seed inoculation, *Rhizobium*, *Trichoderma*, *Bacillus megaterium*

## **TS2P14**

### **Conversion Human Hair into Resource for Plant Nutrients**

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With the advancement of human civilization, research works in agricultural sector are mainly focused on sustainability and maintenance of natural resources as well as introduction of eco-friendly technologies. In this context, human hair which plays one of the important roles in polluting the environment can be utilised as a source of different plant nutrients as it contains high amount of nitrogen and other elements essential for plant growth. Since, as a potential resource, it has an added advantage of being slow but complete biodegradable properties, source of renewable energy and is available in every localities of our country. Another common possible way of re-using the human hair is making wigs or hair-extensions. But it depends upon the variety of hair available and it's quality like length, colour, hair damage etc. On the other hand, when the waste material from hair processing unit is burnt, it releases some toxic elements which can cause respiratory tract infection of the people engaged in the trade as well as in local people. From this point of view, the best way of utilisation of human hair is by converting it into biodegradable organic manure to avoid environmental hazard.

**Key words:** Human hair, Waste, Manure, Natural resource

## **TS2P15**

### **Diseases in Orchids**

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The orchids have taken a significant position in cut flower industry due to its attractiveness, long shelf life, high productivity, right season of bloom, easy in packing and transportation. Orchid accounts for a large share of global floriculture trade both as cut flowers and as potted plants and is estimated around 10% of international fresh cut flower trade. The total orchid cut flower trade of the world mostly consists of 85% *Dendrobium* species and 15% *Phalaenopsis* and *Cymbidium* species and Asia is the main source of orchid to enter the world. In India, some of native genera like *Cymbidium*, *Paphiopedilum*, *Vanda*, *Arachnis* and *Dendrobium* are cultivated on a large scale for cut flower production. The *Cymbidium* is mainly grown at higher elevation of Sikkim, Darjeeling hills and Arunachal Pradesh with cool summer and heavy precipitation. Tropical orchids are cultivated in Kerala and some parts of Tamil Nadu, Karnataka and

Maharashtra. Orchids are infected by a number of fungal, bacterial and viral diseases due to high humidity and high temperature during active growing period. Among fungal diseases anthracnose, Pythium black rot, heart rot, blossom blight, bacterial diseases such as soft rot and viral diseases like Cymbidium mosaic virus (CyMV), Tobacco mosaic virus-0 (TMV-0) and Odontoglossum ring spot virus (ORSV) have been reported in orchids. Suitable protection measures may be taken up to manage these diseases.

**Key words:** Orchids, Cut flowers, Diseases

## **TS2P16**

### **Development of Superior Somaclones of Aromatic Local Rice Cultivar**

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Aromatic rice has great demand in international as well as national markets for aroma. However, it possesses very low yield potential. The traditional local aromatic land races also possess very low combining ability with the modern high yielding varieties and subsequently to development of transgressive segregants. Thus, there is strong need to develop suitable genotype(s) using biotechnological tools. The objective of this endeavor was to develop dwarf, photoperiod-insensitive, high yielding aromatic somaclones from aromatic cultivars. Surface sterilized dehusked rice seeds of four aromatic cultivars were inoculated on MS medium supplemented with 1mg L<sup>-1</sup> of 2,4-D. Regeneration potential of the varieties was assessed by culturing the selected calli on regeneration medium (MS + 1 mg L<sup>-1</sup> kinetin + 1 mg L<sup>-1</sup> BAP + 0.5 NAA). After hardening, regenerated somaclones were tested in the field to isolate the aromatic somaclones with dwarfness, photoperiod-insensitive, high yield potential. The somaclones, TC 4/8 had the maximum yield followed by TC 5-1, TC 4/4, TC 4/5, and TC 4/7. Yield increase of TC 4/8, TC-5-1 was 54.75% and 50.33% more over the yield of parental cultivar, respectively. The plant tissue culture thus may be recommended to create genetic variability in rice as a trustworthy biotechnological tool. Desirable somaclonal variation was created through matured seed derived callus induction and subsequently regeneration of plantlets. Somaclonal variation may be considered as alternative breeding tool for improvement of aromatic traditional rice.

**Key words:** Local cultivars, Aromatic rice, Somaclones, Biotechnological tool

## TS2P17

### Response of Buckwheat Varieties at Different Levels of Management

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A field experiment was conducted during Rabi season of 2016-17 at the instructional farm of Uttar Banga Krishi Viswavidyalaya to evaluate the performance of buckwheat varieties at different level of management. The farm is situated at 26°19'86" N latitude and 89°23'53" E longitude at an elevation of 43 meter above mean sea level. The soil of the experimental site was sandy loam with acidic soil reaction. The experiment was laid out in factorial randomised block design with four replications. There were 32 treatment combinations comprising eight varieties [IC 013533, IC 13510, IC 412733, VL Ugal 7, PRB 1, Himpriya, Shimla B1 and Sangla B1] and four management level [Control, 50 % recommended dose of fertilizers (RDF) + one irrigation, 75 % RDF + two irrigations, 100 % RDF (@ 40:20:20 kg NPK/ha) + three irrigations]. Fertilizers were applied in the form of urea, single super phosphate and muriate of potash. The other recommended management practices were done as and when required. It was observed that all the growth parameters: plant height; yield attributes: number of branches; and yield was significantly varied among different treatment combinations. Treatment combination 100 % RDF + three irrigations and Shimla B1 recorded highest plant height (114.0 cm). Significantly more number of primary and secondary branches were recorded with 100 % RDF + three irrigations and PRB1 (3.0 plant<sup>-1</sup> and 6.08 plant<sup>-1</sup> respectively) followed by 100 % RDF + three irrigations and VL UGAL 7 (3.0 plant<sup>-1</sup> and 6.0 plant<sup>-1</sup>, respectively). Application of 100 % RDF + three irrigations recorded highest seed yield (23.55 q/ha) followed by 75 % RDF + two irrigations with PRB1 which was at par with 100 % RDF + three irrigations and VL UGAL 7 (22.08 q/ha). The lowest yield was recorded with control and IC 13510. It could be concluded that 100 % RDF + three irrigations with PRB 1 followed by VL UGAL 7 would respond well.

**Key words:** Buckwheat, Fertilizer, Irrigation, Yield

## **TS2P18**

### **Modelling Bio-Physical Parameters of the Buxa Tiger Reserve using Satellite Data**

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Use of satellite remote sensing to model forest biophysical parameters is a successful recent practice. It requires less time, cost as compared to the conventional ground survey based analysis and has increased the efficiency and precision of the process. The present research aims to understand different biophysical parameters like photosynthetically active radiation (PAR), fraction of absorbed photosynthetically active radiation (fAPAR), leaf area index (LAI), chlorophyll content etc. of the vegetation cover of Buxa Tiger Reserve (BTR), using satellite data. The BTR is a national park, which is situated in the northern part of West Bengal and has diverse vegetation types like Evergreen forest, Semi Evergreen forest, Sal forest, Dry mixed forest, Wet mixed forest, Riverine forest, Hill forest, and Savannah forest. Therefore the biophysical parameters of BTR are highly heterogeneous. For the estimation, ground measurements were taken at sample plots of different parts of the forest. Specific instruments were used for PAR, fAPAR, LAI and chlorophyll measurement. Satellite data like- LISS-IV, Sentinel, MODIS LAI etc. were also acquired. At present the ground information are being compared with the satellite data or derive secondary indices. We are towards calibration of the model using these data for estimation of the forest bio-physical parameters.

**Keywords:** Forest biophysical parameters, Satellite data, Modelling

## **TS2P19**

### **Diversity and Biomass of Woody Perennials in Pundibari Campus of Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal**

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The study documented woody perennials and estimated their biomass and carbon stock. The study was carried out by individually documenting all the woody perennials with dbh  $\geq$  10cm and all were measured for DBH and height individually. The biomass and carbon stock was estimated by non-destructive method using wood specific gravity and for some species volume equations. A total of 1816 numbers of individuals with dbh  $\geq$  10cm of 95 woody perennials species were

documented. These documented species were belonging to 79 genera and 38 families. The value of specific gravity ranged between 0.10 cm<sup>3</sup> to 0.92 g cm<sup>3</sup> with average value 0.56 g cm<sup>3</sup>. Highest value of specific gravity was recorded in *Legestroemia speciosa* (0.92 cm<sup>3</sup>) and minimum in *Bauhinia verigata* (0.10 cm<sup>3</sup>). The contribution to total biomass was 79.40% from AGB and 20.60% from BGB tree species. In the AGB forestry tree species showed dominance in terms of contribution (322.95 Mgha<sup>-1</sup>) followed by plantation crops (169.695 Mgha<sup>-1</sup>), road side plantation (107.069 Mgha<sup>-1</sup>) and least by fruit crops (45.190 Mgha<sup>-1</sup>).

**Keywords:** Diversity, Biomass, Carbon stock

## **TS2P20**

### **Studies on the Diseases of Important Medicinal Plant of North Bengal**

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A study was conducted on diseases of important medicinal plants their etiology and management under North Bengal situation. Ten diseases on nine important medicinal plants were recorded during the period of survey. Among the diseases recorded Leaf blight disease was observed on *Oroxylum* plant, Sweet Basil, Neem and *Sterculia*. *Cercospora* leaf spot disease was observed on *Smilax*, *Clerodendron*, and *Ritha*. On *Rauwolfia* plants two diseases i.e. target leaf spot and leaf blight was observed. On the basis of periodical survey, the period of tentative occurrence of different diseases of medicinal plants in a calendar year under North Bengal situation were worked out of which Rust disease on *Acorus* was observed from March to November, *Cercospora* leaf spot of medicinal plants were observed from May to November and Leaf blight/ bud rot during May to July. Among the various fungicides tested *Cercospora* induce leaf spot disease of important medicinal plant was effectively managed with Hexaconazole fungicide. Triazole fungicides were also found effective for the management of rust disease of *Acorus*.

**Key words:** Medicinal plants, Diseases, Survey, Fungicides

## **TS2P21**

### **Artificial Diet: It's Importance in Mass Rearing of Insects with special reference to Sugarcane Stalk Borer (*Chilo Auricilius* Dudgeon- Lepidoptera: Pyralidae)**

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Sugarcane (*Saccharum officinarum* Linnaeus) is one of the major cash crop native to the warm temperate to tropical regions of South Asia and Melanesia, and used for sugar production. Mass rearing refers to the production of insects in numbers per generation exceeding 10 thousand to 1 million times the mean productivity of the native female population. Insects are reared for various purposes, e.g. insecticide testing, hormone and pheromone manipulations, biological control, host-plant resistance, male sterilization and genetic engineering, etc. The availability of large number of insects through rearing on artificial diet has added new dimensions in investigating diverse entomological problems such as physiological, toxicological, biological control, host-plant relationship and production of insect pathogens, attractants and hormones. When insect is reared on natural food in the laboratory for its mass production, problems like high rate of mortality and requirement of regular fresh food material usually occur in the laboratory. Therefore, the use of artificial diet makes it convenient to rear insect on it to ensure the continuous supply of large number of immature stages for various research studies.

**Key words:** Sugarcane, Cash crop, Mass rearing, Artificial diet

## **TS2P22**

### **Estimation of Genetic Diversity for Yield Traits of Brinjal**

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For improving the yield potential of varieties and hybrids the decision should be made about the choice of right type of parents for hybridization. The present study was taken up at the Instructional Farm UBKV, Pundibari, Cooch Behar, West Bengal during 2015-2016 for 8 characters of brinjal landraces. The 26 brinjal genotypes were grouped into eleven clusters based on  $D^2$  values. Cluster I and V were comprises maximum 4 genotypes. All other Cluster had digenotypic except Cluster XI was monogenotypic. The inter cluster distances were higher than the average intra cluster distances, which indicated wide genetic diversity among the genotypes

of different groups than those of same cluster. On the basis of the cluster means the important cluster was cluster IV for fruit circumstances, average fruit weight, marketable yield plot<sup>-1</sup> and total yield plot<sup>-1</sup>. The result of cluster mean clearly indicated that genotypes like UBB-8, Suphal-2 green (Malda) and Black Beauty could be selected as parents for future hybridization programme. The genotypes from the cluster I, IV and IV 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.

**Key words:** Brinjal, Genetic diversity, Cluster analysis, Hybridization

### **TS2P23**

#### **Genetic Variability, Heritability and Genetic Advance Study in Tomato (*Solanum lycopersicum* L)**

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A field experiment was conducted to study genetic variability, heritability and genetic advance for yield and quality traits in thirteen tomato genotypes. The experiment was laid out in Randomized Block Design (RBD) with three replications during 2017-2018 at the Main Experiment Station, Department of Horticulture, Sikkim University, Gangtok. Considerable amount of variability was noticed for the twelve quantitative characters as indicated by the analysis of variance. Among the genotypes, genotype ST-102 (T<sub>7</sub>) emerges as best in terms of fruit yield per plant (681.32g). Ascorbic acid content was found maximum for the genotype ST-102 (T<sub>7</sub>) with the value of 34.62 mg where as highest TSS (6.40°B) was recorded for the genotype ST-112 (T<sub>8</sub>). Analysis of coefficient of variation revealed that, the magnitude of phenotypic coefficient of variation was slightly higher than the genotypic coefficient of variation for all the traits. Moderate to high GCV and PCV, high heritability with high genetic advance observed for most of the yield attributing characters. High estimate of GCV and PCV was recorded for total phenol content (56.60% and 56.93% respectively). High heritability was noticed for characters like total phenol content (99%), total soluble solids (95%), ascorbic acid (93%), average fruit weight (91%) and fruit yield per plant (90%). Genetic advance as a percent of mean was recorded very high for total phenol content (115.96%).

**Keywords:** Tomato, Fruit yield, Quality, Variability, Heritability, GCV, PCV

## **TS2P24**

### **Cytokinin mediated changes in growth and flowering of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda**

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African marigold due to its multifarious uses in landscaping, floriculture and value addition is now-a-days considered as one of the most important commercial loose flowers of India in particular and globally in general. The carotenoid obtained from it also finds utility in textile colouration, poultry feed, confectionary and pharmaceutical industries. Yield and quality of this crop largely depend upon several factors of which application of plant growth regulators is a major one. To evaluate the effect of benzyl adenine (BA), a commercial cytokinin, on growth, yield and quality of African marigold, an experiment was conducted at Uttar Banga Krishi Viswavidyalaya in 2016-17. Twelve different concentrations of benzyl adenine namely – 25 ppm, 50 ppm, 75 ppm, 100 ppm, 125 ppm, 150 ppm, 175 ppm, 200 ppm, 225 ppm, 250 ppm, 275 ppm and 300 ppm were applied to plants of African Marigold cv. Pusa Narangi Gainda as foliar spray and the effects were compared to control plants (no plant growth regulator application). Results revealed that application of 175 ppm BA significantly increased the diameter (7.25cm) and fresh weight of flowers (87.42 g / 10 flowers). Maximum fresh (697.10 g) and dry (259.14 g) weights of plant were recorded with 150 ppm BA application. The highest Number of flowers (44.13) per plant was obtained from 50 ppm BA application and 200 ppm BA application resulted in maximum amount of carotenoid (373.99mg/1000g) biosynthesis. In the present experiment B:C ratio was found highest (3.19) with 25 ppm BA application at 15 and 30 days after transplanting. This might be due to lower input cost thereby reducing the cost of cultivation than other levels realizing the higher yield over control, which was established as the best compromise as compared to the additional higher yield obtained by other levels, thereby recommended for commercial production of African marigold in the Terai region of West Bengal.

**Keywords:** African marigold, BA, Benzyl Adenine, Cytokinin

## **TS2P25**

### **Effect of Soil Drying and Rewetting on Nitrogen Mineralization from Soil Amended with Organic Matters**

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Decomposition rate of various organic matters in soil depends on their intrinsic qualities, environmental condition specially temperature and moisture as well as size, diversity and activity of soil microorganisms. Soil water content variation caused by drying and rewetting events constitute an environmental factor that may have an important effect on N mineralization. In the future, many regions of the globe may experience higher mean annual temperatures and greater intra-annual variability in the timing of precipitation events. Under these scenarios, surface soils may experience more frequent drying and rewetting events. However, limited data are available on the effect that drying and rewetting may have on N mineralization from added organic matter. With this background the present study was undertaken with the specific objective to study the effect of drying and wetting of soil on nitrogen mineralization of organic matters under laboratory condition. After 10 days of drying that nitrogen mineralization for all the organics were significantly less as compared to constant moisture treatment. The difference of net nitrogen mineralization was more in tannery waste than other two. After second drying also nitrogen mineralization were more in constant moisture treatment for all the organics. It was also revealed that reduction of net mineralization was more after second drying.

**Key words:** Drying, Rewetting, N-Mineralization, Organic matter

## **TS2P26**

### **Priming of Rice (*Oryza Sativa* L) Seeds with Coconut Water for Enhancement of Germination and Seedling Vigour**

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Seed priming is an effective tool to attain high germination and germination rate, uniformity of seedlings and crop stand. It has been used to reduce seedling emergence time, enhance synchronized emergence, improved emergence rate and better seedling stand and is known to improve tolerance ability against biotic and abiotic stresses through enhance seedling vigour. Present study was conducted to determine the effectiveness of seed priming on the germination,

speed of germination and seedling vigour of five varieties of rice. Rice seeds were subjected to priming for 18 hours in distilled water and coconut water. After of soaking for 18 hours the primed seeds were subjected to shade drying for 72 hours. The effects of priming in distilled water and coconut water for 18 hours are comparable. Priming with coconut water at 100% shown highest germination and seedling vigour against 25%, 50% coconut water, distilled water and control. 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. In this endeavour, the effect of botanical extract like, coconut water studied on germination and other seedling parameters of rice seeds, vars. MTU 1075, Jugal, Sehaphal, Gontra Bidhan-1 and IET 23171.

**Key words:** Seed priming, Coconut water, Germination, Speed of germination

## **TS2P27**

### **Effect of sowing time and spacing on growth and yield of *Valeriana jatamansi***

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A field experiment was started during the *Kharif* season of 2016-17 at Regional Research Station (Hill Zone), UBKV, Kalimpong to study the effect of sowing time and spacing on growth and yield of *Valeriana jatamansi*. The experiment was laid out in split-plot design with two transplanting time (i.e. 1<sup>st</sup> week of June and 1<sup>st</sup> week of July) as main plot treatment and three different spacing (i.e. 30cm × 20cm, 30cm × 30cm and 30cm × 45cm) as sub-plot treatment. Transplanting at 1<sup>st</sup> week of June produced more root and rhizome biomass throughout different times of observation. The plant spacing of 30cm × 45cm produced maximum root and rhizome biomass over 30cm × 20cm and 30cm × 30cm of spacing throughout different times of observation, though two spacing's 30cm × 30cm and 30cm × 45cm showed at par biomass yield. So it may be recommended to transplant *Valeriana jatamansi* seedling during 1<sup>st</sup> week of June with 30cm × 45cm of spacing.

**Key words:** sowing time, spacing, *Valeriana*

## **TS2P28**

### **Evaluation of yield and yield attributes of popular rice varieties of Old Alluvial Zone under Conventional transplanting and System of Rice Intensification**

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An experiment was conducted during Kharif 2014 and Kharif 2015 at Regional Research Station, Old Alluvial Zone, UBKV, Majhian Dakshin Dinajpur for comparing the popular rice varieties of old alluvial zone under two cultivation system *i.e.*, conventional transplanting and SRI. As SRI system is gaining popularity among the farmers of this zone, the objective behind planning this experiment was to compare between the performance of different popular varieties under conventional transplanting and SRI. Also to get recommendation regarding rice varieties for the zone. Six popular rice varieties, viz, Swarna mashuri, Samba mashuri, MTU-1010, Nabin, Satabdi and PR-114 were taken under both the system. In case of all the six varieties, they performed significantly better under SRI. Under conventional and SRI systems, the variety Swarna Mashuri yielded significantly higher than the rest of the varieties (5.82 t/ha and 5.94 t/ha, respectively) followed by MTU-1010 (5.04 t/ha and 5.35 t/ha, respectively), Nabin (4.87 t/ha and 5.05 t/ha, respectively) Samba Mashuri (4.66 t/ha and 4.97 t/ha, respectively), Satabdi (4.3 t/ha and 4.60 t/ha, respectively) and PR-114 (4.01 t/ha and 4.31 t/ha, respectively). The yield contributing characters like no. of effective panicle/plant, panicle length, no. of grains per panicle, grain weight per panicle and 1000 grain weight of Swarna Mashuri resulted significantly higher than rest five varieties in experiment under SRI.

**Keywords:** Conventional transplanting, SRI, Rice, yield

## **TS2P29**

### **Crop Diversification as a key tool to attain sustainability through mitigating impacts of climatic changes**

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The green revolution of the 1960s and 1970s which resulted in dramatic yield increases in the developing Asian countries is now showing signs of fatigue in productivity gains. Intensive agriculture practiced without adherence to the scientific principles and ecological aspects has led to degradation of soil health, decline in availability of freshwater resources and agro-biodiversity. The balance between food supply and demand is shifting abruptly from surplus to deficit due to negative impacts of climate changes. Managing food security and its sustainable development is one of the biggest challenges in India. Sustainability refers to the satisfaction of the needs of the present and local population without compromising the ability of future generation or population in

other locations to meet their needs. Sustainable agriculture in the context of development efforts has to meet production efficiency, stability to ecosystems and satisfaction of the basic needs with the help of appropriate technology and cultural diversity. Within this framework, crop diversification or crop shift is a new paradigm of sustainable agriculture. Crop diversification with the objectives like natural resources sustainability, ecological balance, output growth, employment generation, risk coverage helps to attain increased total productivity in terms of quality, quantity and monetary value under specific, diverse agro-climatic situations worldwide. The major driving forces for crop diversification are- (i) increasing income on small farm holdings, (ii) minimizing price fluctuation, (iii) balancing food demand, (iv) improved fodder production for livestock animals, (v) conservation of natural resources (soil, water, etc.), (vi) minimizing environmental pollution and (vii) decreasing insects, pests, weeds and diseases. The approaches of crop diversity include horizontal approach (crop intensification and crop substitution), vertical approaches (processing, regional branding, packaging etc. to enhance the product value), land use approach (alley cropping, pasture management), water based approach (diversion of high water requiring crops to less water intensive crops), varietal diversification (substitution of low yielding varieties with high yielding varieties to maximize profit), nutrient management (cultivation of legume crops), pest management (intercropping, resistant variety development), risk reduction (crop rotation). So, in short words, crop diversification in agriculture will have a tremendous impact in the uplifting of resource-inadequate farming systems and an overall increase in yield of crops mainly due to maintenance of physical and chemical properties of soil. It will also generate employment opportunities for rural youth around the year for the utmost benefits of the Indian farmers. There are still various constraints for crop diversification like poor basic infrastructure, inadequate post-harvest technologies, very weak agro-based industry etc., but location specific approaches and government policies and strategies for crop diversification need to be approved.

**Keywords:** Green revolution, Climate changes, Sustainable agriculture, Crop diversification

### **TS2P30**

#### **Surveillance of Pest population on different non scented and scented Rice cultivars under changing management scenario**

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Survey was carried out in Dakshin Dinajpur district at Regional Research Station (Old Alluvial Zone), Majhian, under Uttar Banga Krishi Viswavidyalaya on 10 (ten) non scented and 04(four) scented rice varieties. The observations were made on the incidence of different insect pests and their natural enemies at fortnightly interval to monitor insect pests on unsprayed paddy field. Maximum pest population was recorded on vegetative and reproductive stage of the crop. Yellow

stem borer, *Scirpophaga incertulas* (Wlk) and hopper complex (*Nephotettix* spp., *Nilaparvata lugens* (Stal) and *Cofana* spp.) was maximum during September – October while the month of October leaf folder was maximum at vegetative stage, during October- November *Leptocorisa* spp. at flowering stage only. Highest Leaf folder population were recorded on Sawrna Sub-1 (2 folded leaf with larva/hill) however the population of the pest was suppressed by *Apantellis* sp. (pupal mass 1/5hills on an avg. and adult emergence was 18.74/pupal mass).

**Key words:** Scented rice, *Apantellis* sp., Yellow stem borer, hopper complex

### **TS2P31**

#### **Symptom manifestation in rhizome rots and wilt disease complex of ginger by single or combination of pathogens**

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In a field study at different locations of Kalimpong subdivision as well as study under controlled condition with the different pathogens isolated from infected ginger plant and soil from the different villages revealed that association of nematodes, fungi and bacteria made the rhizome rot and wilt disease of ginger more complicated. Different types of symptoms were manifested by single infection with *Pythium*, *Fusarium*, *Ralstonia* and *Pratylenchus* or combined infection with these pathogens. The field study has showed four characteristic types of symptoms manifestation. Higher disease incidence was recorded where *Ralstonia* and nematode were associated with the disease. The study under controlled condition also indicated that induction of wilt was first occurred in *Ralstonia* inoculated pots as compared to *Pythium* and *Fusarium* inoculated pots. Pots inoculated with both *Ralstonia* and *Pratylenchus* expressed wilt symptom earlier (after 20 days), with higher disease incidence of 80 percent, than those inoculated with *Ralstonia solanacearum* alone, where symptom developed after 25 days and incidence observed up to 63 percent. However, plants inoculated with all the pathogen combination have been found to express rhizome rot and wilt disease complex symptoms earliest (after 16 days) with greatest severity (93.33%). The findings from the present investigation thus indicated that *Ralstonia solanacearum* and nematode association had a synergistic effect on the severity of rhizome rot and wilt disease complex of ginger.

**Keywords:** Ginger, Rot and wilt pathogen, Symptom manifestation

### **TS2P32**

#### **Effect of different ecofriendly soil cover on weed management practices in Ginger (*Zingiber officinale* Rose) in Darjeeling Himalayas**

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A field experiment was conducted during the year of 2016 and 2017 at the Regional Research Station (Hill Zone) of Uttar Banga Krishi Viswavidyalaya, Kalimpong, Darjeeling, West Bengal. The experimental field was laid out in Randomized Block Design, having seven varying treatments with three replications. To evaluate the growth and yield of ginger (*Zingiber officinale* Rose) as influenced by ecofriendly and alternative weed management practices. The treatments consisted of dry weed biomass mulch @ 5.0 t/ha (T1), paddy straw mulch @ 5.0 t/ha (T2), FYM Mulch @ 5.0 t/ha (T3), dry leaves of *Schima wallichii* @ 5.0 t/ha (T4), dry leaves of *Artimesia* sp. and *Eupatorium* sp. @ 5.0 t/ha (T5), hand weeding (twice) at 55 and 70 DAS (T6) and unweeded control (T7). The obtained results of ginger under seven varying ecofriendly and alternative weed management practices showed that the hand weeding twice at 55 & 70 DAS appreciably reduced the total weed population per metre square and total dry weight of weeds than unweeded control plot (T7) at all the stages of crop growth. However the highest plant height (81.01 cm), number of leaves per clump (65.94), number of pseudo stem per clump (5.05), yield per plant 0.260 kg/plant and yield 54.12 t/ha was recorded under the hand weeding twice at 55 and 70 DAS (T6) compared to control plot. The results showed that it is necessary to cover the soil surface with different mulch materials and manually weed control practices to achieve a good control of weeds along with enhanced yield attributes and yield.

**Keyword:** Ginger, FYM, mulch, weed, growth, yield

### **TS2P33**

#### **Evaluation of wheat genotypes against spot blotch disease caused by *Bipolaris sorokiniana* under terai region of West Bengal**

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Most important disease of wheat in north eastern plain zone is leaf blight or spot blotch caused by *Bipolaris sorokiniana*. This disease-causing loss in grain yield may range from

10-50 percent. In addition to the reduction in yield the diseases deteriorate the seed quality. To study the response of resistant against leaf blight at Agriculture research farm, Uttar Banga Krishi Viswavidyalaya, total of 163 number entries was planted under leaf blight screening during 2017-18. Data was recorded at three different crop growth stages such as flowering, dough and hard dough stages. Among the three stages, blight record at hard dough stage was most distinct in terms of giving clear comparison between resistant and susceptible entries and therefore data at hard dough stage was used for final categorization of test entries. Among the 163 entries, no entry showed highly resistant response but 03 were resistant and 34 genotypes were moderately resistant, 44 lines were found to be susceptible, 82 lines are highly susceptible entries and not a single entry were found highly resistant during 2017-18.

### **TS2P34**

#### **Weed Management Strategies in Jute (*Corchoruscapsularis* L.) Seed Production in High Rainfall Zone of West Bengal**

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A field experiment was conducted at the instructional farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, during *kharif* 2014 and 2015 to evaluate the comparative efficacy of herbicides fenoxaprop-*p*-ethyl with standard doses of quizalofop-*p*-ethyl and Pendimethalin to control grassy weeds in jute seed production. Seed yield losses in control plot were observed 66.6% in comparison to hand weeding twice. Weed species counted 30 and 60 days after sowing (DAS) was found lowest in fenoxaprop-*p*-ethyl at 67.5g ha<sup>-1</sup> treated plot while seed yield was higher in the fenoxaprop-*p*-ethyl at 56.25g ha<sup>-1</sup>. Morphological attribute so for jute viz., plant height, based in meter, number of capsules plant<sup>-1</sup>, test weight and seed yield were found significantly higher in fenoxaprop-*p*-ethyl at 56.25g ha<sup>-1</sup> which exhibited at par with quizalofop-*p*-ethyl at 900 ml ha<sup>-1</sup> among the herbicidal treatments. The highest weed control efficiency (WCE) was observed in fenoxaprop-*p*-ethyl at 67.5g ha<sup>-1</sup> but yield attributes and yield were found higher in fenoxaprop-*p*-ethyl at 56.25g ha<sup>-1</sup>. The study also reveals post emergence herbicides- fenoxaprop-*p*-ethyl and quizalofop-*p*-ethyl more effective than pre-emergence herbicides viz. Pendimethalin in controlling the weeds in jute.

**Keywords:** Weed management, Jute, Weed control efficiency, pod yield.

## TS2P35

### Effect of rice-based cropping system on growth and yield of *kharif* rice in red and lateritic zone of West Bengal

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A field experiment was conducted during *kharif* seasons of 2014 and 2015 at Agricultural Farm, Palli Siksha Bhavana, Visva-Bharati, Sriniketan, Birbhum, West Bengal to study the effect of growth and yield of *kharif* rice in red and lateritic soil zone of West Bengal. The experiment consisted of ten treatments, was laid out in Randomised Block Design where each treatment was replicated thrice. Plant height of rice did not show significant result among the different rice-based cropping systems investigated under study. However, the taller plant height of rice was observed in rice-potato-green gram cropping system followed (116.27 cm). Dry matter accumulation of rice plant was increased progressively from 30 DAT and upto 75 DAT and the highest value was noticed when rice-potato-green gram cropping system followed as per pooled data (968.85). Crop growth rate increased linearly upto the age of 60 DAT and thereafter decreased and the highest crop growth rate was found in treatment with rice-potato-green gram cropping system to the tune of 20.74 g m<sup>2</sup> day<sup>-1</sup> at 75-90 DAT. Leaf area index also showed the same trend as recorded in crop growth rate of rice. These might be due to mortality of tillers that came at later growth stages. However, significantly highest leaf area index (LAI) was recorded at 75 DAT in rice-potato-green gram cropping system (3.90), when pooled data analysed and the result was at par with rice-rape seed-green gram cropping system. Considering two years of field experiment the number of tillers hill<sup>-1</sup> at harvest was recorded significantly highest in rice-potato-lentil cropping system (391.68). Yield attributes viz., number of panicles m<sup>-2</sup>, number of filled grains panicle<sup>-1</sup>, test weight (391.68, 114.60 and 24.17, respectively) was obtained when rice grown in sequence with potato and green gram during *kharif* seasons of 2014 and 2015. Rice-potato-green gram showed significantly highest grain and straw yield (4.81 and 6.12, t ha<sup>-1</sup>, respectively) of rice when compared with two years pooled data. Where, higher mean harvest index was observed in french bean-baby corn grown in sequence with rice (44.98%). Significantly highest gross return, net return and return rupee<sup>-1</sup> investment (80019 ha<sup>-1</sup>, 43701 ha<sup>-1</sup> and 2.20, respectively) were recorded in rice when rice grown in sequence with potato and green gram as per pooled data analysed.

## TS2P36

### **Integrated farming – an approach towards sustainable production and income generation for farmers of Dakshin Dinajpur, West Bengal**

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Integrated farming can play an important role in increasing manifold production, income and nutrition and employment opportunities of rural populations. The integrated fish farming practices can utilize the waste from different components of the system viz. duckery and various other agriculture by-products for fish production. Animal wastes and waste feed material that enter the food web of a pond ecosystem are utilized as a source of nutrients required for primary production. On farm trial was carried out at twenty eight farmers' ponds covering area of 3.5ha each Farming Systems Research site, Dakshin Dinajpur district during the year 2016-17 to 2017-18 to assess integrated pond based production, income and employment opportunity of the rural farm house holds. Three different components like fish, duck and dyke based vegetables production were employed in the investigation. The results indicated that in integrated pond management, two additional enterprises viz., duck and year round vegetables exhibited encouraging production over traditional management. The trial was promulgated in 03 different technology options which are 1. Farmers' practice (fish culture with irregular duck grazing and no systematic utilization of dykes with appropriate combination of vegetables round the year), 2 = Fish culture + Khaki Campbell @ 300/ha + round the year dyke vegetables on trellis and on ground. and 3 = Fish culture + Cross breed duckery @ 300/ha + round the year dyke vegetables on trellis and on ground dyke vegetable pointed gourd in the trellis and pumpkin followed by French bean and tomato and in each option minimum 07 replication was taken under rural farm field condition. The data collected from each treatment for consecutively 02 years to judge the economic profitability and sustainability of the practice. The average fish production in 3 different technology options obtained from integrated pond management in Dakshin Dinajpur district were 14.8 q/ha, 20.7 q/ha and 22.1 q/h respectively and 55.4% higher over the traditional management. The total economic return in terms of gross return and B: C ratio achieved from integrated pond management was 0.36 lakh/ha, 0.87 lakh/ha 0.89 lakh/ha and 1.6:1, 4.4: 1 and 4.6: 1, respectively. The utilization of family labour round the year in pond based integrated production system contributed to improve the production as well as to create employment opportunity for income generation. The overall results revealed that the integrated pond management is an excellent approach for sustainable production, income generation and employment opportunity of the resource poor rural farmers.

**Keywords:** IFS, income generation, employment opportunity

### **TS2P37**

#### **Fish Farmers' Perception of Climate Change Impact on Pond based Fish Production in the Cooch Behar District of North Bengal**

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The study specifically evaluated the perceived impacts of climate change on pond based fish farming community in the region. The study was conducted through well design structure interview schedule. Purposively 80 nos. of respondent from four villages engaged in pond based fish farming were selected for study. The findings of the study revealed that the extent of impacts of climate change on pond based fish farming in Cooch Behar district of North Bengal are moderate. The results showed that increasing temperature, increasing frequency of natural disaster and irregular rainfalls etc directly hamper the fish production of the study area. 76.25 per cent and 83.75 per cent of the respondents said that the yield was reduced due to uneven distribution of rainfalls and soil salinity respectively. Findings further revealed that climate change has impacted greatly on the declining migration of farming community to others enterprises in search of livelihood. Though the government had started many scheme on climate resilient agriculture to minimize the risk due to climate but still there is need to more focus on it. Therefore, it required multi-media enlightenment campaign of the effects and possible adaptation strategies of climate change, to reach all fish farmers, using the available extension structures on ground by all stakeholders.

**Keywords:** Climate change, pond fish farming, perception, climatic factors

### **TS2P38**

#### **Performance of Toria (*Brassica napus* L) on sulphur application in rain-fed areas under hilly region of West Bengal**

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An on-farm trial was conducted during 2013-14 and 2014-15 to study the effect of sulphur application on Toria (Variety B-54) under rain-fed condition at brown forest soil of hilly areas of West Bengal. The experiment was conducted at the seven villages namely Bong Busty, Charkhol, Sangsey, Bungkulung, Sakyong, Sangsey, Gitdabling of Kalimpong district. Significantly higher values of no. of primary branches (9.78); no. of siliqua/plant (82.12); no. of seeds/ siliqua (35.51) as well as seed yield (10.23q/ha) were recorded with soil test based nutrient management

practice along with soil application of sulphur (80%) @ 20kg/ha. compared to the soil test based nutrient management practice along with foliar application of sulphur and farmers practice. The soil application of sulphur and soil test based nutrient management practice also fetched higher return per rupee invested (1.61) compared to the other treatments during the two years of experimentation.

### **TS2P39**

#### **Effect of integrated nutrient management on growth and yield of aromatic rice variety in Eastern Indian old alluvial soil**

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A field experiment was conducted during *khari* 2016-17 and 2017-18 at the Farm of Regional Research Station (Old Alluvial Zone), Uttar Banga Krishi Viswavidyalaya, Majhian, Patiram, Dakshin Dinajpur, West Bengal to study the effect of integrated nutrient management on growth and yield of aromatic rice. The experiment was laid out in split plot design consisting three varieties in the main plot and four nutrient management practices in the sub-plot. Each treatment combination was replicated thrice. Plant height at maturity varied significantly among the rice varieties. Kataribhog (128.29 cm) showed highest plant height followed by Chinichakkar (124.05 cm) and Tulaipanji (119.42 cm). Dry matter accumulation of aromatic rice was increased progressively from 30 DAT and upto 90 DAT. The highest value of dry matter accumulation was noticed in Kataribhog (2126.3 g m<sup>-2</sup>) at 90 DAT compared with others. Highest crop growth rate was found between 75-90 DAT (13.31 g m<sup>-2</sup> day<sup>-1</sup>) with Kataribhog compared to other aromatic rice varieties. Kataribhog also showed highest yield (3437.5 kg ha<sup>-1</sup>) in comparison with other varieties. Among the nutrient management practices highest value of growth attributes viz., plant height (127.8 cm), dry matter accumulation (2089.4 g m<sup>-2</sup>) as well as yield was recorded where crop received 50% RDN through inorganic fertiliser + 50% nitrogen through vermicompost. This integrated nutrient management treatment schedule also fetched a good return per rupee of investment (1.79) during two years of experiments.

## **TS2P40**

### **Participatory yield improvement strategies of black gram in Dakshin Dinajpur district**

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Resource poor farmers of DakshinDinajpur district face a number of production constraints such as low fertile soil with lack of different micro-nutrients, poor performance of local varieties and lack of access to new improved varieties and technologies. In order to improve the crop productivity of this system, several demonstrations were conducted in the farmers' field of this district during 2015-16 to 2017-18. Sulata, a new variety of black gram was given to farmers for demonstration purpose. Besides variety, suitable rhizobium culture and micro-nutrient like boron was given to the selected farmers for demonstration. Impact study on the acceptance of the new variety was made during the period of investigation. The yield increased upto 30 percent over farmers' variety. Considering management practices 15-20 percent yield enhanced was observed in compare with farmers practice where no rhizobium culture and micronutrient was applied to the black gram.

## **TS2P41**

### **Role of women group on technology dissemination and its adoption among the farming community of northern sub Himalayan terai region of India**

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Different types of extension organisation follow different methods of technology dissemination and its adoption. But its necessary to identify the effective channel for technology diffusion and its adoption among the farming community. It was found from different study that different types of technology were discontinued by the farmers after its adoption which affects technology diffusion and adoptions. But women groups play a pivotal role for technology adoption in their home as wel as field. On the basis the problem a study was conducted on technology dissemination and adoption process by different extension organisation in Cooch Behar District of West Bengal.

Cooch Behar district geographically falls under sub Himalayan terai region of India. For conducting the research scientific azolla cultivation has been taken up as the innovation in terms of which the adoption percentage and behaviour was calculated for the present study. Farm women were selected as a targeted respondent. It was found that the farm women were effectively works on innovative technology when technology disseminated through women groups.

**Keywords:** diffusion, adoption, technology, women group, azolla, innovation

## **TS2P42**

### **Economic Contribution and Perceived Constraints in Pig Rearing by Tribal Farmers in Terai and Hill Regions of West Bengal**

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Pig farming constitutes the livelihood of rural poor belonging to the lowest socio-economic strata and scientific pig rearing can add more income, generate employment and can provide a better scope to meet out the requirement in terms of animal proteins. Keeping this in mind, an attempt was taken to assess economic contribution and perceived constraints in pig rearing by tribal farmers under backyard farming system in terai and hill regions of West Bengal. In all, 60 respondents were randomly selected for data collections who were engaged in reproduction of pig. The pig farmers were categorized as small ( $\geq 2$  sows), medium (3-4 sows) and large ( $\leq 5$  sows). The study shows that rate of return increases with increase in herd size both in terai and hill regions. The Cost Benefit Ratio (CBR) was 2.23, 2.72 and 3.26 among small, medium and large herd size respectively in terai region and 2.58, 2.94 and 3.66 among small, medium and large herd size respectively in hill region indicating that the enterprise is highly profitable since CBR is greater than 2. The highest ranked perceived constraints in pig farming were high cost of natural service related to breeding, high feeding cost with concentrates related to feeding, high incidence of diseases related to healthcare, high investment in scientific pig rearing related to management and low price of pork related to marketing. The higher profit from piggery under backyard farming system is a clear indication of potential enterprise for doubling farmers' income among tribal farmers in both terai and hill region of West Bengal but the perceived constraints of the farmers need to be addressed by the policy makers and extension agents working in these regions to maximize the income in pig farming.

**Keywords:** Cost benefit ratio, Pig rearing, Perceived constraints, Terai, Hill

### **TS2P43**

#### **Image segmentation & machine learning based automated Weeding Machine - A Novel approach**

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Farmers are worried about weeds while cultivating crops in the field. Weeds are harmful, excess for essential crops. A farmer may not be performing always to control accurately weeds due to labour, time and accuracy. So weed to be removed for increasing yields of the crops is necessary. We observe so many techniques are applied on removing weed mechanically, but few numbers of techniques have used to control weeds automatically; among them my proposed image segmentation based automated weeding machine is extremely accurate and isolated from the crop. It is also possible to eliminate separation of weeds from integrated cropping and without any damage of crops. Digital image recognition, image segmentation and artificial intelligence are applied in my proposed technology, automated device designed with machine learning. The problem has been collected and accumulated by new approach with machine learning and image processing effectively and accurately. Separation of weeds from crops is to be done by the Weeding Machine using image segmentation discontinuity and similarity techniques with machine learning. First, proposed device is to identify weed then automatically set weedicides level and spread on target point accurately. The programmable automated weeding machine control without damage of crops by applied weedicides is the best among the rest.

**Keywords:** Weed, Crops, Image recognition, Image segmentation, Artificial Intelligence, Weeding Machine