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Souvenir & Abstracts

International Conference
on

Sustainable Agricultural Development in Changing Global Scenario

October 11-13, 2019

Organized by

Royal Association for Science-led Socio-cultural Advancement (RASSA), New Delhi
&
Institute of Environment and Sustainable Development
Banaras Hindu University, Varanasi

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National Academy of Agricultural Sciences

Prof. Panjab Singh
President

Message

I am happy to know that Royal Association for Science-led Socio-cultural Advancement (RASSA) is organising three days International Conference on 'Sustainable Agricultural Development in Changing Global Scenario' with Institute of Environment and Sustainable Development (IESD), Banaras Hindu University, Varanasi from October 11-13, 2019. The Topic selected by RASSA and IESD is the need of the time.

Talks by eminent speakers and participants on various themes will certainly help in finding the ways and means to develop a road map in holistic manner by involving various stakeholders including farmers.

On the occasion, I convey my best wishes to organisers and participants for success of the Conference.

(Panjab Singh)

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MESSAGE

I am delighted to learn that "Royal Association for Science-Led Socio-Cultural Advancement (RASSA)" is jointly organizing an International Conference on "Sustainable Agricultural Development in Changing Global Scenario" with Institute of Environment and Sustainable Development (IESD), Banaras Hindu University, Varanasi from October 11-13, 2019.

Global agriculture has a major challenge to ensure food and nutritional security to meet the demand of ever increasing human population. The emergence of large serious scale biotic and abiotic stresses, rampant degradation and depletion of natural resources are impediments to the sustainability of the agriculture. The factors like natural calamities spreading over various agro climatic situations of the region, growing number of small holders, shifting land use pattern, declining efficiency of agricultural resources are threatening the livelihood sustainability in the regions.

In this context, the theme of the Seminar "**Sustainable Agricultural Development in Changing Global Scenario**" is appropriate and need of the hour. There is a gap between technology generation and its use by the end users, especially the small and marginal farmers.

The organization of this Conference is very timely and it will have a greater impact in catalyzing our commitment to reach the unreached for ensuring food and nutritional security without putting stress on natural resources.

I wish the Organizers a grand success of this International Conference.

(AK Singh)

डॉ. नरेन्द्र सिंह राठौड़
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No. PS/VC/MPUAT/2019/695
26th September, 2019

MESSAGE

I am glad to know that Association for Science-led Socio-Cultural Advancement (RASSA), New Delhi is organizing an International Conference on "Sustainale Agricultural Development in Changing Global Scenario" in collaboration with Institute of Environment and Sustainable Development (IESD), Banaras Hindu University, Varanasi. This conference is being organized at BHU, Varanasi during October 11-13, 2019.

The theme chosen by the Royal Association for Science-led Socio-Cultural Advancement (RASSA) is topical and relevant in the context of present day requirement for equitable and sustainable agricultural development. While India has made tremendous strides in all spheres of agricultural research and development, thus paving the way for the Green, White and Blue revolutions, ensuring food and nutritional security to the nation, yet the degrading trend of rural resources and adverse climate change scenario have emerged as serious problems. The conversation and management of rural resources is essential to ensure sustainable development of future agriculture. This involves integration of social trade, environmental and ecological issues with efficient agricultural production.

I am sure that the deliverations and discussions during the Conference would help to bring out meaningful suggestions and recommendations pertaining to the key areas of information and communication management towards the development of smart and eco-friendly agriculture.

I convey my best wishes for grand success of the three days International Conference.

(Narendra Singh Rathore)

कुलपति कार्यालय

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Dr. U S Gautam
Vice-Chancellor

MESSAGE

It is learnt that an International Conference on 'Sustainable Agricultural Development in Changing Global Scenario' is being organised by "Royal Association for Science-Led Socio-Cultural Advancement (RASSA)" with Institute of Environment and Sustainable Development (IESD), Banaras Hindu University, Varanasi from October 11-13, 2019.

Themes of the Conference are need of hour to address the Global agriculture, particularly Indian agriculture. Ensuring food and nutritional security to meet the demand of ever increasing human population is a big challenge. The farmers are facing numerous challenges such as biotic and abiotic stress, climate change, quality of seeds, fluctuating price of their produce, erratic power supply, natural calamities etc in sustaining their livelihood. Renewable energy sources, custom hiring, protected cultivation technology, seed village etc are having potential for farmers to increase their income. Many schemes are running by Government of India and State Governments but fewer farmers are having such information.

In this context, the theme of the Conference **"Sustainable Agricultural Development in Changing Global Scenario"** is appropriate and need of the hour as we feel that there is a gap between technology generation and its use by the end users, especially the small and marginal farmers.

I wish Organisers a grand success of this International Conference.

(U S Gautam)

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Institute of Environment and Sustainable Development

MESSAGE FROM THE DIRECTOR

It gives me immense satisfaction that the Institute of Environment and Sustainable Development and Royal Association for Science-led Socio-cultural Advancement (RASSA) are jointly organizing a three days International conference on 'Sustainable Agricultural Development in Changing Global Scenario" October 11th – 13th, 2019. The current scientific understanding indicates that humanity is rapidly altering the Earth's ecological systems and consuming its natural resources in an unsustainable way. Resolving this crisis will require total system transformation by adopting the principles of sustainability. Respect for life and living within limits are two core principles to achieve this. We believe that higher education is in a unique position to lead this transformation by teaching, research and practice.

The proposed international conference will not only provide a good platform to the researchers for sharing their research and discuss the recent advancement in their fields with experts and academicians but also will assist them in exploring various new facets for the future further research. I hope that the deliberation in the conference will widen and deepen the understanding of the participants in the agriculture and environment. I expect that gathering of a large number of delegates going to participate in the conference from various parts of the nation will be benefitted. I hope that the conference will prove to be a productive endeavour.

On my personal behalf and on the behalf of the Institute of Environment and Sustainable Development, I extend my heartily welcome to all the participants and congratulate every single person associated with the conference.

Dr. A.S. Raghubanshi, FNASc
Professor & Director

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Er A K Singh
President

Message

It is matter of great pleasure that Royal Association for Science-led Socio-cultural Advancement (RASSA) and Institute of Environment and Sustainable Development (ISED), Banaras Hindu University (BHU) is organizing an International Conference from 11-13, October, 2019 on 'Sustainable Agricultural Development in Changing Global Scenario' where different stakeholders are expected to discuss and deliberate on various issues in the seminar. The topics covered for deliberations give indications of relevance to evolve path and strategy to face the challenges likely to confront the humanity and environment in the times to come.

The country made tremendous progress in increasing the production of food, fruits, vegetables, milk, meat and poultry products that indicate qualitative improvements needed for nutritional fortification in diet. However, the country still faces several issues and limitations where farmers are yet to realize the dreams to get basic amenities, infrastructure and income needed for a happy, healthy and peaceful life with adequate opportunity for their children to progress and prosper with their vocation in rural areas. This has led to alarmingly high rate of migration of people from villages to cities in the past decades.

Indian agriculture is tasked to manage the food, feed and clothing for 17% of world population with land and water share of hardly 2.4% and 4% respectively. With more than 50% of land area and 78% of water already deployed in agriculture, there is no scope for further increase in availability of these resources. Available water is not evenly distributed and hardly 50% of arable land has assured irrigation leaving balance 50% to depend on rains. The arable land faces different types of degradation coupled with highly fragmented, scattered, small land holdings denying any meaningful economical mechanization. Assured food distribution and economic activities enabling everyone to acquire adequate food and nutrition is needed to ensure that no one goes without food. Increased efforts are also needed to ensure processing and value addition locally in rural areas for income and employment generation.

I firmly believe that proactive deliberations in the Conference shall be able to draw sustainable development plan for rural India with better linkages with cities as partners of growth and extend best wishes to organizers for success in their mission.

(A. K. Singh)

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Message from the Organizing Secretary

I express my feeling of gratitude and privilege to warmly welcome all the esteemed, speakers, distinguished guests and participants of the "**International Conference Sustainable Agricultural Development in Changing Global Scenario**" RASSA-BHU-2019. The prime motive of the conference is to ponder into novel and contemporary ideas relevant to identify the role of doubling farm income based on different technologies for a sustainable agriculture. Definitely the futuristic vision of our Honourable Vice Chancellor is the driving force behind this event. We are also highly thankful to RASSA and Council of Scientific & Industrial Research, New Delhi for their financial assistance to organize "RASSA- BHU 2019" which is being held at Institute of Environment and Sustainable Development, Banaras Hindu University from 11th -13th October 2019.

Recent advancement in the field of Sustainable Agriculture has emerged as some of the promising solution for sustainable future. This conference is also aligned in the same way and explores the various themes like Climate Smart Crop and Livestock Production Technologies., Advances in Food Science & Postharvest Technology., Environment, Sustainability & Climate Change, Biodiversity and IPRs: Issues and Challenges, Trends and Future Prospects of Industry, Entrepreneurship and Development, and Education, Extension and Policy Issues.

I am also thankful to the Head, Dean, Director, staffs and other colleagues of the IESD, BHU Administration, Coordinator – Malaviya Moolya Anusheelan Kendra and members of RASSA Society organizing committee, research scholars and students of the Institute of Environment and sustainable development for their indomitable support.

(Rajeev Pratap Singh)

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LEAD PAPERS

USE OF TRADITIONAL VARIETIES AND WILD RICE RESOURCES WITH GENOMIC TOOLS FOR INFUSING CLIMATE RESILIENCE INTO MODERN HIGH YIELDING CULTIVARS

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One of the biggest challenges for 21st century Agriculture is to produce sufficient food for growing human population which is predicted to touch 10 billon mark by 2050 from diminishing land acreage, deteriorating soil healthand abiotic stresses induced by global climate change. Traditional varieties of crop plants and their wild relatives are adapted to a wide range of geographical and climatic conditions and are a rich source of genes and their alleles that can be harnessed to develop climate-resilient cultivars. Therefore exploration, evaluation and utilization of fast depleting crop land races wild relatives gene poolsisthe need of the day.

We have collected traditional varieties and wild rice samples from th fifteen agroclimatic zones of India and evaluated a large pool of wild rice (*Oryzarufipogon* Griff./ *Oryzanivara* Sharma et Shastry) germplasmto identify accessions that can withstand drought, flooding and and soil salinity stresses better than what is available in the cultivated rice germplasm pool. Precise introgression of novel genomic regions and genes for drought, flooding and salinity tolerance identified in these wild rice germplasm is in progress using modern genomic tools.After screening 292 accessions for salinity tolerance, two were found highly salt tolerant, 11 tolerant, 29 moderately tolerant, 70 sensitive and 180 highly salt sensitive. Similarly, screening of 202 wild rice accessions and check varieties in a rain-out shelter for drought stress tolerance at vegetative stage using four parameters*viz*.canopy temperature, chlorophyll content, leaf rolling and relative water content identified35 accessions highly tolerant, 52 moderately tolerantand 115 highly susceptible to drought stress. Further, screening of 283 wild rice accessions for anaerobic germination and submergence tolerance identified 13 and 26 genotypes highly and moderately tolerant to anaerobic germination, respectively. Screening of 283 accessions for submergence tolerance identified 11 accessions highly tolerant, 40 accessionsmoderately tolerant and 232 accessions sensitive to complete submergence for 18 days.Total 11 crosses have been made using accessions highly tolerant toanaerobic germination, submergence, drought and salinity stresses.

Backcross progeniesfrom five crosses of modern high yielding rice varieties with wild rice accessions withanaerobic germination and salinity tolerance have been genotyped and phenotyped to identify major genomic regions (QTLs)these traits in a bid to simultaneously map and transfer these useful genomic regions in to high yielding cultivars. In addition to genes for climate resilience efforts are also underway to combine genes for resistance to biotic stresses such as bacterial leaf blight, blast sheath blight and root knot nematodeand further enhancement of the yield potential of mega rice varieties without loosing their quality attributes crucial for consumer acceptance. Genomics-assisted backcross breeding has also been employed to transfer major genes for drought, flooding, salt and heat tolerance present in the traditional low yielding but climate resilient rice varieties into modern high yielding cultivars. Four such high yielding climate resilient rice varieties, viz. 'DRR Dhan 50', 'CR Dhan 802', 'Ranjit-Sub1' and 'Bhadur-Sub1' have already been released for commercial cultivation by Indian farmers and notified by central Sub-committee in 2018. Use of modern genomic tools has accelerated the breeding processes for developing new climate resilient rice varieties and reducing time taken to develop new varieties by fifty percent. There is an urgent need to disseminate the seeds of these new climate resilient high yielding rice varieties to the rice farmers of largely rain-fed agro-ecosystem of Eastern India to usher in the second green revolution.

MAIZE HAS POTENTIAL FOR CROP DIVERSIFICATION

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Maize is one of the major cereal crops with wide adaptability under diverse agro-climatic conditions that serves as an important driving crop for diversification under all ecologies. Maize being a potential crop in India occupies an important place as human food (24%), animal feed (11%), poultry feed (52%) and as a source of large number of industrial products (12%). In northwestern plains, maize is generally grown in maize-wheat cropping system resulting in stagnant/reduced productivity and profitability. But diversified maize based cropping systems produced more yield with higher profitability and efficient utilization of inputs.

Maize is known as queen of cereals because it has the highest genetic yield potential among the cereals. It is cultivated on nearly 177 m ha in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes nearly 40% (1065 m t) in the global grain production (FAOSTAT, 2019). The India rank 4th in area while stood at 6th position in maize production largely because of the average productivity in India is less than 2.5 t ha^{-1}. The lesser maize productivity in India is largely due to 80% of its 9.2 m ha cultivated area is rainfed mainly during *kharif* season which is a gamble of South-West monsoon (SIA, 2013). Since 1950-51, the area, production and productivity of maize have increased by more than 3.4, 12 and 4.5 times from 3.2 m ha, 1.7 m t and 547 kg ha^{-1} due to increasing maize demand and adoption of maize in niche areas with improved production technologies. The maize is cultivated throughout the year in all states of the country for various purposes including grain, fodder, green cobs, sweet corn, baby corn, pop corn, etc.

The increased production and productivity in World and India has been possible due to various technology revolutions in genetic improvement and crop management.

Off season cultivation of maize

The adoption of maize in low rainfall areas and under lowering water table situations is coming up at very fast rate due to availability of good quality hybrids in the country, where maize is more remunerative than rice.

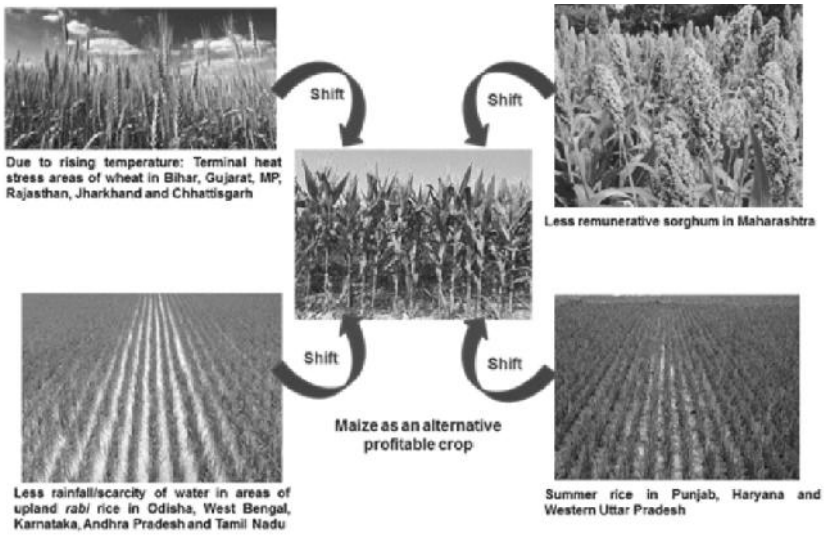

Figure 1: Maize as better remunerative alternate crop in era of climate change

The maize is a solution crop for the lowering water table in the *rabi* rice growing areas of Andhra Pradesh, Karnataka and Tamil Nadu and also for the low rainfall areas of upland rice in the states of West Bengal and Odisha (Figure 1). Similarly, maize is solution for the heat stress in wheat causing significant yield reduction in the Northern India. The favourable temperature in the *rabi* season of the states like West Bengal, Odisha, Rajasthan, Gujarat and Madhya Pradesh offers a great potential for maize hybrid seed production and areas under seed production is coming up very fast in these areas in recent years. The remunerative seed production in these states will cater the needs of the states as well as have potential for export to neighbouring states and countries. The cultivation of spring maize after harvest of potato is now became reality in North Indian states like Punjab, Haryana and western Uttar Pradesh and giving more productivity.

There are two types of inputs involved in the production of the crops which includes either monetary or non-monetary. "*Non-monetary inputs are defined as those cultural operations which help to achieve higher yield at no extra cost and whose cost does not change with the level of output*". These includes selection of suitable crops and crop rotation, appropriate tillage and crop establishment practices, choice of right cultivars, sowing time, proper plant population, seed requirement and priming, method of sowing, rate and time of input application (fertilizer, water and pesticide) and proper harvesting time for different maize types. The monetary inputs which covers largely for tillage, labour, seed, pesticide, water and fertilizers making farming less remunerative presently due to escalating fuel and labour prices in our country. In this scenario, the efficient management of non-monetary inputs which covers largely the management skills and timely operation in crop management have potential to improve the resource-use efficiency at farm level. Hence, selection of suitable cropping and intercropping system as non-monetary input has immense importance in enhancing profitability of farming in India.

Selection of suitable crop and crop rotation

Maize has wider adaptability and compatibility under diverse soil and agro-climatic conditions and hence it is cultivated in sequence with different crops under various seasons and agro-ecologies of the country. Hence, it is considered as one of the potential driver of crop diversification under different situation. The selection of the suitable crop is the key for remunerative crop production. The selection should be made on the basis of available resources and the profitability of crop production. For example, in recent years due to rising temperature during grain filling period of wheat causing terminal heat stress in central and eastern Indian states covering parts of Bihar, Gujarat, Madhya Pradesh, Rajasthan, Jharkhand and Chhattisgarh which provides an opportunity to select maize during *rabi* season.

The less remunerative sorghum production area in Maharashtra is also shifting in maize. In Odisha, maize is coming up as a potential alternative crop in low rainfall areas of rice cultivation during *kharif*. Likewise, the *rabi* rice areas in the states of Odisha, West Bengal, Karnataka, Andhra Pradesh and Tamil Nadu facing problem of ground water shortage and the maize is coming up as a potential crop. The cultivation of spring maize after harvest of potato and sugarcane has become reality in some of the states (Punjab, Haryana, western UP, lower valley of Uttrakhand) and emerged as an alternative profitable crop replacing summer rice.

Beside the selection of the suitable crop the appropriate crop rotation is the key to sustainability and improving farm profitability. Among different maize based cropping systems, maize-wheat ranks 1st having 1.8 m ha area mainly concentrated in rainfed ecologies and is the 3rd most important cropping systems in India. The other major maize systems in India are maize-mustard, maize-chickpea, maize-maize, cotton-maize etc. Recently, due to changing scenario of natural resource base, rice-maize has emerged a potential maize based cropping system in peninsular and eastern India. In *peri*-urban interface, maize based high value intercropping systems are also gaining importance due to market driven farming. Further, maize has compatibility with several crops of different growth habit that led to development of various intercropping systems in our country. Studies carried out under various soil and climatic conditions under All India Coordinated Research Project on Cropping Systems revealed that compared to existing cropping systems like rice-wheat and rice-rice, maize based cropping systems are better user of available resources and the water use efficiency of maize-based cropping systems was about 100 to 200 % higher at different locations.

Maize type selection

The maize have several types likenormal yellow/white grain, sweet corn, baby corn, popcorn, quality protein maize (QPM), waxy corn, high oil corn, fodder maize, seed production, etc. Some of the maize types popular in India are as follows:

***Normal maize*:** The normal yellow and white maize is being grown for the grain as well as the green cob purposes. For grain purpose it can be grown in hinterlands means the area far from the market place and for green cob purpose it should be planted within vicinity of the market place for enhancing farm profitability.

Quality Protein Maize: Quality Protein Maize (QPM) has specific features of having balanced amount of amino acids with high content of lysine and tryptophan and low content of leucine and isoleucine. The biological value of protein in QPM is 80% just double than that of normal maize protein which is very close to the milk protein i.e. 90%. There are >9 QPM hybrids of different grain colours have been developed and released in India for their cultivation in different agro-climatic conditions across the country. The production technology of QPM is same as of normal grain maize except isolation of 150 to 200 meter with normal maize must be maintained for the purity of QPM. This QPM should preferred and promoted in the maize eating tribal areas of Madhya Pradesh, Rajasthan, Chhattisgarh, Gujarat, Maharashtra, Jharkhand, Himachal Pradesh, Jammu and Kashmir, NEH states and Bihar to ensure nutritional security. Moreover, it can be cultivated in other areas also because it lowers down the feed requirement of poultry and piggery industries due to its high biological value.

***Baby corn*:** Baby corn is a young finger like unfertilized cobs harvested within 1-3 days of silk emergence depending upon the growing season. The baby corn cultivation is an employment generation enterprise which engages all the members of the family like youth for marketing, women and children for picking, peeling and packaging, etc. In general, the cultivation practices of baby corn are similar to grain crop except (i) higher plant population (ii) higher dose of nitrogen application because of higher plant population (iii) preference for early maturing single cross hybrid and (iv) harvesting within 1-3 days of silk emergence. It can be cultivated round the year therefore; three to four crops of baby corn can be taken in a year and thus can be preferred in irrigated areas in *peri*-urban interface for crop intensification. Moreover, the fodder from green tassel, cob sheath and green plan left after picking can be used as nutritious fodder for the animal during lean period which also promotes the livestock industries. In this way the fodder growing areas may also adopt for the baby corn cultivation which will give an additional income to the famers.

***Sweet corn*:** Sweet corn is very delicious and rich source of energy, vitamin C and A. It is becoming very popular in urban areas of country therefore; its cultivation is remunerative for peri-urban farmers. Besides green cobs the green fodder is also available to the farmers for their cattle. Generally sweet corn is early in maturity and is harvested in 70-75 days during *kharif* season. Green cobs are harvested after 18-20 days of pollination during *kharif* but the duration may vary season to season.

***Pop Corn*:** It is hard endosperm flint maize and one of the common snack items in many parts of the world. It should be grown in isolation of 150 to 200 meter with normal maize. It is to be preferred in the hilly tracts as pop corn village concept in the far away areas from the cities.

Fodder maize: **The most important factor for preference of maize fodder is that it** can be used at any crop growth stage which is not the case with other crops having anti-quality factors at some early crop stages. Its quality is adversely affected after anthesis due to immobilization of the nutrients. The tall, leafy and longer duration cultivars with staygreenness trait are most preferred for maize fodder cultivation. The cultivation of maize for fodder can be done round the year in any part of the country except the sowing in North India should be avoided in the month of December and January due to very low temperature conditions.

Seed production: Seed village concept is necessary for maintaining the genetic purity and addressing the isolation issues. To address the issue of isolation non-traditional areas as well as seasons are more suitable for the seed production. The seed production of public bred hybrid in West Bengal and Rajasthan is an excellent example for *in-situ* seed production and its availability at affordable prices. So, the seed production of hybrids can be taken up in these areas for enhancing income of farmers and ensuring availability of quality hybrid seed at affordable prices in the market due to reduced transportation and handling cost.

Sequential cropping

Maize provides sufficient opportunities for intensified sequential cropping due to wider adaptability under diverse soil and climatic conditions. Due to availability of different maturity groups of genotypes and various kinds of corn, it can be fitted well in any cropping sequence. The important maize based intensified cropping sequences including cereals, pulses, oil seed crops, vegetables *etc.* adopted in irrigated and rainfed conditions of different agro-climatic zones have cropping intensity of 200 and 400 % (Table 1).

At DMR, under conservation agriculture, maize-mustard-mungbean closely followed by maize-wheat-mungbean gave the highest maize equivalents with all tillage practices. Similarly, under different nutrient management practices, maize-baby corn-mungbean was the best cropping sequence in terms of net return and benefit:cost ratio. Suitable maize-based cropping and intercropping systems for various parts of the country are given in Table 1 and 2.

Table 1. Maize based sequential cropping systems in different ago-climatic zones of India

Agro-climatic region	Cropping system	
	Irrigated	Rainfed
Western Himalayan Region	Maize-wheat Maize-potato-wheat Maize-wheat-mungbean Maize-mustard Maize-sugarcane	Maize-mustard Maize-legumes
Eastern Himalayan Region	Summer rice-maize-mustard Maize-maize Maize-maize-legumes	Sesame-Rice+maize
Lower Gangetic Plain region	Autumn rice-maize Jute-rice-maize	Rice-maize
Middle Gangetic Plain region	Maize-early potato-wheat-mungbean Maize-wheat Maize-wheat-mungbean Maize-wheat-urdbean Maize-sugarcane-mungbean	Maize-wheat
Upper Gangetic Plain region	Maize-wheat Maize-wheat-mungbean Maize-potato-wheat Maize-potato-onion Maize-potato-sugarcane-ratoon Rice-potato-maize	Maize-wheat Maize-barley Maize-safflower
Trans Gangetic Plain region	Maize-wheat Maize-wheat-mungbean Maize-potato-wheat Maize-potato-onion Mungbean-maize-toria-wheat Maize-potato-mungbean	Maize-wheat
Eastern plateau and hills region	Maize-groundnut-vegetables Maize-wheat-vegetables	Rice-potato-maize Jute-maize-cowpea
Central plateau and hills region	Maize-wheat	Maize-groundnut
Western plateau and hills region	Sugarcane + Maize	
Southern plateau and hills region	Rice-maize Maize-rice	Sorghum-maize Maize-sorghum-Pulses Maize-potato-groundnut

East coast plain and hills region	Rice-maize-pearlmillet Maize-rice Rice-maize Rice-rice-maize	Maize-maize-pearlmillet Rice-maize + cowpea
West coast plain and hills region	Maize-pulses Rice-maize	Rice-maize Groundnut-maize
Gujarat plains and hills region	Maize-wheat	Rice-maize
Western dry region	Maize-mustard Maize-chickpea	Maize+legumes
Island region	Rice-maize	Maize-rice Rice-maize + cowpea Rice-maize-urdbean Rice-rice-maize

Table 2. Maize based intercropping systems

Intercropping systems	Suitable area/situation
Maize + Pigeon pea; Maize + Cowpea; Maize + Mungbean; Maize + Urdbean ; Maize + Sugarcane ; Rice + Maize ; Maize + Soybean	All maize growing areas
Maize + high value vegetables; Maize + flowers; Baby corn + vegetables; Sweet corn + vegetables	*Peri*-urban interface
Maize + turmeric; Maize + ginger; Maize + mungbean; Maize + Frenchbean	Hilly areas

The research conducted through AICRP on maize for suitable intercrops in different types of maize also revealed that the intercropping is beneficial in maize. During *rabi*; coriander, amaranthus, fenugreek and peas had better compatibility over rest of the intercrops and highest maize equivalent yield (10.98 t ha^{-1}) was recorded with maize + coriander intercropping system at Jorhat. At Chhindwara, sweet corn intercropped with different cut flowers did not produce any significant yield penalty on cob yield of sweet corn and resulted in additional benefit with cut flowers. Similarly, at the same location, sweet corn intercropped with onion also resulted in comparable yield of sweet corn both under sole and intercropping. At Bahraich, maize yield was significantly higher when it was intercropped with palak than radish and for maize yield 1:1 row ratio was better but for intercrops, 1:2 ratios was superior.

The increase in profitability of intercropping systems at Delhi was varied from Rs 1,52,841 under baby corn + beet root, Rs 95,987 under baby corn + coriander, Rs 86,704 under baby corn + knolkhol, Rs 78,920 under baby corn + peas, and Rs 5,010 under baby corn + fenugreek.

In the *kharif*, maize based intercropping trials were conducted at Arbhavi, Bahraich, Banswara, Udaipur and Pantnagar. Intercropping of *kharif* legumes in maize either in uniform row or paired row system helped in significant increase in maize equivalent yield and profitability almost at all the locations. Among the different legumes, groundnut had better compatibility with maize. So, from the above discussion it can be said that maize can be taken as alternative profitable crop for efficient utilization of resources and their use-efficiency.

Specialty corn for diversification

For diversification and value addition of maize as well as the growth of the food processing industry, cultivation of specialty corns like baby corn, sweet corn, pop corn *etc*. in *peri*-urban pockets of the country becomes popular at it provides regular employment to rural masses. The farmers are earning 50-60 thousand rupees per annum per acre with the cultivation of 2-3 crops of baby corn and sweet corn and 100 quintal nutritious fodder/crop/acre. Specialty corn helps the livestock industry in meeting the scarcity/regular supply of green fodder for the growing dairy industries to increase the milk production of the country. By feeding this fodder, there is increase of about 15-20 % milk and farmer does not require additional land for fodder. Therefore, speciality corn cultivation helps the livestock industry in meeting the regular supply of green fodder for the growing dairy industries to increase the milk production of the country.

GENOMIC APPROACHES FOR RED ROT MANAGEMENT IN SUGARCANE

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Sugarcane (*Saccharum* species hybrid) is the major source of sugar in the world fulfilling 80% of world sugar requirement. In the world, sugarcane crop occupied around 27.1 million hectares and produced nearly 1.89 billion tonnes of canes and 178.9 million tonnes of sugar (FAOSTAT 2016). Globally, Brazil ranks first in acreage and has 21% share in world sugar production, followed by India (16%), Europe (9%), China (7%), Thailand (6%) and USA (5%) (FAOSTAT 2016). India, with 32.3 million metric tonnes sugar production, is a key player in world sugar economics. In recent past, sugarcane research has come to the limelight when ethanol derived from cane molasses was exploited as a renewable biofuel source, turning sugarcane into a global commodity with great economic potential. In fact, much of the sugarcane in Brazil is now diverted for the production of the green fuel, ethanol.

The present-day cultivated sugarcane is a result of interspecific hybridization involving *Saccharum officinarum*, *S. spontaneum*, and other related genera. Being a long duration crop sugarcane has to cope with different abiotic and biotic stresses. Among the biotic stress, the most common threat to sugarcane is red rot disease. Red rot is a devastating disease of sugarcane caused by the fungus *Colletotrichum falcatum* Went, [Perfect stage *Glomerellatucumanensis* (Speg.)] that has a colossal damage potential. The disease, under epiphytotic conditions, may lead to total crop failure. The impact of the disease is severe in the Indian sub-continent where red rot is considered as a major threat to the profitable cultivation of sugarcane. The fungus keeps on producing new pathogenic strains leading to the breakdown of resistance in newly released varieties and hence the deployment of linked markers for marker-assisted selection for resistance to this disease can fine tune the breeding programme. Due to this multispecies origin, sugarcane is considered to possess one of the most complex plant genomes. The genetic manipulation of sugarcane for red rot resistance using traditional breeding has been cumbersome due to its heterozygous complex polyploid genome which does not permit an easy and predictable gene introgression. Under these circumstances, modern genomic tools could very well aid conventional breeding in overcoming genetic bottlenecks and thereby enhancing breeding efficiency for red rot resistance. A fundamental pre-requisite of a genomics-based breeding is the identification of trait-associated molecular markers. Genetic mapping utilizing lineage and association mapping has made remarkable attention to recognize genes responsible for different traits with agricultural and evolutionary significance in many crops including sugarcane. In order to decipher the marker-trait associations (MTAs) for resistance to red rot, we used a panel of 119 diverse sugarcane genotypes consisted of cultivated varieties, advanced breeding lines, and genetic stocks. All the 119 genotypes were screened for resistance against three (*Cf01*, *Cf08,* and *Cf09*) races of *C. falcatum*. Genotyping was performed based on a set of 115 polymorphic SSR primers which generated a total of 944 dominant loci. Marker-trait associations for resistance to three races of red rot were studied employing general linear model (GLM) and mixed linear model (MLM) approaches containing population structure and kinship as co-factor and detected four MTAs that were able to explain 10-16% of the trait variation, individually. Utilizing the advantage of synteny between sorghum and sugarcane genome we identified the candidate genes potentially involved in plant-pathogen/stress interactions in the vicinity of the sorghum homologs of sugarcane markers. Among the four MTAs, EST sequences diagnostic of three could be BLAST searched to the sorghum genome with significant sequence homology. Several genes encoding important plant defense-related proteins, viz., cytochrome P450, Glycerol-3-phosphate transporter-1, MAP Kinase-4, Serine/threonine-protein kinase, Ring finger domain protein and others were localized to the vicinity of these MTAs. These positional candidate genes are worthy of further investigation and possibly these could contribute directly to red rot resistance. Markers developed from identified candidate genes may find a potential application in marker-assisted sugarcane breeding.

WINGED BEAN IMPROVEMENT: A SCENARIO FOR SUSTAINABLE AGRICULTURE THROUGH MUTATION BREEDING

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Breeding of pulses by exploiting genetic diversity using conventional methods has been practiced in the past. At present, these methods are inadequate for making any significant breakthrough to handle nation ever-increasing food demand. In the scenario of high population, depleting arable land and water resource, global food insecurity is a major challenge to human existence. The food insecurity is further facilitated by major climatic change that plays a pivotal role in reducing the food production. The salvaging step lies in tailoring climate rich smart varieties embedded with superior proteins, minerals and high yield which may help in increasing the food productivity by their wider adaptability to range of ecosystems. The most viable approach to develop the climate rich smart varieties is mutation breeding which creates the genetic variability by modifying a single gene without altering the entire genome. Winged bean is popularly known as "One Species Supermarket" for its nutrient-dense green pods, immature seeds, tubers, leaves, and mature seeds. This underutilized crop has potential beneficial traits related to its biological nitrogen-fixation to support low-input farming. The seeds of winged bean (*Psophocarpus tetragonolobus* (L.) Dc) were treated with aqueous solution of EMS (0.02, 0.04 and 0.06M) to find out their relative mutagenic effects. A comparative study of spectrum of viable mutation, grain yield per plant and its six economically important components viz., days to flowering, plant height, pod length, pods per plant, seeds per pod and test weight was made in M2 generation. The mutation spectrum was wider in the higher concentration (0.06 M) and early flowering, long podded and yellow testa colour mutants occurred only in this treatment. Flate podded and wrinkled grain mutants were exclusively observed in 0.04 M of EMS. Some of the mutants viz. extreme dwarf, high yielding semidwarf and sterile mutants were common in both 0.04M and 0.06M concentrations of EMS, whereas light yellow leaf and short grain mutants were common in all the concentrations. Induced variability for grain yield and its components occurred both in positive and negative directions depending upon the character in question. Days to flowering and plant height showed general decrease while remaining characters showed a significant increase in the mean values. Hence, the present review condenses various facets of contemporary knowledge for pulse crop varietal improvement, particularly winged wean, through induced mutagenesis with special thrust on qualitative as well as yield attributing traits.

Keywords: Winged Bean Improvement, Mutation, Sustainable Agriculture, Food Insecurity.

IMPACT OF PHYTOPLASMA DISEASE ON AGRICULTURAL CROPS IN INDIA

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Phytoplasmas have been associated with 150 plant species in India including vegetables, spices, medicinal plants, ornamentals, cash crops, palm species, fruit trees and weeds. Nine 16Sr groups of phytoplasmas have been identified so far on different plant species in India. Among them, aster yellows (16SrI) group is the most prevalent and dominant group identified in India and has been associated with more than 25 diseases followed by *Ca*. P. aurantifolia (16SrII), *Ca*. P. trifolii (16SrVI), Rice yellow dwarf (16Sr XI) and Bermudagrass white leaf (16Sr XIV) groups. Sesame phyllody, brinjal little leaf, sugarcane grassy shoot, sandal spike, coconut root wilt, arecanut yellow leaf and phytoplasmas infection on many valuable ornamentals are the major phytoplasma diseases in India causing serious economic losses to agricultural crops plants. The nine identified groups of phytoplasmas in India belonged to seven international recognized species of '*Candidatus* Phytoplasma'.The phytoplasma diseases are well documented from all over the country. The major sources of natural spread of these phytoplasma diseases in nature are vegetative propagation, natural hosts and insects. Little attempt has been made on management aspects of severe reported phytoplasma strains in India. Presently the suggested effective management practices in India are growing resistant varieties, control of insect vectors and weed species near around phytoplasma infected fields and using healthy planting materials.

SUGARCANE BASED INTEGRATED FARMING SYSTEM MODELS FOR ENHANCING INCOME OF SUB-TROPICAL INDIAN FARMERS

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The goal of sugarcane farming system is to produce sustainable sugarcane to meet society's sweeteners requirement, food, energy and biofuel needs in the present without compromising the ability of future generations to meet their own needs. Practitioners of sustainable sugarcane farming seek to integrate three main objectives into their work: a healthy environment, economic profitability, and social and economic equity. Weakening of the traditional joint family concept combined with unchecked linear growth in human population lead indiscriminate fragmentation of land holdings. Every person involved in the food system—growers, sugar industry, food processors, distributors, retailers, consumers, and waste managers—can play a role in ensuring a sustainable cane farming system. The field experiments were conducted on Sugarcane Based Integrated Farming System (S-IFS) models during 2016-2017 to 2018-19for three consecutive yearsat ICAR-Indian Institute of Sugarcane Research, Lucknow situated in subtropical India, with the objectives to enhance the income of small farm holders and their livelihoods. The different components of the farming system includes cultivation of different horticultural crops (banana, papaya, and karonda planting), bee-keeping, mushroom cultivation and intercropping of high value crops in sugarcane under autumn season. Allocation of farm land was kept to meet minimum essential annual requirements of food and fodder of a household with 7 family members and overall improvement in livelihood. Impact of different treatments on yield and income through different models of farming systems were evaluated. The farming systems developed were Agri (0.7 ha)- horti (0.2 ha) system (Net income: Rs. 5,00474), Agri (0.7 ha)-api (0.05 ha) system (Net income 4,15614), Agri (0.7 ha)-mushroom farming(0.05 ha) system(Net income 4,13614), Agri(0.7 ha)- horti (0.2 ha)- api system (Net income 5,03473), Agri (0.7 ha)- horti (0.2 ha)- mushroom farming (0.05 ha) system (Net income 5,01473), Agri (0.7 ha)-api (0.05 ha)- mushroom farming (0.05 ha) system (Net income 4,16614),Agri(0.7 ha)- horti (0.2 ha)- api(0.05 ha)- mushroom(0.05 ha) farming system (Net income 5,04473).The net income from sole sugarcane was observed to be Rs.164154/ha. The different intercropping systems with sugarcane were recorded for the higher cane equivalent yield(119.0 to 247.9 t/ha) and B: C ratio (2.48 to 4.77).From the results of the experiments it can be inferred that sugarcane basedintegrated farming systems hold promise in increasing the net income of the farmers by 2-3 times to the sole sugarcane.

PHYSIOLOGICAL APPROACH FOR DROUGHT MITIGATION THROUGH NUTRIENT SPRAY

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Drought mitigation study in soybean was carried out with three different nutrients i.e., K, Ca and Zn and their combinations to study effect of these nutrients on physiological characters of soybean genotypes. The nutrient spray given two days after withholding irrigation ameliorates drought effect and showed increase in yield over drought. The increase in yield was up to 73% in JS-20-29 and 67% in NRC-37 over the drought and it was mainly because of increase in different physiological parameters i.e., gas exchange parameters, RWC, MSI, SPAD, Canopy temperature and yield attributing characters. The present study revealed that the nutrient spray increases the RWC, MSI and SPAD at both the stages in both the genotypes. The 11.5 to maximum 93% increase in RWC was observed with nutrient spray and maximum increase was recorded with K, 1%. The maximum increase in MSI at stage-I was observed with (K,1% +Zn, 0.5%) in both the genotypes. The similar results were also recorded for SPAD. The nutrient spray increased SPAD and maximum SPAD was measured with (K,1% +Zn, 0.5%) in both the genotypes. The nutrient spray cools down canopy by decreasing canopy temperature. The minimum canopy temperature (28.8^{0}C) in JS-20-29 was noted with (K, 1%+ Ca,0.25%+Zn0.5%) and it showed 11% lower CT than the drought plants. The photosynthetic parameters, photosynthesis, stomatal conductance and transpiration measured at both the stages were also adversely affected by drought condition and increase(maximum) in photosynthesis, stomatal conductance and transpiration over drought were measured with the treatment (K,1% +Zn, 0.5%) followed by (K,1% + Ca 0.25% + Zn, 0.5%) in both the genotypes at both the stages. Photosynthesis and stomatal conductance showed positive relationship with seed yield. The nutrient application also showed increase in chl. A, Chl B and total chlorophyll content. The best treatment (K, 1%+Ca, 0.25%) showed 31.8% increase in JS-20-29 and 30 % in NRC-37. The yield attributing characters i.e., plant dry weight, seed: husk ratio, 100 seed weight and photosynthetic parameters showed positive significant relationship with seed yield. The maximum increase in photosynthesis and yield attributing characters were observed with the treatment (K,1% +Zn, 0.5%) in both the genotypes at both stages. The yield attributing characters i.e., plant dry weight, seed: husk ratio, 100 seed weight and photosynthetic parameters showed positive significant relationship with seed yield. The maximum increase in photosynthesis and yield attributing characters were observed with the treatment (K,1% +Zn, 0.5%) in both the genotypes at both stages. Genotype JS-20-29 found superior over NRC-37 in the study. Thus, the spray of Potassium (1%) and zinc (0.5%) found effective for drought mitigation in Soybean crop.

MODERN TECHNOLOGIES FOR IMPROVING PRODUCTIVITY AND PROFITABILITY OF FRUIT CROPS

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India is blessed with a diversity of agro-climatic conditions prevailing in the different regions of the country. A wide range of climatic and edaphic conditions in the Indian sub-continent ensures that it is ideally suited to produce almost all types of fruits. The horticulture crop production surpassed food crop production for the first time during 2013-14 and this trend continued during 2017-18 with 311.7 MT with a productivity of 12.3 tonnes/ha. Percentage share of horticulture output in agriculture is more than 33 per cent over the last decade. Over the last decade, the area under horticulture grew by about 3% per annum and annual production increased by 5.4%. Within horticulture, production of fruits is estimated at 97.35 MT in 2017-18, about 4.8% higher than the year before. India ranks second in fruit production in world, after China. As per recent estimates (2017-18), India produces 94.88 million tonnes with the area of 6.4 million hectares and contributes 10 per cent of the world fruit production. India ranks first in of banana (25.7%), papayas (43.6%), and mangoes (including mangosteen and guava) (44.4%) in the world. Average productivity of fruits is 12.4 tonnes /ha as against world average productivity of 11.3 tonnes /ha. Though the average productivity of fruits in India is little bit higher, but in many fruits the productivity is very less in comparison to world highest productivity. Despite significant increase in production of horticultural crops, low productivity and profitability in several fruit crops is still a hurdle and is required to be attended in order to meet future challenges and avail global opportunities in the country. The role of innovative horticulture technologies is thus required to be continuously updated and given to all the stakeholders leading to safe, remunerative and sustainable production.

Quality Planting Material

Inadequate availability of plant material is one of the important deterring factors in development of a sound horticulture industry in the country. Production of disease-free, quality planting materials of only released and recommended varieties/hybrids both in the public and private sectors are of paramount importance in any horticultural activity. It is of special significance especially in perennial horticultural crops which have a long juvenile/ gestation phase and any mistake committed by the grower in the initial stage will result in enormous loss in the later stages. In general fruit plants are propagated by vegetative means so as to maintain the genetic purity and commercial propagation techniques for fruit crops like mango, guava, banana, citrus, grape, apple, cashew nut, pomegranate, ber, bael, aonla, date palm, jamun etc have been standardized for mass multiplication. A rapid multiplication through wedge grafting in guava, mango, cashew nut, grapes, aonla and jamun has been standardized. Presently banana is commercially propagated by tissue culture.

Adoption of High Yielding Varieties

Improving orchard efficiency by gap filling and rejuvenation of old, unproductive and senile orchards through substitution of old varieties with improved high-yielding varieties and hybrids of crops like mango, guava, litchi, aonla, cashew etc. High yielding and hybrid varieties play a major role in increasing productivity of fruit crops. Effort have been made to develop high yielding varieties of various fruit crops for different agro –climatic conditions and these cultivars have been widely adopted for cultivation by farmers in the different parts of the country. About 880 improved high yielding varieties which are having high quality and also tolerant/ resistant to many biotic and abiotic stresses have been released from different centres for ecological conditions across the country. Regular bearing biotic and abiotic resistant mango hybrids, guava hybrids and grape hybrid of export quality and suitable for wine making, gynodioecious papaya varieties for table and popain production, seedless cultivators of citrus etc. are the successful research attempts in boosting fruit production.

Use of Rootstock for Biotic and Abiotic Stress

Fruit plants are generally propagated on the rootstocks employing budding or grafting techniques. Propagation of fruit plants on the suitable rootstocks has several advantages over the propagation on its own roots as cutting, stool or layer. Rootstocks have an effect on the size of the tree, precocity in bearing and resistance to biotic and abiotic stresses in many fruit crops such as mango, apple, peach, pear, citrus, grapes, etc. The use of rootstock in mango cultivation gaining popularity and many new cultivars are being planted on stress tolerant rootstock. The popular rootstocks identified for salinity tolerance are Bappakai, Olour, Kurakkan, 13/1 and Gomera 1. In citrus, rootstock Rangpur lime can adapt to water stress, alkalinity, salinity and it can also transmit resistant to cold. Similarly, Cleoptera mandarin has the ability to tolerate cold and salinity. Trifoliate orange is hardiest rootstock to low temperature followed by sour orange and sweet orange. *Citrus unshiu* is a freeze tolerant rootstock. Apple rootstocks Like EM-IX, EM XVII and Anlarp 2 are resistant to winter injury. Salt Creek and Dog Ridge have been found salt resistant for grape.

High Density Planting

Improving productivity through high density planting/meadow orcharding by reduction in planting distance or use of plant growth inhibitors and dwarfing rootstocks as recommended in crops like mango, citrus, apple, pear, guava, and pineapple. HDP system is normally understood as a system in which a higher number of plants are accommodated per unit area in comparison to the conventional planting density. High density planting and meadow orchading system are the fastest way to minimise the gestation period, increase productivity and economic conditions of farmer. The choice of planting system is mainly dependent upon topography, crop, variety, plant density etc. This can be achieved through the use of dwarfing root stock, dwarf scion varieties, continuous training and pruning and use of growth retardants like paclobutrazol. In apple M 27 is a ultra dwarf root stock while M-9 and M-20 are dwarf and M-7, M-2, M-26, MM106, Merton 793 are semi dwarf and M12, M16, M-25, MM111, Novale are vigorous rootstock. Quince C is a known rootstock for inducing dwarfness in pear. In citrus Dragon Fly is used as dwarfing rootstock. Troyer citranges is used as a dwarfing rootstock for Kinnow and Karna Khatta for semi vigorous and Sohsarkar for vigorous root stocks for Kinnow mandarin. Creeper and Vellaikulumban induce dwarfness in vigorous mango cultivars like Banganpalli or Alphonso.

Use of Novel Growth Regulators

Growth and development of any plant parts or whole organism is controlled by the activity of different biochemical molecules i.e., enzymes, proteins, micronutrients etc. Other than these, some organic substances are also necessary to initiate or accelerate any metabolic mechanism within the plant system. Pioneering studies in the 19th century by Julius von Sachs and Charles Darwin demonstrated that various plant growth processes are regulated by "substances" that move from one part of the plant to another. Out of these chemicals, five (Auxins, GAs, CKs, ABA and Ethylene) are well recognized for their functions. But the more recent ones (Brassinosteroids, Salicylic acid, Polyamines, Nitric acid and Jasmonates) cannot be excluded from the list of hormones because of their involvement in important functions of plants. Brassinosteroids at the dose of 0.5 mg/l effectively reduced the rate of berry softening along with reduced rate of degradation in TSS and TA during low temperature storage and significantly reduced post harvest decay. Salicylic acid treatment reduced oviposition, larval development and adult emergence of *Bactrocera dorsalis* and suggest a role of SA in enhancing mango tolerance to *B. dorsalis*. Therefore, these novel growth hormones have been successfully confirmed their commercial potentiality of use in fruit crops in different aspects, such as, seed germination, dormancy, flowering, fruit set, fruit ripening, quality and yield, resistance to biotic and abiotic stresses and post harvest management.

Improving Water Use Efficiency

It is well known and widely accepted that water is precarious input in agriculture. At the same time with the rising temperature in earth sphere the evaporation demand of the soil and transpiration losses from the crops are getting aggravated. It constitutes foremost ingredients in plants because it makes a major part of plant biomass. About 90% of cytoplasm of plant is constituted by water alone. Water scarcity is pervasive on the earth sphere across all plant growth realms. It is estimated that about 22% of the geographical area and 17% of the population of our country would face severe water scarcity at 2050. Drip irrigation or more broadly known as

micro irrigation is mainly suited for fruit crops where it saves 30-70 per cent irrigation water and increase yield by 25-40 per cent. Irrigation at critical stage of plant is essential and irrigation at this stage yield higher than at any other stages. In fruits, fruit set, flower formation and fruits development stages are critical stages for irrigation. Fertigation offers scope for enhancing yield and quality of fruits. Investigations taken up at TNAU revealed that application of 13.5g urea and 10.5g of muriate of potash/week through fertigation (irrigation to replace 100% CPE) and soil application of super phosphate 278g per plant in bimonthly intervals improved growth, yield and quality characteristics in papaya cv. 9-1 (D). Water use efficiency can be increased by mulching at the base of trees very inexpensively. Using black polythene sheets or heavy mulching with organic material, such as, straw, dried grass, banana leaves, immediately surrounding the main trunk drastically reduces weed growth. Mulching with organic materials should be applied thick enough (12 – 15 cm) to prevent weed growth yet permit rain water penetration to the root area. Black polyethylene sheets prevent soil surface evaporation and tend to produce water under the sheets through condensation, supporting tree growth besides affording weed control.

Integrated Nutrient Management

The continuous use or excess supply of inorganic fertilizers as source of nutrient in imbalanced proportion is also a problem, causing economic inefficiency, damage to the environment and in certain situations, harm the plants themselves and also to human being who consume them. On the other hand, increase in productivity of fruit produce removes large amounts of essential nutrients from the soil. Without proper management, continuous production of crops reduces nutrient reserves in the soil. Another issue of great concern is the sustainability of soil productivity, as land began to be intensively exhausted to produce higher yields. Overtime, cumulative depletion decreases production, yield and soil fertility and lead to soil degradation. The new approach to farming often referred to as sustainable agriculture, seeks to introduce agricultural practices that are eco-friendly and maintain the long term ecological balance of soil ecosystem. The judicial use of organic inputs with inorganic is considered as the alternative source to meet the nutrient requirement of the crops. Integrated Nutrient Management refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner. Application of 75 and 100% of recommended dose of 300:300:300 g of NPK in six splits along with *Azospirillum* + VAM (50g/plant) + PSB + *Pseudomonas fluoroscens* (25g/plant) + *Trichoderma viride* (50g/plant) has proved to enhance growth and yield of papaya cv. CO.7. Maximum yield (24.29 tons/ha), TSS/acid ratio (6.02) and B:C ratio (6.46) was fund with 75% RDF + VAM 500g/plant + PSB 100g/plant + Azospirillum 100g/plant in Nagpur mandarin.

Canopy Architecture Management

Canopy architecture management refers to the scientific organization of tree canopy with optimum number of strong & rigid self supporting branches shoot and leaf ratio to harvest maximum solar energy. It generally deals with the organization and maintenance of the tree structure in relation to the size, shape, orientation of branches and light interception for maximum production with quality fruits. In fruit trees, the fruiting potential is largely governed by its architecture, canopy density and photosynthetic efficiency. The canopy management, particularly its components like tree training and pruning, affects the quantity of sunlight intercepted by trees, as tree shape determines the presentation of leaf area to incoming radiation. Light is critical to growth and development of trees and their fruits. The green leaves harvest the sunlight to produce carbohydrates and sugars which are transported to the sites where they are needed – buds, flowers and fruits. Better light penetration into the tree canopy improves tree growth, productivity, yield and fruit quality.

Precision Farming

Precision farming deals with all elements of information based farm management system to recognise, analyse and finally manage variability within fields for optimizing profitability, sustainability and production of land resources. It is an approach where inputs are utilized in right amount, at the right time and at the right location within the field to get higher average yield as compare to traditional cultivation techniques. It is comprehensive system designed to efficient management of resources through location specific high tech interventions which includes micro propagation, high density planting, drip irrigation, fertigation, protected/green house cultivation, soil and leaf nutrient based fertilizer management and mulching etc.

Integrated Pest management

Fruit crops are attacked by number of pests *viz*., fungi, viruses, bacteria, nematodes and insect pests. Several methods are available to combat these pests, but integration of them is the key for reducing resistance development in pests, and to reduce environmental pollution by use of chemical pesticides. To achieve the desired goals, all the available tactics of management have to be used judiciously to form the basis of Integrated Pests Management in fruit crops. Developing IPM strategies with biological control for important diseases and insects affecting commercial fruit production is very important. Apart from chemical control attempts have also been made to use bio-pesticides and bio-agents to control various insects and diseases. Fruit fly causes serious damage to fruits of mango, guava, ber etc. Bagging fruits with cloth bags and nets gives good protection from fruit fly. Use of pheromone traps also gives good control of fruit fly. However, proper sanitation of fields, appropriate canopy management, use of bio-agents is feasible approaches for management of various pest and diseases.

Mechanization in Horticulture

The cultivation of horticultural crops is predominantly dependent upon human labour. Major field operations for horticultural crops include nursery/seedling preparation, post hole digging for planting, inter culture, aeration, earthing, irrigation, plant protection, harvesting, grading, handling, packaging and transport. The fruits plants are generally perennial plants planted in pits. The tractor or power tiller operated post-hole diggers are available in the country up to 30 cm diameter. These pits are filled with good soil and manure. Inter-row spaces of the pits can be tilled with power tiller/tractor drawn tillage machinery to destroy the weeds, increase aeration and conserve moisture. Small power tillers can be used in terraced fields. The fruit seeds and stones are sown manually for raising the nursery seedlings for grafting or direct planting. Telescopic handles can be used for the pruning of the twigs and branches, which are not in the reach of human hand. Hand tools or power tillers with rotavators can be used for weeding and interculture. Different types of sprayers and dusters are available from manually to power operated such as knapsack sprayers foot operated sprayers, power operated mist blowers and dusters for plant protection. Fogging machines and mist blowers are available which can be used in the green houses and for covered crop cultivation. Harvesting is the most labour intensive operation due to delicate nature of fruits. For table purpose, harvesting would continue to be done manually. Mechanical harvesters for fruits can be used where fruits are sent immediately to processing industries for extraction of juices or making other products. Fruit harvest equipment is designed to vibrate fruit with enough force that ripe fruit will fall from the tree. Usually more than one pass is required per season because the fruit does not ripen uniformly. Grading of the fruits is done according to the size and colour, which is presently being done manually.

IMPROVEMENT OF FRUIT CROPS: GLOBAL AND INDIAN SCENARIO

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The world fruit industry is still based on grower selection from chance seedlings as well as mutations (sports) and as a result many fruit species are characterized by a narrow germplasm base. These elite seedlings have unique attributes such as outstanding flavor and texture, high fruitfulness and productivity, but also special problems associated with limited adaptation, and pest and disease susceptibility.

The first fruits crops to be domesticated appear to be the date palm, olive, grape, almond, fig, and pomegranate. Asian temperate pome fruits (apple, pear and quince) and stone fruits (apricot, cherry, peach, and plum) were fully domesticated by antiquity. Citrus fruits were domesticated early in China but reached the West in waves starting with citron. Tropical Asian fruits (mango and banana) and fruits from the Americas (avocado, papaya, and pineapple) were developed in prehistory. A number of popular fruits and nuts were only domesticated in the 18th to 20th centuries including various brambles, vacciniums, pecan, and kiwifruit, while many fruits, although extensively collected and marketed are in the process of domestication (lingonberry, various cacti, durian). Domestication of fruit crops resulted from selection of elite natural variants with further improvement arising from recombinants produced by natural inter crosses involving selected types. Cultural practices often unique to each crop, such as irrigation, pollination control, grafting, rootstocks, pruning and training, storage, and processing, were developed to extend use, increase productivity, and improve quality.

Fruit crops are characterized by a number of common features. Noteworthy is the obvious appeal of taste which many consider delicious—often a combination of sweetness, acidity and aromatic constituents. The desirable taste and colors of many fruits is a naturally selected trait associated with seed dispersal often mediated by mammal. Domestication of fruits involves a combination of events including species selection, recurrent selection of elite clones, and vegetative propagation combined with horticultural technology such as irrigation in dry climates, pruning and training, pollination in the case of date palm, and storage and processing technology. Genetic changes associated with domestication of fruits include the breakdown of dioecy, loss of self-incompatability, induction of parthenocarpy and seedlessness, polyploidy and all opolyploidy, loss of toxic substances, ease of vegetative propagation, and loss of spines, thorns, or pubescence. Other changes due to selection include increase in fruit size, increase in sugar content, and increase in storage and shelf life. Factors contributing to genetic improvement include interspecific recombination, polyploidization, and continued selection involving generations of sexual recombinants.

Fruit breeding as an organized activity is a 19th century innovation. Current progress was achieved through intensification of the same forces that have occurred during domestication with increasing emphasis on increased adaptability through hardiness, lowered chill requirement, photoperiod insensitivity, resistance to biotic stress, plant architectural modifications, and selection of color mutations. Molecular techniques hold out the promise of increasing the efficiency of selection through molecular markers and insertion of individual genes through transgene technology.

Early beginnings of fruit breeding technology can be demonstrated in strawberry and pear. The new hybrids (now known as *F.* ×*ananassa*or pineapple strawberry, after their shape and aromatic flavor, initiated the modern strawberry industry. Selection through the years has resulted in tremendous changes as the plant evolved from a predominantly dioecious species with male and female plants into a hermaphroditic species, in which flowers contained both stamens and pistils. The development of the day neutral character from interspecific crosses has resulted in continuous fruit production and has transformed the industry. Modern breeding has greatly increased fruit size and firmness.

Systematic breeding of European pear was first carried out by Jean Baptiste Van Mons (1765–1842), a

Belgian physician, pharmacist, and physicist and an early apostle of selection in plants. He collected clones of pear and sequentially planted (open pollinated) seed of the best material making new selections for eight generations. An early fruit book, *The American Fruit Culturist* (1863) by John J. Thomas (1810–1895) states that the mean time from seed planting to fruiting in the first cycle was 12 to 15 years, 10 to 12 in the second cycle, 8 to 10 by the third, 6 to 8 by the fourth, and 5 by the fifth. By the 8th generation several fruit trees fruited *at the age of four years* (emphasis by the author, presumably based on correspondence of Von Mons). This may be the first example of data on long-term selection in plants. Recent breeding efforts have concentrated on fireblight resistance. Thomas Andrew Knight (1759–1838) was the first to improve fruits by selection from genetic recombination derived from inter-pollinations of clones.

Much of the world fruit industries are still based on grower-selected clones. The reason for the lack of progress of fruit breeding programs is twofold. First, vegetative propagation permits the genetic fixation of naturally occurring variation. Because of the vast populations involved in seedling orchards, the quality of the selected clones over hundreds and even thousands of years of selection is very high. Second, the difficulties and expense inherent in fruit breeding have inhibited long term breeding efforts. Progress from breeding a number of fruit crops, however, has shown significant advances in the second half of the 20th century and selections from controlled crosses are increasingly important in many crops. In apple, although chance seedlings such as 'Delicious' and 'Golden Delicious' have long dominated the world market. 'Fuji', a seedling derived from a Japanese breeding program ('Ralls Janet' × 'Delicious') is now the leading world cultivar. Selection from sexual recombinants is still the dominant force in the domestication process as well as modern fruit breeding. The isolation of elite selections, combined with mass plantings created a situation where mass selection and recurrent selection could operate naturally. This has recently been confirmed in apple, where elite selections from Kazakhstan are very close to cultivated varieties.

The objectives of fruit breeding varied with location. In northern locations objectives were based on hardiness. Breeding for apple hardiness is an essential character in the northern US and in Scandinavia. In southern locations low chill requirements received attention. Breeding for low chill has greatly increased the range of peach and nectarine in subtropical areas. Throughout the humid parts of the country disease and pest resistance were important objectives. In the western US, the main characters being selected were firmness and amenability to long distance shipping. Selection for fruit quality, based on flavor, color, and shelf life, and texture was the goal of modern fruit breeding programs but this factor often was sacrificed for appearance and shipping quality. Improved fruit texture has been important in apple and peach. Where processing was important to the industry, processing quality became key. Many processing industries soon came to be dependent on unique cultivars with special qualities such as 'Bartlett' pear. The processing industry of pineapple was long based on a single cultivar. 'Cayenne' and its spineless sport ('Smooth Cayenne') that was uniquely adapted to producing canned slices. However, organoleptic quality is increasingly being considered as key if fruits for the fresh market. A sweeter, yellow-fleshed seedling of pineapple resulting from hybridization in Hawaii. PRI 73-114 ('MD-2') is now being marketed as “Del Monte Gold” and has transforming the world fresh fruit industry because of better fresh fruit quality and appearance than 'Smooth Cayenne'.

The biotechnological revolution in the last half of the 20th century is based upon novel genetic strategies derived from microbial and molecular techniques including, in vitro propagation, embryo rescue, protoplast fusion, marker-assisted selection and recombinant DNA (transgene) technology. However, the great hopes for marker-assisted selection and transgene technology has yet to reach its potential. Fruit breeding has been in a state of flux because the traditional support by government experiment stations received throughout the world has declined as a reaction to the high costs of long term programs that are necessary. However, the globalization of the fruit industry has underscored the economic value of improved germplasm indicating that support for fruit breeding needs to be increased. Returns from patents offer one solution to impede the decline in funding and to encourage breeding effort. Patents are essentially a direct tax on the industry to improve breeding and also offer incentives to breeders when they share in patent royalties. In some countries the costs of foreign patents has encouraged investment in local breeding programs.

The objectives of breeding efforts in the future must be twofold. The most important is to increase quality in order to increase consumption. This is important to reverse the decline in per capita fruit consumption in developed countries. The second effort must be to increase the efficiency with special emphasis on productivity, annual bearing, and pest resistance. However, the future of fruit breeding is crop specific. For example the tremendous advances in seedless table grapes have intensified breeding efforts. In contrast, the breeding of wine grapes is impeded by the association of traditional cultivar name with the name of the wine. As a result the wine industry has not encouraged cultivar change except for clonal selection. Practically no advances have been made in the genetic improvement of banana but there are major projects via international efforts (International Network for the Improvement of Banana and Plantain or INIBAP). The lack of diversity in export banana makes breeding essential due to disease pressure (such as sigatoka) but seedless banana is notorious difficult to hybridize.

In the case of underutilized or new fruit corps, knowledge of domestication should be used to predict future changes. Thus one might anticipate that in kiwifruit, hermaphroditic mutations would eliminate the need for staminate clones as pollinators, and that fruit skin mutations or breeding could lead to non-pubescent clones, with more attractive and more edible fruit surface. The use of interspecific hybridization should lead to improvement *Prunus* and *Rubus*. A number of tropical fruits are candidates for commercialization, provided post harvest technology can be improved. One of the likely candidates for domestication is pitaya (species of *Selenicereus*, *Hylocereus*, and *Cereus*), an extremely attractive fruit of columnar cactus, but breeding efforts to improve quality is required, since many selections have been insipid.

The history of Indian fruit crop improvement is hardly one hundred years old. The varietal improvement work was initiated in guava by late Dr. G.S. Cheema & Deshmukh in 1905 followed by Burns and Prayag on mango in 1921 at Ganesh Khind Fruit Experiment Station, Pune. As a result L-49 guava was developed through a selection from cv. Allahabad Safeda in 1927. These initiatives set the tone for emphasis on fruit crop improvement in India. Since then fruit crop improvement has been carried out in a number of crops through introduction, selection, hybridisation and mutation breeding. In earlier times improvement in fruit crops was brought about largely by making selections from the indigenous variability. Simultaneously exotic germplasm was also introduced. These activities performed by local growers, often patronized by the then rulers and some enthusiastic horticulturist continued over the years and resulted in the development of several popular *cvs* of different fruits.

After independence of India fruit crop improvement got a fillip with the setting up of a network of Institutes/Project Directorates/ National Research Centres and Regional Station of Institutes in different regions of the country who took up crop improvement work on a number of crops, e.g. mango, guava, grape, aonla, pomegranate, etc. which has resulted in a number of superior varieties. Some of the breeders, who have contributed to fruit crop improvement significantly are Drs. S.K. Mukherjee, R.N. Singh, P.K. Majumdar, and D.K. Sharma at IARI, New Delhi; Mansha Ram at IARI, Pusa, besides a number of workers like K.C. Naik, N. Kumar from Coimbatore & Periyakulumand MPKV, Rahuri. Development of the Amrapali hybrids became a milestone in mango improvement for dwarfness and regularity to the breeders of the India and abroad. Consequently, breeders of the several countries are utilizing Amrapali hybrids as one of the parents for mango improvement.

Breeding of fruit trees is quite different than breeding of annual crops. Besides, there are several constraints impeding fast testing and release of varieties. In addition, there are several inherent problems in some fruits crops such as structural differences in floral biology, apomixes, parthenocarpy, cross incompatibility, number of seeds per fruit and large acreage required for meaningful assessment.

PROTECTED CULTIVATION TECHNOLOGY: A SUSTAINABLE APPROACH FOR CHANGING HORTICULTURE SCENARIO

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Agriculture in India often finds itself confronted to various constraints under changing dimensions that are currently manifest in rapid climate change, soil degradation, population pressure, land fragmentation, water scarcity, marketing and entrepreneurship etc. Horticulture is fast emerging as one of the most dominant faces of Indian agriculture. India is second largest producer of the vegetable crops after China estimated to 146 mT from 8.4 mh area and highest producer of the fruit crops. There is little possibility of addition to the cultivable area though area under horticulture has been increased during the last two decades largely at the cost of other crops. Of all the horticultural technologies, protected cultivation -cum- plasticulture is emerging as one of the most promising fields particularly in terms of higher productivity, quality, increased income, entrepreneurship etc. though the area coverage of about 60,000 ha alone appears abysmal. But the progress of area coverage under protected technologies in terms of percent coverage is highly satisfying. The other major reasons for higher adoption include – promotion of hi-tech horticulture by public financial institutions. Net result is that despite the technology performing exceedingly well by up to date farmers, majority of them keep facing challenges to cope up with the demands of hi-end horticulture. This article deals with overall gamut of technology, its potential, suitable areas and crops, tackling the challenges of biotic and abiotic stresses, market linkages and overall empowerment of farmers in terms of knowledge, input availability and use-efficiency, plant protection, post-harvest loss management, and market linkages etc. It can be safely presumed, that, if adopted, in right earnest, plasticulture in horticulture has immense potential in realizing the sustainable solutions for higher productivity, better livelihood and nutritional security to the farmers who adopt the technology, particularly as clusters of hi-tech farming cooperates.

Plasticulture in horticulture includes protected cultivation-cum-covered cultivation under greenhouses, polyhouses, net houses, tunnels, mulches etc. all of which include intelligent and exhaustive use of plastics in various forms depending upon the requirements, suitability of regions, climates, crops and technologies infrastructure or paraphernalia e.g. UV stabilized polythene sheets, insect-proof nets, shade nets, mulches, drip irrigation pipes, filters, tanks, plastic-lined water harvesting, etc. all are discretely made up of plastics.

Protected Horticulture

Plasticulture or protected cultivation or covered cultivation can make a cognizable and tangible contribution in all of these policy initiatives of the Govt., both directly and indirectly, in horticultural sector. It is interesting to note that plasticulture including protected cultivation is apparently the only sector of agriculture which is a solution for most of the its inherent constraints into an ideal system which could address them as modules of systematic and sustainable farming including healthy planting material, quality seed production, conservation and optimization and input use efficiency of water and other resources, precision farming, GAP, IPM, INM, Grafting, soilless cultivation besides minimized impaction of climate change aberrations etc. which all find convergence to strengthen farming into a hub of profitable horticulture. Apart from this, the hi-tech agriculture encourages better yields from fragmented land, entrepreneurship potential, GAP produce, export potential etc. It is by virtue of these strengths that protected cultivation technology can play a lead role in overall gamut of horticulture. Plasticulture is, thus, the future of horticulture. The potential of addressing soil erosion, recycling abilities, as well as amelioration of soil and water pollution are additional boons to overall ecosystem besides the economy of agriculture. Also, protected cultivation is most amenable to hi-tech supply chain networks in horticulture which ensures higher income to growers. Over and above of these advantages, plasticulture is very amenable to women workforce.

Suitable Horticultural Crops for Polyhouse Farming

Horticulture-based farming systems are highly diverse numbering more than 300 species, depending upon the climate, culture, season, size of land holdings, knowledge, market etc. Being high value crops with higher nutritional contents, besides with a higher demand in urban and peri-urban areas, horticultural crops provide a paradise for the progressive grower on one end and marginal farmer. Major crops for these systems are indeterminate tomato, cherry tomato, cucumber, capsicum, bitter gourd, musk melon, summer squash, vegetable nursery etc. in vegetable groups. Among flower crops, rose, gerbera, Lilium, tulip, anthurium, carnations, orchids, chrysanthemum and their nursery. Among, fruit crops group, strawberry, papaya and all fruit-nursery propagation or hardening are used for economically profitable horticulture based farming systems.

Vegetables based Greenhouse Farming

After years of field experiences and feedback from the interaction with farmers following crops appear to give higher yield and better quality that ensure more income for improving livelihood and nutritional security. Wherein, indeterminate tomato hybrids (*GS-600, ID-32 and ID-37, Rakshita, Himsona, Himsikhar, Snehlata, Naveen* etc.) on an average give quality yield of 80-100t/acre/crop with net returns nearing Rs 3.0-4.0 lakh/acre/yr which is about 2-3 times higher yield and income as compared to traditional open farming systems. In the case of coloured capsicum (known as solanaceous apple) hybrids like *Natasha, Swarna, Indra, Bombi, Orobelle, Bachata, Inspiration* etc. in green, red and yellow colours produce 40-50 t/acre/crop yielding 6-7 times higher yield and income as compared to open cultivation of capsicum. Because the coloured capsicum cannot be grown properly in open condition. This crop, therefore, demands to be produced under protected horticulture. Among vegetables, cucurbits appear most suitable for protected cultivation both in terms of season and number of crops for better utilization of structures. 2-3 crops per year of parthenocarpic cucumber (cv. Isatis, Kian, Hilton, Sun Star, Multistar, Fadia, Mini Angel etc), summer squash (cv Pusa Alankar, Pusa Pasand, Australian Green, Seoul Green, Kora, Yellow Zucchini, Himanshu, etc), bitter gourd (Pusa Rasdar) or musk melon (Pusa Sarda) and yellow musk melon can be taken in polyhouses during early and off-seasons. Average production of 120-150 t/acre/year can be obtained in cucumber. These vegetables are transplanted during July to Aug. and harvested from May to June in the plain conditions. However,in hill areas, transplanting is done in the month of Feb.to March and harvesting during Oct. These vegetables result in better livelihood and nutritional security as compared to traditional vegetable farming in the open.

Horticulture farming under Net-built structures

Generally two types of net-built structures are used *viz*., shade-net and insect-proof net houses often termed synonymously, but indeed, a shadenet is primarily a covering of UV stabilized coloured plastic net where main objective is to provide protection to the horticultural nurseries and plants from harsh sunlight and hot winds during summer seasons. On the other-hand, insect proof nethouses are built for the primary objective of screening out the entry of insects or other pests by the physical barrier of nets of various mesh sizes depending upon crop and season. Both the nethouses can be made by iron or GI pipe or bamboo or wooden or stone pillars etc. and are one of the most feasible forms of protected cultivation. Basic cost of fabrication of these structures may range from Rs 8-10 lakhs/acre.

Shade net Protected Structures

Shade nets generally use two colour nets (green and black) in horticulture-based farming systems. Both colour shade nets are available in 30, 50, 75 and 90% capacity of shading protection, wherein this percentage means the percentage of reduction in sunlight. In vegetable crops 30-50% capacity of either colour or 50-90% shade nets are used for fruit-propagation in horticultural crops. Shade nets also cut down the sunlight, in turn minimizing evapotranspiration losses of moisture in general as well as reduced transpiration from plants. The total effect creates an altered relative humidity and temperature regime of microclimate favouring the plant growth. That is why these structures are especially useful for dryland and arid areas with water scarcity by increasing water use efficiency when used in combination with drip irrigation. Shading nets are the perforated plastic materials used to provide relief to the plants from the scorching sunlight, hot winds, direct rainfall, hails, birds and animals as well as insects-pests. Nets of 25% to 75% shading capacity are being used for raising nursery,

indoor plants, hardening of tissue cultured plants and growing of vegetables. During high light intensities, leafy vegetables and ornamental greens are recommended to be grown under shade nets. This structure enhances 25-35% more yield as compared to traditional methods during peak summer season. Suitable crops identified for shade net houses from economic viability include horticulture nurseries, leafy vegetables, summer tomato and capsicum. Because these systems are mainly used to grow off-season cultivation of crops, their produce fetches much higher prices in the market, hence providing good economic returns to growers, thereby improving livelihood and nutritional security to the farming families. Ornamental crops like lilium, tulip, anthurium and orchids can also be grown economically depending upon suitability of different agro-climatic zones. Therefore, shade nets have come to occupy a prime importance in horticultural promotion in the country especially vide propagation of quality planting material.

I.P. Net Protected Structures

Insect-proof nylon net based cultivation is newer concept more suitable for rainfed areas with much fewer days of precipitation. These structures make use of insect proof screens of different intensities of perforations, ranging from 25 mesh to 60 mesh. IP nets of 40 or higher mesh are effective means to control entry of most flying insects and save crop from diseases. As compared to polyhouses, these structures are almost equally capable of screening out the insects and birds thereby avoiding the use of pesticides. These structures permit early planting of tomatoes and cucumber, bitter gourd, musk melon, summer squash, brinjal and chilli etc. without the risk of vectors. Higher mesh size (i.e. above 50), however, reduces the air exchange of the structure. UV- stabilized white coloured nets are now available which have a longer life. This structure enhances 25-35% more yield as compared to traditional methods during peak summer season. IP net structures can be used successfully for seed production in rainfed areas. Crops suitable for these structures include tomato, cherry tomato, cucumber, bitter gourd, musk melon, summer squash, papaya, meadow and high density orcharding of mango, guava and pomegranate and strawberry etc. besides very few flower crops. In irrigated areas, these structures may face problems during rainy season as it tends to flood the crop inside. Hence it is advisable to cover its roof by polythene sheets during rainy period. But this is possible only with small, half-moon type or gable type structures. Insect-proof covered cultivation technique give 2-3 times more yields and hence increase the income by about 30% normally but even more at times where insect damage is more. Thus, farmers are able to save the crop hence being safer for farmers.

Plastic Mulching

Plastic mulching technology, also called surface covered cultivation, largely involves mulching with polythene sheets for addressing three major issues *viz*., soil and water conservation, leaching of nutrients as well as reduction of weeds and to some extent insect pest damage. Drip irrigation is an integral part of mulching technology. Mulching involves covering the soil around the plant bases with an organic or inorganic material which makes condition more favourable for plant growth and development**.** Organic mulches, like leaves, straw, sawdust etc. add nutrients and humus to the soil as they decompose, improving its tilth and moisture holding capacity. Synthetic or plastic mulches have various beneficial effects on crop production. Plastic mulch accelerates plant growth by increasing soil temperature, conserving soil moisture, weed control, production of quality produce and reduction in leaching of nutrients. The plastic mulch is available in different colours. Each colour has its own significance. Transparent polyethylene mulch raises the soil temperature by soil solarization used mainly for managing soil-borne diseases and nematodes. This effect derives mostly from the suppression of latent heat loss through evaporation. Black polyethylene film also gives effective weed control by cutting down solar radiation by more than 90%, resulting in etiolated growth and the eventual death of weeds under the film. The yellow plastic mulch attracts insectsso it can be used toattract and kill insects. The silver-reflective type of plastic mulch associated with higher reflectance causes insect disorientation and repels aphids. The different types of mulches are reflective plastic mulches, infra-red transmitting mulches and biodegradable plastic mulches. There are different types of laying methods for plastic mulch but large area usage has to involve the help of mechanised and tractor operated mulch layers. Similarly, several low-cost hole cutting devices and transplanting devices are now pouring in market. Suitable horticultural crops that can take advantage of mulching include plants growing vertically by nature and not the creeping types e.g. solanaceous crops and Cole crops. Although, cucurbits like summer squash can also be grown on mulching but with proper staking systems only for

taking better advantage of the strengths of this type of cultivation. In fruit crops also the mulching is very important especially in strawberry and gooseberry. Other fruit crops like papaya, grapes, pomegranate, guava, mango etc. under high density and meadow planting methods do use the mulching technology strategically. This technology is again useful for areas with water scarcity or rainfed ecosystems and can conserve moisture to the extent of 50% water saving and 30% nutrient saving. Thus, we can conserve resources, economise input use and efficiency and harvest 25-30% higher yields as also the quality, playing a significant role increase in income and overall upliftment of livelihood of farming families.

Drip irrigation-cum-fertigation technique

Micro-irrigation is classified mainly into two types, i) drip irrigation and ii) sprinkler irrigation. Drip irrigation is one of the best available tools made out of plastics in agriculture for the judicious use of water for growing various crops in large scale on sustainable basis. Drip irrigation is a low, labour intensive and highly efficient system of irrigation, which is also amenable to use in difficult situations and problematic soils, even with poor quality water. This technology is the practical example of "*More Crop Per Drop*" theme of agriculture in PMSY and has provision for 50-60% subsidy for the adoption of technology. Irrigation water savings through drip irrigation can be affected by adopting a suitable drip irrigation system ranging from 36-79%. In drip irrigation, water is supplied through a network of plastic pipes using dripper/emitters. Water is supplied at a regular interval and at a required time/ quantity. Productivity gains vary from 20 % to 50 % depending upon the crop. Drip irrigation works by applying water slowly, directly to the soil. Drip irrigation has high efficiency as there is no loss of water in form of evaporation or run- off and water is applied directly to the plant roots. This is one of the major tools of precision farming which effectively increase water and nutrient use efficiency thus contributing significantly in water scare areas, increasing production and overall livelihood upliftment through horticulture based crops. Similarly, sprinkler irrigation is one of the more effective tools of water conservation. It is used mainly in production of horticultural crops in the open type of cultivation mainly orchards. This is used mainly in carpet natured crops and high density crops and leafy vegetables like beans, peas, root based crops like radish, carrot etc. and ornamental landscapes and lawns including early transplanted stages of fruit crops. This irrigation technique has given a flip to the intercropping system in horticultural crops. Currently, about 69.5 mha areas are under micro-irrigation, of which drip irrigation covers about 27 mha. Lately, other cropping systems have also started to adopt the drip irrigation to finally taking agriculture to overall aim of rainbow revolution.

Plasticulture-cum-covered-cum-protected cultivation based horticultural production systems, thus, have immense uses in order to conserve the water, nutrient and energy resources besides increasing the production, generating additional income for the farmers, creating more employment opportunities in rural areas for the unemployed youth and women folk. In future, there is need to encourage environmentally degradable material, developing plastic based system for storage and handling of vegetable produce, besides adopting good agricultural practices and IPM. There is need of developing technology for production of eco-friendly plastic and eco-friendly disposal of waste plastic.

FLORICULTURE IN PERI-URBAN AREAS: A NEW VENTURE OF GREEN ECONOMY

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Floriculture in India is amplified with dynamic and restless progress with recorded impressive annual growth rate notably in peri-urban areas due to rise in income alongwith living standards of people. Flowers has transformed from a symbol of love to an industry, fostering both income as well as employment. Since, the country is blessed in terms of diversification of agro-climatic conditions persuading in different parts ensuring a successful production of most of the ornamental crops throughout the year. Now cultivation of commercial flowers increased tremendously in peri-urban and surrounding areas which holds cutflowers i.e. rose, tuberose, chrysanthemum, gerbera, gladiolus, anthurium, etc. and loose flowers i.e. marigold, jasmine, annual chrysanthemum, crossandra, etc. Attractive cut flowers like alstroemeria, carnation, lily, orchids are also gaining popularity in some areas as premium choice of the consumers. Several cut greens are also in big demand in cities which are used in various flower decorations. These crops being grown in both open field and protected conditions have been proved as profitable ventures in and around cities of India. In peri-urban areas the floriculture industry comprised chiefly of four sectors, *viz*, The florist trade traditional and contemporary cut flowers and cut foliage, both fresh and dried and bouquets, floral baskets, flower arrangements and garlands as value added products; The plant nursery for supply of plant material including tissue culture plants, seeds, bulbs, corms and other propagated material; Plant rental service for supply of foliage plants on annual rent for a specific period and last flower perfume and oil industry. Introduction of new potential flowers and production of cut greens in peri-urban areas of the country would be an effectual step to energized the floriculture province.

BIOTECHNOLOGICAL INTERVENTIONS FOR DISTANT HYBRIDIZATION IN CROPS

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Wide or distant hybridization, a mating between individuals of different species or genera, provides a way to combine diverged genomes into one nucleus. Wide hybridization breaks the species barrier for gene transfer and thus makes it possible to transfer the genes of one species to another, which results in changes in genotypes and phenotypes of the progenies. It is very important for species evolution and speciation since chromosome doubling of wide hybrids is responsible for the origin of many allopolyploid species. Repeated backcrossing of wide hybrids to their parental species has contributed to the evolution and speciation of some species by gene introgression, i.e. the infiltration of chromosomes from one species into another through repeated backcrossing of wide hybrids to their parental species (Mallet, 2007). The use of other techniques of crop improvement like development of transgenics or genetic modifications, pose great difficulties in commercializing of new varieties because of requirement of extensive biosafety tests, opposition by the consumers and activists/environmentalists, several patent restrictions in commercial use of genetic modification techniques, etc. With recent advances in plant tissue culture, molecular biology, biotechnology and scientific instrumentation, the importance and scope of distant hybridization has widened and the potential of distant or wide hybridization in crop improvement seems more promising than ever.

Barriers in Distant Hybridization

There are several problems associated with wide hybridization such as occurrence of self and cross incompatibility, failure of zygote formation / zygote development, disharmony between the parental genomes, incompatibility, endosperm abortion, etc need to be overcome.

Techniques to overcome barriers in distant hybridization

In vitro pollination and fertilization	Diploidization of haploids to obtain homozygous lines through anther/pollen culture
Embryo Rescue	Development of alien addition or substitution lines through the use of monosomics and nullisomics
Cybridization	Induction of triploidy (for seedless fruits)
Induction of polyploidy	Induction of triploidy (for seedless fruits)
Induction of amphidiploids	Inter-specific or inter-generic grafting etc
Protoplast fusion and somatic hybridization	

Appraisal of offspring obtained through distant hybridization

Morphological identification

The comparison of morphological characteristics between hybrid offspring and parents is the simplest way to confirm the authenticity of a distant hybrid.

Cytological identification

The study of chromosome characteristics and Flow cytometry are is a reliable way of identifying distant hybrids.

Molecular marker identification

Molecular markers *viz.* RAPD, AFLP, SSR and ISSR are used for identification

Achievements

Interspecific hybridization in Tomato (Solanum Lycopersicum L)

Tomato leaf curl virus (TLCV), Bacterial wilt and blights are major yield limiting factors in India. Considering the importance of tomato for fresh market and processing industries, worldwide research programmes have been designed to develop superior hybrids of tomato having high nutritive value, longer shelf life, multiple resistances coupled with high yield. Tomato is self-pollinating, but can easily hybridize within the species or cross with wild relatives under appropriate conditions, thus permitting gene introgression from wild relatives. A number of interspecicfic hybrids have been developed by utilizing the wild species of tomato for interogression of traits like high lycopene content, beta-carotene, high TLCV resistance and shelf life. Some of the wild tomato species along with trait of interest have been shown in Table 1.

Table 1: Tomato species taken and their important economic traits

1.	*L. pennellii* (Corr.)	Resistance for salt tolerance, *Myzus persicae*
2.	*L. peruvianum* Mill.	Resistance for TLCV, bacteria l canker of tomato, powdery mildew,
3.	*L. pimpinellifolium* (Jusl.) Mill	Resistance for TLCV, salt tolerance, bacterial canker of tomato
4.	*L. esculentum* var. *cerasiforme*	Resistance for White Fly, *Helicoverpa zea*
5.	*L.cheesmanii f.*	Resistance for TLCV, high sugar and β-carotene, Resistance for *Myzus persicae*
6.	*L. hirsutum f. typicum*	Resistance for TLCV, Resistance for *Helicoverpa , Spodoptera Exigua, chilling tolerance*

Interspecific hybridization in okra

The use of resistant cultivars is the best method to minimize the loss, since the other methods are either impractical or not economically feasible. Identification of stable genetic source with tolerance or resistance to virus diseases such as OYVMV is of paramount importance. One of the main reasons for slow progress through breeding of Okra is the efforts of breeders in the past with a narrow genetic base (Singh, 1987). Therefore, the intergression of YVMV resistance into cultivated varieties of Gujarat i.e. GAO-5 (*Abelmoschus esculentus*) from a wild species *A.moschatus* Subsps. tuberosus has been successfully done through embryo rescue.

Interspecific hybridization in Custard Apple (*Annona squamosa)*

In India, area under custard apple is reported to be more than 40,000 ha mainly in wild form in the states of Andhra Pradesh, Tamil Nadu, Orissa, Assam and Rajasthan. However, well organized orcharding of this fruit crop can be seen in Saurashtra region of Gujarat where in water scarcity areas this crop is slowly replacing pomegranate, which demands comparatively more water due to longer reproductive phase. Twelve interspecific hybrids among the four different species of Annona have been developed successfully. The custard apple has many relatives as follows.

Table 2: List of Annona species taken under study and their important economic traits

1.	Ramphal or Bulock's heart or Bull's heart (*Annona reticulata*)	Fruits are larger in size, heart shaped, smooth and less seeded but pulp is inferior in quality.
2.	Sour sop (*A. muricata*)	The fruits have many soft spines and highly acidic
3.	Lakshman phal / Cherimoyer / Cherimola / Cherimoya (*A. cherimoya*)	Fruits are most delicious, slightly acidic, sweet with buttery consistency of pulp and low seed content
4.	Atemoya (*A. atemoya)* (*A. squamosa x A. cherimoya*)	better quality and adaptability to high temperature
5.	*Annona squamosa*	Fruits are rich in carbohydrate mainly in the form of sugar (23.5%), protein (1.6%), calcium(17mg/100g), phosphorus (47mg/100g) and iron (1.5mg/100g).

Interspecific hybridization in cotton

In India diploid cotton constituted a predominant area (97%) at the time of partition. Specific interest in hybrids marginalized *G. herbaceum* to poor resources and management mainly under rainfed eco-system. Consequently distinct *G. herbaceum* tracts developed in Gujarat and Karnataka. Choice of *G. herbaceum* in these tracts was not preferential but obligatory due to harsh cotton growing conditions. Within the aim of fibre quality improvement in *G. herbacium*, the fibre length in herbaceum cotton has been enhanced using the interspecific hybridization between G.herbaceum and G.raimondii, and G.herbaceum and G. barbadense through embryo rescue technique and hybrids were validated through molecular markers.

Interspecific hybridization in watermelon

The modern watermelon cultivars share a narrow genetic base and are susceptible to various stresses. To broaden the genetic base of water melon, an attempt was made to develop interspecific hybrids between *C. lanatus* and *C. colocynthis* followed by hybridity testing of F_1 through SSR markers and biochemical analysis of F_2. Out eight markers, two markers could correctly discriminate the true hybrid. Biochemical analysis of pulp of selected F_2 plants and parents indicated that in many F_2 plant's biochemicals were higher than parents which indicated that the blending of genes from both species made a favorable effect.

Conclusion

Distant hybridization helps in tackling both biotic and abiotic stress and also in enhancing quality in fruit crops. But there is a need to develop techniques to break incompatibility and interventions of biotechnological tools like Embryo rescue, Genome sequencing, transcriptomics, Makers assisted selection are strongly required to be adopted. It can dramatically widen the available genetic pools so that novel genetic variation can be utilized by plant breeders. Crossing between individuals of different species or genera provides a way to combine diverged genomes into one nucleus.

Future Thrust

Plant breeders require access to new genetic diversity to satisfy the demands of a growing human population for more food that can be produced in a variable or changing climate and to deliver the high-quality food with nutritional and health benefits demanded by consumers. The close relatives of domesticated plants, crop wild relatives (CWRs), represent a practical gene pool to be used by plant breeders. Techniques like Genome Editing may also be one of the promising tool for precise introgression of the genes from distant species in to their cultivated forms. Advances in DNA sequencing technology will enable the efficient sequencing of CWR and their increased use in crop improvement. Genome analysis results in discovery of useful alleles in CWR and identification of regions of the genome in which diversity has been lost in domestication bottlenecks.

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SUSTAINABLE HEALTHY SEED POTATO PRODUCTION THROUGH AEROPONIC SYSTEM IN INDIA

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Unlike most crops where 'true' seed is used for cultivation, potato is usually propagated through tubers. This vegetative mode of propagation is beset with many problems; the most important of which is a progressive and significant decline in the yield potential of seed tubers over the years. Low multiplication rate, high seed (tuber) rate, dynamic amassing of degenerative infections, perishability and massiveness are the inherent issues in seed potato production. This may result in non-accessibility/non-availability of sufficient amounts of value seeds at reasonable cost and seed cost alone reflects 40% which is half to the aggregate expenses of development in potato. To go around a portion of these issues, a few alterations, for example, tuber ordering for infection opportunity, seed increase stages and seed accreditation guidelines have been created and incorporated with regular potato seed generation programs. The coming of tissue culture, in which infection free plants can be delivered through meristem culture, kept up uncertainly under controlled conditions and duplicated in counterfeit media under sterile conditions in the research centre during the time regardless of developing season, has reformed seed potato production world over. Ongoing advancements in robotization of minitubers generation have additionally upgraded flexibility of these systems in potato seed creation. Additionally, to quality assurance through plant tissue culture, aeroponic technique of minitubers production ensures high multiplication rate at initial stages of quality seed potato production.

Keywords: Aeroponic, *in vitro*, soil-less production, virus-free, seed potato

CLIMATE CHANGE IMPACT ON LIVESTOCK PRODUCTION

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Animal production constitutes an important core of integrated farming in terms of income and employment generation, equity and sustainability, especially in the developing and under developed countries. Having passed through the era of green revolution, growth in agricultural production has slowed down considerably in recent times; however, the animal husbandry sector is registering an upward trend. On an encouraging note, the milk production in the country has shown a consistent growth rate at about 5%, egg production at above 7%, and mutton production at still higher rate; in addition to the benefits coming from non-food products of livestock such as fibre (wool, mohair, hairs, etc.), skin or leather, dung and draught energy. The contribution of animal sector is estimated at about 8% of Gross domestic product (GDP) and approximately 26% of the overall agricultural production in India. Agriculture has been linked to the significant effects on climate change, primarily through the production and release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide, but also by altering the earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to global warming. Land use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide.

Recent years have witnessed an unprecedented rise in the planet's temperature, thereby, making it increasingly uninhabitable, and this phenomenon is commonly referred to as “Global warming”. Normally, the earth must radiate some of the energy it receives from sun, back into the atmosphere in order to maintain its temperature, however, certain atmospheric gases form a blanket around the earth, thereby, allowing the solar radiation to penetrate but preventing it from escaping back.

Such climate change is expected to cause an increase in weather-related disasters and extreme weather events, such as droughts, heat waves, storms, desertification, and increase in insect infestations. Long-term changes in climate due to their significant negative impact on animal productivity will jeopardize the future of all animal species including those found in oceans, forests, our homes, and on farms. High producing animals will most likely be affected to a greater extent by global climate change than animals with lower production levels. Global climate change may have negative effects on conception rates, particularly in instances when the breeding season primarily occurs in the spring and summer months. It has been reported that conception rates in dairy cows were reduced 4.6 percent for each unit change when the THI reaches above 70 (Hahn, 1995). Similarly, a decrease in pregnancy rates of *Boss taurus* cattle of 3.2 percent for each increase in average THI above 70, and a decrease of 3.5 percent for each increase in average temperature above 23.4°C has been noted, with minimum temperature having the greatest influence on the percent of cows getting pregnant (Amundsen *et al.*, 2006). Clearly, increase in the temperature and/ or humidity have the potential to affect conception rates of domestic animals not adapted to those conditions. In an effort to maintain optimum levels of production, climate change will likely result in livestock producers selecting breeds and breed types that have genetically adapted to conditions that are similar to those associated with the climate change.

However, in warmer climates, breeds that are found to be more heat tolerant are generally those that have lower productivity levels, which is likely the mechanism by which they were able to survive as a dominant regional breed. In addition, climate change and associated variation in weather patterns will likely result in more livestock being managed in or near facilities that have capabilities for imposing microclimate modifications (Mader *et al.,* 1999). Domestic livestock, in general, can cope with or adapt to gradual changes in environmental conditions; however, rapid changes in environmental conditions or extended periods of exposure to extreme conditions drastically reduce productivity and are potentially life threatening. The economic losses from reduced cattle performance (morbidity) are likely to exceed those associated with cattle death losses (Mader, 2003). Surrounding environmental conditions directly affect mechanisms and rates of heat gain or loss by all animals (NRC, 1981). The risk potential associated with livestock production systems due to global warming can be

characterized by levels of vulnerability, as influenced by animal performance and environmental parameters (Hahn, 1995). When combined performance level and environmental influences create a low level of vulnerability, there is little risk. As performance levels (e.g., rate of gain, milk production per day, eggs/day) increase, the vulnerability of the animal increases and, when coupled with an adverse environment, the animal is at greater risk. Combining an adverse environment with high performance pushes the level of vulnerability and consequent risk to even higher levels. Current management systems usually do not provide as much shelter to buffer the effects of adverse weather for ruminants as for non-ruminants. From that perspective, environmental management for ruminants exposed to global warming needs to consider for 1) general increase in temperature levels, 2) increases in night time temperatures, and 3) increases in the occurrence of extreme events (e.g., hotter daily maximum temperature and more/longer heat waves). In terms of environmental management needed to address global climate change, the impacts can be reduced by recognizing the adaptive ability of the animals and by proactive application of appropriate countermeasures (sunshades, evaporative cooling by direct wetting or in conjunction with mechanical ventilation, etc.). Specifically, the capabilities of livestock managers to cope with these effects are quite likely to keep up with the projected rates of change in global temperature and related climatic factors. However, coping will entail costs such as application of environmental modification techniques, use of more suitably adapted animals, or even shifting animal populations.

Development of new technologies and their implementation at farmers level for efficiently and effectively reducing the green house gasses emission for preventing the further increase in global warming and climate change. Finally, it must be realized that any National policy in this direction, like any "Save Environment Campaigns" of this nature, can only become successful by creating mass awareness about the gravity of problem, the necessity of a timely action; and above all, active involvement and willing initiatives of people to bring the change in their diet, activities and lifestyle as a contributor to their carbon footprint.

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PHYTOMITIGATION OF TOXIC EFFECTS OF XENOBIOTICS

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We are living in an environment where we are continuously exposed to a number of xenobiotics in the form of various toxic chemicals, pollutants, synthetic drugs, food additives etc. Many of these chemicals generate free radicals/reactive oxygen species (ROS) which can damage membranes and organelles, and lead to various diseases. It is estimated that one third of deaths occur due pollutant born diseases like heart diseases, liver related diseases, cardiovascular diseases, cancer, diabetes, Alzheimer's disease and age-related functional disorders etc. Epidemiologic studies have shown that medicinal plants play very important role in the prevention of many acute and chronic diseases due to presence of various bioactive compounds which are responsible for health promotion and disease resistance. It is well-known that plant produces these chemicals to protect itself but recent researches, revalidating ancient Ayurvedic concepts, demonstrate that they also protect humans against diseases. Some of the well-known phytochemicals are lycopene, isoflavones, allyl sulfides, carotenoids, flavonoids and polyphenols. Triphala is a well known polyherbal formulation. Synergy of three fruits, Amla (Emblica officinalis), Harad (Terminalia chebula) and Baheda (Terminalia bellerica) in equal proportions (1:1:1) provide the classical combination of Triphala. The proficiency behind Triphala's many benefits come from the individual herbs which constitute the formula. Each of three herbal fruits of Triphala takes care of the body by gently promoting internal cleansing of all conditions of stagnation and at the same time it improves digestion and constipation. Triphala is one of the richest sources of various bioactive phytochemical compounds. Many pharmacological activities of Triphala such as antioxidant, antimutagenic, hepatoprotective, immunostimulatory etc. have been reported.

UTILIZATION OF TRADITIONAL SWEETENER IN MODERN FOOD SYSTEM FOR NUTRITIONAL FOOD SECURITY IN INDIA

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About 65% of the Indian population lives in rural villages. Agriculture is pivotal to all strategies for planned socio-economic development of India. In the palatability of food stuff, that majority of population consumes, the importance of sweeteners as a factor, has long been recognized. Over the years modern food habits/systems of the human beings have been greatly influenced by research and developmental activities and also due to their health consciousness. The common Indian diet is deficient in nutrition. Majority population suffers due to mal/under nutrition. About 30% of the population is estimated to be below poverty line. About 40% of boys and 41% of the girls between age group of 1 and 5 years are moderately or severely under-nourished. About 74% children under 3 years of age and 52% of married women between 15 and 45 years of age group suffer from anemia. Percentage of children less than 3 years classified as under nourished on anthropometric indices of nutritional status ranges from 62 to 65%. Per capita availability of cereals and pulses, the only source of protein for majority Indian population, at about 470 grams per day also leaves much to be desired. Thus, there is a need to have nutritionally improved food in our food system.

So far the country has been able to fight problem of food shortage, but the giant task before it, now, is to fight mal/under nutrition. Therefore, the nutritional potential of value added products from sugarcane juice in particular is of considerable importance for majority population. Jaggery, locally made in rural areas, is rich in minerals like- Calcium, Magnesium, Potassium, Phosphorus, Sodium, Iron, Manganese, Zinc, Copper, and Chloride, vitamins (Vitamin A, Vitamin B1, Vitamin B2, Vitamin B5, Vitamin B6, Vitamin C, Vitamin D, Vitamin E, Vitamin PP and protein and can mitigate the nutritional problems of different kinds and would help in nutritional food security of our country.

Higher incidences of diabetic patients and related diseases, dental decay and also increase in obese population have affected the consumption of sugar or caloric sweeteners worldwide. The 2005 Dietary Guidelines for Americans recommended choosing foods that limit the intake of added sugars, balancing caloric intake from foods and beverages with physical activity; and choosing and preparing foods and beverages with little added sugars or caloric sweeteners which caused reduction of cane/beet sugar by about 35% in USA over last 45 years and similar has been the trend worldwide. Hence, to meet the requirement of enduring food and nutrition, there is need to develop sweetener products (viz; solid jaggery, liquid jaggery, granular jaggery and jaggery chocolates and vinegar etc.) from natural sources like sugarcane juice. Also jaggery is made from palmyra, palm, date palm, and or coconut palm. The sweetness is accomplished in different proportions by jaggery of different kinds, fruit concentrates, honey, invert sugar, molasses and plant syrups etc in our food system

There are several value added products prepared form sugarcane juice which have capability to fight the malnutrition problem to a great extent. The most important product produced in bulk is jaggery (gur) followed by liquid jaggery (cane juice concentrate), vinegar and granular (powder) jaggery. Most of them contain sucrose, glucose & fructose, protein, fat, calcium, phosphorus, potassium, magnesium, iron, and copper. In addition, they also have carotin (about 168mg/100g), thiamin (0.02mg/100g), riboflavin (0.05mg), Vitamin A (900-1200i), vitamin B (60-80i) vitamin C (0.50mg/100 g) and energy (383 kcal). The jaggery preparations have been typical rural sector enterprise generally owned and manned by rural people and also it has vast geographical base. Awareness about the nutritional and medicinal values of different value added products and the transfer of developed technology and processes would help people fighting nutritional problems. The medicinal values of various value added products of cane juice have been recognized by our ancestors and medicine men from the time immemorial. They have advocated their use for maintaining healthy society. Ancient Ayurvedic literature and scattered rural know how depict about use of jaggery in relation to human health and curing of certain

diseases. The cooling, diuretic, aperient, acts as tonic, refreshing, improving throat conditions, normalizing semen and sperms, lactogenic and cardiac tonic are some of its important properties. The use of jaggery is prescribed in various diseases viz. anemia, jaundice, cold and cough, breathlessness, and kidney problems etc.

Jaggery is considered a mild laxative and supposed to have more warming effect and sweetening quality than sugar. As already mentioned, the jaggery is nutritionally rich endowed with innumerable medicinal qualities. The presence of calcium, iron, manganese and magnesium etc increase its medicinal values. Regular use of jaggery considerably prolongs the life span of man as stated on the Ayurveda Day celebration at Regional Ayurveda Sansthan, Lucknow on October 24, 1992 (Rashtriya Sahara- a Hindi Daily). On the other hand, Rangwani (1996) reported that magnitude of risk caused by high sugar consumption was compatible to that of fats and red meats. In a Dutch study of the biliary tract (including gall bladder and bile ducts) the most consistent finding of cancer risk was associated with high sugar intake. He further reported that researchers in Italy, who examined the dietary habits of about 1000 colon cancers and 600 rectal cancer patients over a seven year period, found a link between colorectal cancer and sugar consumption, with the risk increasing in accordance with the amount of sugar consumed. Hence, value added products from sugarcane juice such as jaggery in different forms, its allied products, vinegar, and chocolate etc. assume more significance/importance.

Major share (>75%) of sucrose consumption in rich countries has been through manufactured foods i.e. confectionery, cake biscuits, ice creams and soft drinks etc. But, excessive sucrose consumption leads to variety of problems. Therefore, to overcome these problems, alternate sweeteners preferably from sugar corps which are lesser harmful should be used and luckily India has one such very important resource namely sugarcane from which eco-friendly nutritive sweeteners namely; solid, liquid and granular jaggery and various jaggery based value added products are prepared. With the input of refinement in the technologies maintaining proper standard for manufacturing these products, the scope for their export would further increase and would come to the rescue and earn foreign exchange and also sustain the sugarcane production. In such case the products should be of high quality without any kind of contaminations including that caused due to farm inputs of pesticides and chemicals.

The matured sugarcane of recommended varieties is harvested, detrashed, cleaned, crushed in mechanical crushers, juice filtered, clarified and heated, boiled, and concentrated for making product of choice(s) and packed in attractive packages The process was standardized at IISR, Lucknow. Also to help solving problems of storage, reduce demand and supply gap of nutritive and eco-friendly sweeteners jaggery is made in granular and also liquid form which stores safely for about two years. These processes were standardized at RARS (ANGAU), Anakapalle and at JRS(MPKV),Kolhapur respectively..Thus made liquid jaggery contains proteins, fats, calcium, phosphates, potassium, iron and magnesium. The invert sugar content of liquid jaggery (33.71%) is much more compared to other forms of jaggery (6.28%) and also the white sugar and are quickly and easily assimilated by human digestive system. The orange and grape essences are also added for good palatability and taste in food system. GBPUA&T, Pantnagar standardized the process for making jaggery chocolate which compared well in hardness, texture and taste to that of commercially available chocolates. Several other value added jaggery products/sweet meets viz; reori, gazak, chikki, patti, and ramdana etc need to be standardized as energy foods particularly for the majority needy people. To accelerate the fermentation process the sugarcane juice is inoculated with yeast processed further under aerobic condition for making vinegar (3.2) after a few days which helps in digestion besides adding flavour. Literature including Ayurveda revealed that use of jaggery (gur) has been known to cure vaious diseases like coryza, headache, cardiac, piles, and kidney etc. Some of the uses of sugarcane and gur for the treatment of human diseases were also collected, collated and discussed.

Thus, traditional sweeteners like jaggery and various other value added products manufactured from sugarcane juice have potential to fight malnutrition. Besides being nutritive they are medicinal as well as health and eco-friendly. The improved process of their manufacturing is also safe as neither it discharges affluent nor requires boiler houses. Search for healthy, fresh and tasty food is endless. But, since jaggery in different forms comprises of useful minerals, vitamins and antioxidants, it can be taken as health supplement and may replace sugar in making of health foods which would mitigate problems of mal/undernutrition and help in nutritional food security in the country. Above products may be included in various health programs of the country and UNICEF etc. For the purpose jaggery industry also needs to be encouraged and modernized which in turn would also generate more employment opportunities for rural youth (inclusive of men and women).

RECENT APPROACHES TO REDUCE POST-HARVEST LOSSES OF HORTICULTURE PRODUCE THROUGH ENGINEERING AND PROCESSING INTERVENTION

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The horticulture production of the country during 2016-17 is estimated to be around 287 million tonnes which is marginally higher as compared to 2015-16. Production of fruits is estimated to be 92 million tonnes which is about 2% higher than the previous year. Production of vegetables is estimated to be around 168.6 million tonnes which is marginally lower by 0.3% than the previous year. Production of spices is estimated to be around 7 million tonnes which is almost same as previous year. Production of onion is estimated to be around 197 lakh tonnes. Production of potato is estimated to be around 439 lakh tonnes which is 1% higher than the previous year. Production of tomato is estimated to be around 189 lakh tonnes which is about 1 % higher than the previous year. (Ref: Press Information Bureau, Government of India, Ministry of Agriculture & Farmers Welfare, 29-August-2018 18:07 IST). Post-harvest loss is one of the concerns of food security and poverty reduction strategies in many developing countries. It causes reduction in producers out puts, unavailability of food, effects of economy of people and the country. The term "post harvest loss" - PHL refers to measurable quantitative and qualitative food loss in the post harvest system (de Lucia and Assennato, 1994). This system comprises interconnected activities from the time of harvest through crop processing, marketing and food preparation, to the final decision by the consumer to eat or discard the food. India produces large quantity of horticultural produce in the world, per capita consumption is very low for our over a billion population. Major portion is being wasted at various stages of from production till it reaches end-user and its mainly due to inadequate facilities for processing. Delay in the use of harvested produce will affect its – fresh ness, palatability, appeal and nutritive value. The magnitude of loss is high in horticultural crops as compared to other due to the nature of the crops.

Fruits and vegetables used for processing in different countries

Sl. No	Countries	% processing
1	Malaysia	83
2	Saudi Arabia	30
3	Philippine	78
4	Brazil	70
5	Australia	60
6	UAS	40
7	UK	50
8	India	2.20

India share in global trade of horticultural produce is miniscule and it is < 1% and only 2.2% of the total horticultural produce is being processed. Due to inadequate post harvest handling 20- 30% of horticultural produce are lost annually and such loss in terms of monitory values goes to about Rs.7000/- per annum. This loss of great magnitude not only robs labour and recourses of the farmer and the nation but also dwindle away a big profit of the farmer. Managing the post harvest losses is very much important. Preservation of the produce is one of the ways to manage post harvest losses. Harvest and post-harvest losses of fruits at different stages in percent at national level (Nanda et al.2012)

Crop	Total loss in farm operations	Total loss in storage	Total Overall Loss
Apple	9.08	1.31	10.39
Banana	6.04	1.72	7.76
Citrus	7.55	2.14	9.69
Grapes	6.52	2.11	8.63
Guava	11.90	3.98	15.88
Mango	6.92	2.24	9.16
Papaya	4.12	2.58	6.70
Sapota	7.41	2.31	9.73

- **Recent approach to reduce post-harvest losses**

Post harvest handling

Post harvest handling is the stage of crop production immediately following harvest, including cooling, cleaning, sorting and packing. The instant a crop is removed from the ground, or separated from its parent plant, it begins to deteriorate. Post harvest treatment largely determines final quality, whether a crop is sold for fresh consumption, or used as an ingredient in a processed food product. The most important goals of post harvest handling are keeping the product cool, to avoid moisture loss and slow down undesirable chemical changes, and avoiding physical damage such as bruising, to delay spoilage. Sanitation is also an important factor, to reduce the possibility of pathogens that could be carried by fresh produce, for example, as residue from contaminated washing water. After the fi eld, post harvest processing is usually continued in a packing house. This can be a simple shed, providing shade and running water, or a large-scale, sophisticated, mechanized facility, with conveyor belts, automated sorting and packing stations, walk-in coolers and the like. In mechanized harvesting, processing may also begin as part of the actual harvest process, with initial cleaning and sorting performed by the harvesting machinery (Simson and Straus 2010).

Packing house operations

It is important to minimize mechanical damage by avoiding drops, rough handling and bruising during the different steps of pack house operations. Secondly the pack house operations should be carried out in shaded area. Shade can be created using locally available materials like, shade cloth, woven mats, plastic tarps or a canvas sheet hung from temporary poles. Shade alone can reduce air temperatures surrounding the produce by 8–17 °C. The packing house operations include the following steps:

(i) ***Dumping***: The first step of handling is known as dumping. It should be done gently either using water or dry dumping. Wet dumping can be done by immersing the produce in water. It reduces mechanical injury, bruising, abrasions on the fruits, since water is more gentle on produce. The dry dumping is done by soft brushes fi tted on the sloped ramp or moving conveyor belts. It will help in removing dust and dirt on the fruits.

(ii) ***Pre-sorting***: It is done to remove injured, decayed, misshapen fruits. It will save energy and money because culls will not be handled, cooled, packed or transported. Removing decaying fruits are especially important, because these will limit the spread of infection to other healthy fruits during handling.

(iii) ***Washing and cleaning***: Washing with chlorine solution (100–150 ppm) can also be used to control inoculums build up during pack house operations. For best results, the pH of wash solution should be between 6.5 and 7.5

(iv) ***Sizing/grading***: Grading can be done manually or by automatic grading lines. Size grading can be done subjectively (visually) with the use of standard size gauges. Round produce units can be easily graded by using sizing rings (Dhatt and Mahajan 2007).

Pre-cooling of horticulture produce

Pre-cooling of the produce soon after their harvest is one of the important components of the cool chain, which ultimately affect the shelf life of the produce. The main purpose of precooling is to immediately remove the field heat from the produce. It could be summarized the method of pre-cooling as follows:

i. ***Room cooling***: It is low cost and slow method of cooling. In this method, produce is simply loaded into a cool room and cool air is allowed to circulate among the cartons, sacks, bins or bulk load.

ii. ***Forced air cooling***: Forced air-cooling is mostly used for wide range of horticultural produce. This is the fastest method of pre-cooling. Forced air-cooling pulls or pushes air through the vents/holes in storage containers. In this method uniform cooling of the produce can be achieved if the stacks of pallet bins are properly aligned.

iii. ***Hydrocooling***: The use of cold water is an old and effective cooling method used for quickly cooling a wide range of fruits and vegetables before packaging. For the packed commodities it is less used because of difficulty in the movement of water through the containers and because of high cost involved in water tolerant containers. This method of cooling not only avoids water loss but may even add water to the commodity. The hydro cooler normally used are of two types: shower and immersion type.

iv. ***Vacuum cooling***: Vacuum cooling takes place by water evaporation from the product at very low air pressure. In this method, air is pumped out from a larger steel chamber in which the produce is loaded for pre-cooling. Removal of air results in the reduction of pressure of the atmosphere around the produce, which further lowers, the boiling temperature of its water. As the pressure falls, the water boils quickly removing the heat from the produce. Vacuum cooling cause about 1 % produce weight loss (mostly water) for each 6 ° C of cooling.

v. ***Package icing***: In some commodities, crushed or flaked ice is packed along with produce for fast cooling. However, as the ice comes in contact with the produce, it melts, and the cooling rate slows considerably. The ice keeps a high relative humidity around the product. Package ice may be fi nely crushed ice, flake ice or slurry of ice. Liquid icing distributes the ice throughout the container, achieving better contact with the product. Packaged icing can be used only with water tolerant, non-chilling sensitive products and with water tolerant packages such as waxed fi berboard, plastic or wood (Dhatt and Mahajan 2007).

Postharvest treatments

Fresh fruits are living tissues subject to continuous change after harvest. Some changes are desirable from consumer point of view but most are not. Postharvest changes in fresh fruit cannot be stopped, but these can be slowed down within certain limits to enhance the shelf life of fruits. The post-harvest treatments play an important role in extending the storage and marketable life of horticultural perishables. The most important postharvest treatments include:

(i) ***Washing with chlorine solution***: Chlorine treatment (100–150 ppm available chlorine) can be used in wash water to help control inoculums build up during packing operations. Maintain pH of wash water between 6.5 and 7.5 for best results.

(ii) ***Ethylene inhibitors/Growth regulator/fungicide treatments***: 1-MCP (1-methyl cyclopropene), AVG (Amenoethoxyvinylgycine), silver nitrate, silver thiosulfate, cycloheximide, benzothiadiazole etc. are some of the chemicals which inhibit ethylene production and/or action during ripening and storage of fruits. The growth regulators or fungicidal application such as GA 3 can be effectively used to extend/enhance the shelf life of fruits.

(iii) ***Calcium application*** : The post-harvest application of $CaCl_2$ or Ca (NO 3) $_2$ play an important role in enhancing the storage and marketable life of fruits by maintaining their fi rmness and quality. Calcium application delays aging or ripening, reduces postharvest decay, controls the development of many physiological disorders and increases the calcium content, thus improving their nutritional value. The post-harvest application of CaCl 2 (2–4 %) or Ca (NO 3) 2 for 5–10 min dip extend the storage life of pear

up to 2 months, plum up to 4 weeks and apple up to 6 months at 0–2 ºC with excellent color and quality. Calcium infiltration reduces chilling injury and increase disease resistance in

(iv) ***Thermal treatments***: Thermal treatments included (a) hot water treatment: Fruits may be dipped in hot water before marketing or storage to control various post-harvest diseases and improving peel color of the fruit (Table 3). (b) Vapor heat treatment (VHT): This treatment proved very effective in controlling infection of fruit flies in fruits after harvest. The boxes are stacked in a room, which are heated and humidified by injection of steam. The temperature and exposure time are adjusted to kill all stages of insects (egg, larva, pupa and adult), but fruit should not be damaged. A recommended treatment for citrus, mangoes, papaya and pineapple is 43 ºC in saturated air for 8 h and then holding the temperature for further 6 h. VHT is mandatory for export of mangoes.

(v) ***Fumigation***: The fumigation of SO 2 is successfully used for controlling post- harvest diseases of grapes. This is achieved by placing the boxes of fruit in a gas tight room and introducing the gas from a cylinder to the appropriate concentration. However, special sodium metabisulphite pads are also available which can be packed into individual boxes of a fruit to give a slow release of SO 2 . The primary function of treatment is to control the Botrytis Cinerea . The SO 2 fumigation is also used to prevent discoloration of skin of litchis.

(vi) ***Irradiation***: Ionizing radiation can be applied to fresh fruits and vegetables to control micro-organisms and inhibit or prevent cell reproduction and some chemical changes. It can be applied by exposing the crop to radiations from radioisotopes (normally in the form of gamma-rays measured in Grays (Gy), where 1 Gy = 100 rads.

(vii) ***Waxing***: Waxing of fruits or vegetables is a common post-harvest practice. Food grade waxes are used to replace some of the natural waxes removed during harvesting and sorting operations and can help reduce water loss during handling and marketing. It also helps in sealing tiny injuries and scratches on surface of fruits and vegetables. It improves cosmetic appearance and prolongs the storage life of fruits and vegetables. The wax coating must be allowed to dry thoroughly before packing (Dhatt and Mahajan 2007). It could be concluded that, postharvest handling is the stage of crop production immediately following harvest, including cooling, cleaning, sorting and packing. The instant a crop is removed from the ground, or separated from its parent plant, it begins to deteriorate. Postharvest treatment largely determines final quality, whether a crop is sold for fresh consumption, or used as an ingredient in a processed food product. The most important goals of postharvest handling are keeping the product cool, to avoid moisture loss and slow down undesirable chemical changes, and avoiding physical damage such as bruising, to delay spoilage.

(viii) ***Processing***: Processing activities are of critical importance to expansion and diversification within the fruit and vegetable sector in that they increase market opportunities for fresh fruits and vegetables and add value while minimizing postharvest losses. Furthermore, processing improves the viability, profitability and sustainability of fruit and vegetable production systems by increasing farm incomes, and generating rural employment and foreign exchange. Traditional processing technologies such as thermal processing (bottling and canning), freezing, dehydration (salting, brining and candying) drying, and fermentation are widely applied in the processing of fruits and vegetables at various levels (artisanal, intermediate and high) and scales (cottage, small, medium and large). Tropical juices and fruit pulps, canned pineapples, tomato paste and canned and dried mushrooms are examples of fruit and vegetable products produced using traditional processing technologies and which are increasingly entering in international trade (Rolle 2006). Dried and canned mushrooms produced in China, currently account for 52 % of world trade in processed mushrooms, while canned pineapples produced in Thailand accounts for approximately 45 % of that product in world trade. Minimal processing technologies, specialized packaging and natural preservation systems are increasingly being applied in the preservation of fruits and vegetables for both developed and developing country markets, in response to growing consumer demand for convenience and for “fresh-like” fruits of high quality which are nutritious, flavorful and stable. These processing technologies focus on adding value with comparatively little product

transformation while increasing product diversity. While minimal and traditional processing technologies present considerable opportunities for innovation and vertical diversification in the fruit and vegetable sector.

Agro-processing centres (APC)

Agro-processing centres (APCs) is an enterprise where required facilities for primary and secondary processing's, storage, handling and drying of cereals, pulses, oilseeds, fruits and vegetables are made available on the charge basis to people. Value-added agro-based products and processed food items are also prepared and marketed by the centre. An individual/co-operative/ community organization/ voluntary organization may manage this type of centre. The centre meets processing, preservation, handing and marketing needs when surplus produce available in a production catchment (village or a cluster of villages). Thus, the centre is a means of providing income and employment to rural people through agro-based processing activities for various produces and thus losses gets nullified by a multi-product processing plant. Examples of Different agro-processing models are given below

1. Amul Pattern Co-operatives Production of milk by large number of cattle owners, processing and marketing network by organized cooperatives
2. Tea Industry Model On-farm primary processing, blending and marketing in an organized sector
3. Sugar Industry Organized industry located in production catchments with loose tie-up with growers; government playing moderating role like deciding support price for sugarcane Gur and Khandsari On-farm cottage industry catering to an ethnic need and lately to health conscious people competing with sugar industry and giving better dividends to cane growers
4. Cotton Textile Industry Pre-cleaning/ginning and baling in production catchments, spinning and weaving in an organized sector
5. Power looms Decentralized, efficiently managed units, no labour problems or shutdowns, catering to certain range of consumers
6. Mills (Atta Chakkis) Small, low capital units, doing custom processing to satisfaction of customers
7. LijjatPapad: Traditional product using underutilized, mostly female human resource, organized as co-operative, availing established marketing network
8. Mobile Door to Door Service Craftsmen and mechanics moving on bicycle or cart (and now tractor trolley) with necessary equipment for door-to-door processing service

Cold Chain

Cold Chain Industry equipment's are responsible for increasing the shelf life of a particular product. Most important component in post-harvest handling of horticulture produces. Due to the shift in focus from increasing productivity to providing better storage and transport facility, the Indian Cold Chain Industry has gained importance. The industry has become an important part of the supply chain of products from farm to door. Looking at the rise in infrastructure to curb wastage, the cold chain industry in India is expected to grow at a compound annual growth rate (CAGR) of 19 percent from 2017-2022. The major revenue contributors in the Indian Cold Chain Industry are cold stores. The prime motive of the cold chain industry is to protect the goods from turbulent weather conditions. If the cold chain solutions are applied effectively, they would extend the produce's life and also keep the product nutrients well intact. Currently, India has 6,300 cold storage facilities unevenly spread across the country, with an installed capacity of 30.11 million metric tonne. Out of these cold chain storages, 36 percent have a capacity of below 1,000 MT. The current capacity allows only 11 percent of the total produce to be stored. These numbers, however, look forward to grow in the coming future. These are mostly used for storing potatoes. However, the market is gradually getting organised and focus towards multi-purpose cold storages is rising. More than 50% of the cold storage facilities in India are currently concentrated in Uttar Pradesh and West Bengal, while other states still face a challenge with investments from the government and private operators.

Conclusion

Therefore, it could be concluded that, the lack of sorting to eliminate defects before storage and the use of inadequate packaging materials further add to the problem. In general, minimizing rough handling, sorting to remove damaged and diseased produce and effective temperature management will help considerably toward maintaining a quality product and reducing storage losses. Storage life will be enhanced if the temperature during the postharvest period is kept as close to the optimum as feasible for a given commodity. The fruit and vegetable sector has grown substantially both in volume and in variety of outputs traded globally. Processing activities are of critical importance to expansion and diversification within the fruit and vegetable sector in that they increase market opportunities for fresh fruits and vegetables and add value while minimizing post harvest losses.

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CONVENIENCE PROCESSED VEGETABLES TO MEET FOOD CHALLENGE

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Value addition of vegetables in India is mainly confined at small scale industries with the production of pickles, chutneys, preserves and candies with no quality and hygienic standards. Value addition of vegetables is an integral part for increasing the farmer's income by reducing post-harvest losses, sustainable food and nutritional security and thus increasing the employment both in rural and urban cities. Presently post-harvest losses in vegetables are estimated to be around 15-20%. Effective post-harvest management practices can minimize these losses and transform vegetable produce to nutritionally rich value added quality products. Carnauba and shellac based edible coatings significantly increase the shelf life of vegetables. Low cost drying technology of vegetables offers a highly effective and practical means of preserving large quantities of vegetables to good quality dried vegetables with extended shelf life of 6-8 months at ambient storage. Steeping preservation is aimed at preserving large quantities of vegetables during peak season of production. Vegetables are preserved in steeping solution consisting of permissible chemical preservatives with the hurdle concept of two or more preservatives as a result synergistic preservation effect is achieved. Steeping preservation technologies are non-thermal and suitable alternative to processing technologies with considerable scope for adoption at rural sector by women. Another minimal processing technologyenables marketing of vegetables in packaged form for extending the shelf life of 8-10 days with specific uses of curries, salads, stuffing's, toppings and garnishing. Leafy vegetables have very limited shelf life after harvest due to high wilting and high respiratory activities. Easy-to-cook leafy vegetables can preserve the large quantity of vegetables with retention of nutrients and maintaining good organoleptic properties after curry preparation for 8-10 months of ambient storage. The process completely removes the cumbersome initial processes of sorting, cleaning and washing of vegetables before curry preparation. Market demand for convenience foods is increasing. Convenience form of ready-to-eat vegetables in the form of chips can be developed with good satisfaction to the large sections of consumers. Furthermore, instant vegetable soup mix with high protein content can be ideal supplement to nutritionally malnourished population. Various nutritionally rich convenience moringa based value added products can be developed for large section of the population.

IMPACT OF PACKAGING ON SOME VEGETABLE'S SHELF LIFE AND NUTRITIONAL CONTENT

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Packaging means a system by which a fresh produce will reach from the production center to ultimate consumer in safe & sound condition at an affordable price. Vegetables was packed in Low Density Polythene punnets or bags (L.D.P.E) and other packaging used 100% was Oxo- Biodegradable bag (O.B.P.) having Addiflex Additive with holes and kept at different temperature condition i.e. low, normal and high temperature. The study showed that packaging effect was high on vegetables depending upon two different types of it. Both the packaging i.e. Low Density Polyethylene bags and Oxy-Biodegradable poly bags showed different results with great difference in them with respect to physical parameters and nutritional parameters and when kept at different temperatures. Vegetables packed in Oxy-Biodegradable Poly bags showed high amount of Crude Fiber, Iron, Vitamin C, Protein and Total Ash, as compared to packed in Low Density Polyethylene bags whereas the shelf life was better in vegetables Packaged in L.D.PE. Compare to O.B.P. Thus focusing on the slogan that is "Say NO to Plastic" O.BO.P. has turned out to be the best, easy and non-expensive replacement for plastics whether it is L.D.P.E., H.D.P.E., or cloth bags.

Keywords: Packaging, L.D.P.E, O.B.P., Microbial Load

DEVELOPMENT OF MULTIFUNCTIONAL MICROBIAL STIMULANTS FOR SUSTAINABLE AGRICULTURE

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Loss in agricultural productivity and food contamination are major concerns of food security today. Microbes are essential component of agro-ecosystems. About 99% of microbial resources are not known and those reported indicate that rhizospheric soil microbes possess significant plant growth promoting and disease management activities. The application of selected soil microbes has potential to maintain the productivity without compromising to the food quality. The inconsistency in efficacy of microbial preparations due to its sensitiveness to stress conditions and competition with the native microflora are major bottlenecks in its large scale uses in mainstream agriculture and horticulture. The use of agro chemicals in agriculture cause enormous health hazards and water pollution and also require a lot of energy and economic inputs. Hence, development of biostimulants with higher efficacy, better stability and multiple role will be boon to sustainable and safe food security. We have isolated microbes having different plant growth promoting and biocontrol activities and tolerance to drought, heat, salinity and pesticide etc. The consortia of compatible PGPMs posses better efficacy, stability and multiple benefits as growth promotion, biocontrol, bioremediation and corban sequestration. We have also developed cost effective organic matrix based carriers for microbes and applied them in the experimental plots of wheat, rice and other plants which show enhanced productivity and better soil fertility. We are attempting to translate our experimental results in the farmers' field and establish linkages for its application commercialization with industry and farmers.

Keywords: Agroecology restoration, Biofertilizers, Biopesticides, Climate resilient agriculture, Food security.

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RENEWABLE ENERGY NEEDS IN INDIAN AGRICULTURE

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Energy is one of the major parameters for establishing growth and progress of the country, rather the standard of living depends directly upon the per capita energy consumption. Renewable energy sources and technologies have potential to provide solutions to the long-standing energy problems being faced by the developing countries. The renewable energy sources like solar energy, wind energy, biomass energy, hydro energy, geothermal energy, ocean energy, and fuel cell technology can be used to overcome energy shortage in India. Renewable technologies are considered as clean sources of energy and optimal use of these resources minimize environmental impacts, produce minimum secondary wastes and are sustainable. Renewable energy technologies provide an excellent opportunity for mitigation of greenhouse gas emission and reducing global warming through substituting conventional energy sources. India is increasingly adopting responsible renewable energy techniques and taking positive steps towards carbon emissions, cleaning the air and ensuring a more sustainable future. In India, from the last two and half decades there has been a vigorous pursuit of activities relating to research, development, demonstration, production and application of a variety of renewable energy technologies for use in different sectors.

In agricultural systems, energy is available from different sources as human, animal, sun, wind, biomass, coal, fertilizer, seed, agro-chemicals, petroleum products, electricity etc. Energy sources that release available energy directly to the system are classified as direct energy sources. Renewable energy and farming are a winning combination. Solar, Wind and biomass energy can be harvested forever, providing farmers with a long-term source of income in most sustainable manner. Use of renewable energy in farming systems can mean several different things. Fertilizing the land and controlling pests that do not depend on chemicals, will normally involve the use of renewable resources. Such methods reduce farmer's vulnerability to the rising price of oil. Renewable energy also includes generation of power to do number of farm tasks: pumping water for irrigation, for livestock or for domestic use; lighting farm buildings; farm protection system; powering processing operations and others.

Renewable Energy

Renewable energy refers to energy resources that occur naturally and repeatedly in the Environment, available abundantly everywhere, produced freely in the nature and can be harnessed for human benefit. These energy resources are inexhaustible within the time horizon of humanity. Examples of renewable energy sources include solar, wind, biomass, tidal and geothermal (getting energy from the heat beneath the earth) that are replenished naturally.

Renewable Energy: Globally and India's position

Global installed capacity of renewable energy is 6,73,000 MW, India enjoys 4th and 6th rank globally in wind and solar energy with generation capacity of 34165 and 20820 MW respectively. (MNRE as on 30-04-2018)

During recent years, due to the increase in fossil fuel prices and the environmental hazards caused by the use of conventional fuels (coal, petroleum, natural gas etc.) the entire world is reverting back to renewable energy sources.

Why Renewable Energy?

Injudicious use of fossil fuels has increased the amount of carbon containing gases in the upper atmosphere which led the problem of global warming and climate change. Climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate change affects agriculture in a number of ways, including through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations;

changes in the nutritional quality of some foods; and changes in sea level.

(Source: Center for Climate and Energy Solutions)

Climate change is already affecting agriculture, with effects unevenly distributed across the world. Future climate change will likely negatively affect crop production in low latitude countries. Climate change will probably increase the risk of food insecurity for some vulnerable groups. Renewable energy technologies are clean sources of energy that have a much lower environmental impact than conventional energy technologies.

Energy in agriculture

Agriculture sector consumes about 20-21 % of all electricity and more than 4 billion liters (13%) of diesel in India (www.mospi.gov.in, 2017). Major agricultural activities in which the energy is consumed are: Pumping of irrigation water, use of tractors for different farm operations, processing and value addition of farm produces etc.Energy use in agriculture needs to be increased from its present value 1.8 kW ha-1 to 2.5 kW ha-1 to meet the production target of next 20 years (www.agricoop.nic.in, 2015-16).

Scope of renewable energy in agriculture

There is significant potential for agricultural involvement in the production and consumption of solar, wind and biomass energy. Renewable resources are abundant and widely distributed throughout the India. A number of commercial technologies are available to harness these resources. Government of India has set lofty targets of achieving 175 GW of capacity from renewable energy technologies by 2022. Union government announced a fund of Rs 1.4 lakh-crore for the ambitious Kisan Urja Suraksha evam Utthaan Mahaabhiyan (KUSUM) scheme. The scheme will work towards promoting solar power production for solar farming to help farmers (MNRE, Govt. of India). The state government of Gujarat also launched Surya shakti Kisan Yojana (SKY) to enable farmers to generate electricity for farm requirements as well as sell the surplus power to the grid and earn extra income. Key renewable energy technologies for agricultural applications are as under.

1. Solar Photovoltaic (SPV) technology

Photovoltaic, as the word implies (photo = light, voltaic = electricity), converts sunlight directly into electricity. Photovoltaic (PV) cells are made of special materials called semiconductors such as silicon, which is the most commonly used material nowadays. Basically, when sunlight strikes the cell, a certain portion of it is absorbed within the semiconductor material. The energy knocks electrons loose, allowing them to flow freely. This flow of electrons is a current, and by placing metal contacts on the top and bottom of the PV cell, current is drawn off to use externally. This current, together with the cell's voltage (which is a result of its built-in electric field or fields), defines the power (or wattage) that the solar cell can produce. Due to the low voltage of an individual solar cell (typically 0.5V), several cells are combined together in series/parallel configuration, andsealed in a protective laminate to make it module. Photovoltaic array(also called a solar array) consists of multiple photovoltaic modules. A typical photovoltaic system for agricultural, residential, commercial, or industrial application, normally contains: a string of photovoltaic (PV) modules, inverter (for DC to AC conversion), a mounting structure to supports the solar modules, battery bank and charge controller for power storage if required, electrical wiring and interconnections.

Technologies based on SPV

i. Solar water Pumping System

The solar pump is a stand-alone system powered by solar PV (photovoltaic) array (panel). The PV power is used for operating AC/ DC surface centrifugal mono-block/ submersible pump set for lifting water from bore / open well or water reservoir for irrigation and drinking water purpose. The system requires south facing shadow-free area for installation of the Solar Panels.

Benefits:

- Automatic operation, so no need for any manual intervention

- No conventional grid electricity or fossil fuel required
- Long operating life up to 25 years
- Day time irrigation is possible
- Highly reliable, durable and economical,
- Extremely low repairing and maintenance as compared to diesel engine.
- Eco-friendly
- Suitable for water table depth up to 300 feet.
- Quite suitable where grid electricity is unavailable

ii. Solar fencing system

Solar powered fencing system is safe, effective and reliable perimeter protection solutions from the unwanted intruders inside the property. It works on solar energy with backup facility to run uninterruptedly during the day and nights as well as cloudy days. Restriction is provided through an electric pulse which is sent around the fence line every 1.2 seconds.

The pulse delivers a SAFE, SHORT, yet SHARP SHOCK. An alarm is sent to the monitoring center so they can dispatch a security guard ensuring the site is secure day and night. The whole system can be derived into three segments, power unit, central control (Electronic) unit and the fence. The solar photovoltaic module converts the sunshine into electrical energy and sends them to central control unit through a backup battery.

iii. Solar farming (Agrivoltaic)

Government of India sets an ambitious target of achieving 1,00,000 MW of solar power generation capacity in the country by 2022. (MNRE, Govt. of India). Solar power plants are land intensive and require approximately 2 ha of land for 1MW capacity installation. The new concept of agriculture and solar power generation in common field will provide electricity to the farmers in the villages on one hand and saving large expenditure on the development of huge infrastructure to the government on the other side. The solar power plant benefits agriculture by conserving water/efficient use of water as evaporation loss could be minimized significantly and increased productivity as a result of semi-greenhouse effect. Solar Photovoltaic power generation on agricultural land without affecting crop production would open up new prospects, enabling farmers not only to fulfill their own energy requirement but to earn extra income through trade of power.

2. Solar Thermal Technology

Solar Thermal is a clean, highly efficient means of using renewable energy from the sun to provide hot water, air and steam for domestic, commercial and industrial process. Most of the energy we receive from the sun comes in the form of visible light, a shortwave radiation (0.39 to 0.78 μm wave length) and infrared radiation (more than 0.78 μm), of which radiation up to 2.2 μm when strikes a solid or liquid, it is absorbed and transformed into heat energy, the material becomes warm and stores the heat, conducts it to surrounding materials (air, water, other solids or liquids) or re radiates it to other materialsof lower temperature. Technologies based on solar thermal

i. Solar dryer

Solar drying is done traditionally by open sun drying under open sky. This process has several disadvantages like spoilage of product due to adverse climatic condition like rain, wind, moist, and dust, loss of material due to birds and animals, deterioration of the material by decomposition, insects and fungus growth.

Also the process is highly labor intensive, time consuming and requires large area. With cultural and industrial development artificial mechanical drying came in to practice. This process is highly energy intensive and expensive which ultimately increases product cost.

An improved technology utilizes solar energy for drying agriculture product is the use of solar dryers where the air is heated in a solar collector and then passed through beds of product. There are two basic types of solar dryer appropriate for agro product: Natural Convection Dryers where the air flow is induced by thermal gradients; and Forced Convection Dryers wherein air is forced through a solar collector and the product by a fan. Tunnel dryers are convenient for large scale solar drying, food processing industries for dehydration of fruits and other vegetables, dairy industries for production of milk powder and seasoning of wood and timber.

ii) Solar Water Heating

Solar water heating (SWH) is the conversion of sunlight into heat for water heating using a solar thermal collector. A variety of configurations are available at varying cost to provide solutions in different climates and latitudes. SWHs are widely used for agricultural, residential and some industrial applications. A sun-facing collector heats a working fluid that passes into a hot water storage system for later use. SWH are active (pumped) and passive (convection-driven).Based on heat absorbing devices, two types of commonly used solar collectors in solar water heaters are : Flat Plate Collector (FPC) and Evacuated Tube Collector (ETC). FPC contains an insulated metallic box with glass sheet on top surface and inside there is blackened metallic absorber (selectively coated) sheets mostly made up of copper with built in channels or riser tubes to carry water. The absorber absorbs the solar radiation and transfers the heat to the flowing water.

Evacuated Tube Collector is made of double layer borosilicate glass tubes evacuated for providing insulation. The outer wall of the inner tube is coated with selective absorbing material. This helps absorption of solar radiation and transfers the heat to the water which flows through the inner tube.

Solar water heating system can heat the water up to 80˚C. Solar water heaters (SWHS) of 100-500 liters capacity are suited for agricultural and dairy application. The most cost- effective way to install a SWHS is to integrate the collector assembly, cold-water supplyand piping with the design of a new house under construction. A 100 liters capacity SWH can replace an electric geyser for residential use and saves 1500 units of electricity annually. Avoided utility cost on generation: The use of 1000 SWHS of 100 liters capacity each can contribute to a peak load saving of 1 MW annually. Environmental benefits: A SWHS of 100 liters capacity can prevent emission of 1.5 tones of carbon-dioxide per year.

iii) Solar Distillation System

Solar distillation refers to the use of solar radiation to purify water with relatively simple equipment. The equipment, commonly called a solar still, consists primarily of a shallow basin with a transparent glass cover. Solar radiation heats water to the point of evaporation. As the water evaporates, water vapor rises, condensing on the glass surface for collection. This process removes impurities such as salts and heavy metals as well as eliminates most microbiological organisms.

3. Biomass Energy Technologies

Biomass is organic material that comes from plants and animals, and it is a renewable source of energy. Biomass contains storedenergy from the sun. Plants absorb the sun's energy in a process called photosynthesis. When biomass is burned, the chemical energy in biomass is released as heat.

i) Biogas Technology

Biogas technology provides an alternative source of energy mainly from organic wastes. It is produced when bacteria degrade organic matter in the absence of air. Biogas contains around 55-65% of methane, 30-40% of carbon dioxide and small quantities of Hydrogen, Nitrogen, Carbon Monoxide, Oxygen and Hydrogen Sulphide. The calorific value of biogas is appreciably high (around 4700 kcal or 20 MJ at around 55% methane content). The gas can effectively be utilized for generation of power through a biogas fired Generator Set after dewatering and cleaning of the gas. In addition, the slurry produced in the process provides valuable organic manure for farming and sustaining the soil fertility.

Mainly there are two types of biogas plants

i) Fixed Dome Biogas Plant (Deenbandhu Biogas Plant and Janata Biogas Plant)

ii) Floating Drum Biogas Plant (KVIC Biogas Plant)

Application of biogas

1. Biogas gas-grid injection

Gas-grid injection is the injection of biogas into 100% biogas run engine to produce electrical power which is coupled with exiting grid system. The electricity can be used for on-site utilization of power.

2. Biogas Bottling for Transportation

Biogas, like Liquefied Petroleum Gas (LPG) cannot be converted into liquid state under normal temperature and pressure. Removing carbon dioxide, hydrogen sulfide, moisture and compressing it into cylinders makes it easily usable for transport applications & also for stationary applications. Already CNG technology has become easily available and therefore, bio-methane (enriched biogas) which is nearly same as CNG, can be used for all applications for which CNG are used. Purified/enriched biogas (bio-methane) has a high calorific value in comparison to raw biogas.

ii) Biomass Briquetting Technology

Briquetting is a technology of densification of biomass / crop residues to increase its bulk density, lower moisture contents, uniform size and shape for easy handling, transport, storage and uniform burning. Briquettes have high specific density, about 1100-1200 kg/m^3 and bulk density about 600-800 kg/m^3 as compared to loose biomass which have bulk density in the range of 80-200 kg/m3. Briquetting can be done with and without binder. At higher temperature (>100°C) the lignin present in the biomass is fluidized and acts as its own binder. Biomass briquettes are a biofuel substitute to coal and charcoal. They are used to heat industrial boilers in order to produce electricity from steam. The most common use of briquettes is in the developing world, where energy sources are not as widely available.

4. Wind Energy Technology

India has the fifth largest installed wind power capacity in the world. As of 31 July 2018 the installed capacity of wind power in India was 34.4 GW, mainly spread across Tamil Nadu (8253 MW), Gujarat (4593 MW), Maharashtra (5576 MW), Karnataka (3113 MW), Rajasthan (4355 MW), Madhya Pradesh (1686 MW), Andhra Pradesh (1435 MW), Kerala (35.1 MW). Wind power accounts for 48.09%of India's total installed renewable power capacity.

Large wind farms consist of hundreds of individual wind turbines which are connected to the electric power transmission network. To tap this market, farmers can lease land to wind developers, use the wind to generate power for their farms, or become wind power producers themselves.

There are two different types wind turbines presents in the market namely Horizontal Axis Wind Turbine (HAWT) and Vertical Axis Wind Turbine (VAWT).

HAWT: Horizontal-axis wind turbines (HAWT) have the main rotor shaft and electrical generator at the top of a tower, and must be pointed into the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a wind sensor coupled with a servo motor. It requires tower to mount generator and other component. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive an electrical generator. It has maximum theoretical efficiency of 60%.

VAWT: Vertical Axis Wind Turbine (VAWT) have the main rotor shaft arranged vertically. One advantage of this arrangement is that the turbine does not need to be pointed into the wind to be effective, which is an advantage on a site where the wind direction is highly variable. It is also an advantage when the turbine is integrated into a building because it is inherently less steerable. Also, the generator and gearbox can be placed near the ground, using a direct drive from the rotor assembly to the ground based gearbox, improving accessibility for maintenance.

Summary

Energy is one of the major parameters for establishing growth and progress of the country. Due to the increase in fossil fuel prices and the environmental hazards caused by the use of conventional fuels (coal, petroleum, natural gas etc.) the entire world is reverting back to renewable energy sources. Renewable energy technologies are clean sources of energy that have a much lower environmental impact than conventional energy technologies. In agricultural systems, energy is available from different sources as human, animal, sun, wind, biomass, coal, fertilizer, seed, agro-chemicals, petroleum products, electricity etc. Renewable energy and farming are a winning combination. Wind, solar, and biomass energy can be harvested forever for sustainable agricultural development and providing farmers with a long-term source of income.

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AGROFORESTRY SYSTEMS FOR CARBON SEQUESTRATION TO MITIGATE CLIMATE CHANGE

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Agroforestry is an integrated approach of using the interactive benefits from combining trees and shrubs with crops and/or livestock which combines agricultural and forestry technologies to create more diverse, productive, profitable, healthy and sustainable landuse systems. Knowledge, careful selection of species and good management of trees and crops are needed to optimize the production and positive effects within the system and to minimize negative competitive effects. Agroforestry systems can be advantageous over conventional agricultural and forest production methods through increased productivity, economic benefits, social outcomes and the ecological goods and services provided. Biodiversity in agroforestry systems is typically higher than in conventional agricultural systems. Agroforestry incorporates at least several plant species into a given land area and creates a more complex habitat that can support a wider variety of birds, insects, and other animals. Agroforestry also has the potential to help reduce climate change since trees take up and store carbon at a faster rate than crop plants.

In a study in agroforestry systems in Chhattisgarh it was noticed that Plantations contributed higher C in tree and soil compartments. Agrisilvi culture practice reduced C sequestration in the soil. Soybean and cowpea crops in rainy season, wheat in winter season are recommended for inter cropping. Biomass, N and C storage followed the differential allocation pattern. The agrisilvi cultural and plantations systems showed better potential for improving soil health by means of enriching organic C in the soil as this is warranted for sustainable production. Sole Teak plantations were comparatively more promising in C sequestration, while Agroforestry provides multiple benefits which compensate the overall ecological and economic gains. Despite the fact that world over emphasis is given on agroforestry, still our understanding is meagre how far these agroforestry are sustainable in climate change scenarios in especially in developing countries like India.

MODERNIZATION OF FARMING FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN HILLS

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Agriculture is one of the oldest and most important profession to provide food and fibre for livelihood in the world. In hills, it is much more evident as most of the hill population totally depend on farming and doing all the operation traditionally. On the other hand, population pressure is increasing day by day and land becomes scarcer due to more infrastructure and development for better facilities to human being. The Indian Himalayas cover an area of 53.7 million ha, which is 16.4 % of the total geographical area of the country. The productivity is quite less and resources are very poor particularly in the hilly region. Hill agriculture continues to be animate energy intensive and has difficult terrain, wide variation in slopes and altitude, extreme cold winter. As a result, adoption of improved and modern technologies commercially available has been very difficult as such. These problems resulted less people entering the farming profession and most farms are facing the challenge of a workforce shortage. Besides, the young generation is also not interested in farming due to low output and less income which ultimately forcing the rural youth to leave the farming in search of white collar job. Situation will be grimmer if proper attention to modernize the farming will not be given in due course of time for directly or indirectly attracting the young farming community.

In Indian agriculture, mechanization plays an important role and assures timely completion of farm operations as well as less expenditure per unit area. Worldwide, agriculture is more than $5 trillion industry, and now the industry is turning to Artificial Intelligence (AI), robotics and modern technologies to organize data for farmers, help with workload and improve a wide range of agriculture-related tasks in the entire food supply chain. In addition, the modern techniques of crop production have not only created an impact on increasing productivity with minimum cost of cultivation but also on reducing drudgery involved in farming operations.

This will be possible by formulating adequate introduction of technologies, policies and programmes by the hill state government to increase the productivity and distraction of youths from conventional agriculture due to its toiling nature and non-viability etc in hill farming.

Keywords: Agriculture, Modernization, Sustainability, Hills.

APPROPRIATE TECHNOLOGIES DEVELOPED FOR HILL FARMING IN UTTARAKHAND

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Agriculture has been the lifeline of Indian economy since time immemorial and is considered to be the livelihood of over 65 percent of the population of the country. It is the single largest private sector providing employment to about 54.6 percent of country's workforce. India has largest arable land of 160 Mha constituting about 11.2 percent arable land of the world and ranks second next to USA. The net sown area was 118.75 Mha in 1950-51, which has, according to 2014-15 land use statistics, increases to 140.10 Mharecording an increase of about 117.98 percent (Anonymous[1], 2018). The total food grain production of the country has increased from 50.82 Mt in 1950-51 to 281.37Mt in 2018-19. This increase in food grain production has been possible to achieve only because of introduction of high yielding varieties, proper and increased use of fertilizers, chemicals, irrigation water and farm machineries. However, the growth in food grain production is not up to the mark as the demand of the same has been estimated as 333 Mt to feed 1.65 billion population of the country by 2050 (Anonymous[2], 2015). Hence sharpening/ fine-tuning of technological tools are of paramount importance to achieve the estimated food grain production.

Small land holding of the Indian farmers is one of the major constraints for low food grain production. The average size of holding, in India, is continuously decreasing due to rapid urbanization and population explosion. The continuous division and fragmentation of inherited land holdings has increased the number of holdings, obviously, of smaller size unsuitable for complete mechanization. According to the agriculture census 2015-16, the total numbers of operational holdings in the country were 146 millions of which 86.21 percent fall under the category of marginal and small farmers (Anonymous[3], 2016). Similarly, the average land holding size was 1.68 ha in 1985-86, which reduced to only 1.08 ha in 2015-16. This small land holding is mainly scattered, irregular in shape and has lack of approach road. In order to produce more from small operational holding, the role of machinery cannot be undermined. National and global findings have shown that the crop production machineries have increased the productivity by 10-15 percent. It has also reduced the cost of production by 20-25 percent and various losses (field, transport, processing and storage) to the tune of 10 percent. The use of farm machineries has been more mainly in plain regions but it has left lesser impact on hill agriculture due to its meager presence.

State of Agriculture in Uttarakhand Hills

Hills and mountains are recognized as climate makers and it differsfrom plain region in terms of topography, elevation, physiographic feature, diversity of habitats, land use systems, socio-economic conditions etc. The total area under hilly region, including Ghats, is about 91.06 Mha with the largest area (51.43 Mha) under Himalayan region stretching from Jammu and Kashmir in North to Sikkim and Manipur in Northeast (Rautaray, 2008).

The state of Uttarakhand has about 5.35 Mha land out of which only 13.85 percent is cultivable land and about 67 percent land is covered with the forest. The net sown area is about 0.701 Mha and irrigation facilities are available for 0.345 Mha area (Chhimwal et al., 2019). Agricultural land is mainly scattered and fragmented into smaller size making it unsuitable for use of large machines for farming operations. The soil of this region is mostly shallow and coarse textured. The runoff water during heavy rainfall carries away the top fertile soil, leaving behind less fertile soils. Individual holdings are very small and about 73.65 percent cultivators are in the category of marginal farmers operating only 0.35 ha area (Chhimwal et al., 2019).The average holding size is only 0.85 ha, in the year 2015-16, as compared to the national average of 1.08 ha.Rice, wheat, maize, millets, gram, pea, lentil, *gahad*, *jhingora* etc are the major crops grown in hills of Uttarakhand. Temperate climatic condition helps to grow some fruits and vegetables. Mixed-crop farming integrated with animal husbandry and agro-forestry is the predominant farming system.

Power Availability for Hill Farming

The main sources of farm power for farming operations in hilly region of Uttarakhand are human and animals. The agriculture in hills of Uttarakhand is mainly women centricand more than 80 percent of the work force is derived from them. The total working hours for women in hills exceeds 10 to 14 hours a day. The hill bullocks are small, weighing about 200-250 kg, and are being used hardly for about 200 hours annually mainly for tillage operation resulting into uneconomical upkeep (Anonymous[4], 2009). According to a survey conducted in 44 villages of Kumaun and Garhwal division, the average power availability from draught power was found to be 0.36kW/ha which is quite low as compared to national average of 1.23 kW/ha. The power availability per hectare in Garhwal region was found 32.37 percent less as compared to Kumaun region (Anonymous[4], 2009).

Tools and Implements

Hill agriculture demands specially designed farm equipment, suitable for women workers, for carrying out the various farm operations. The present level of mechanization is far from satisfactory levelmainly due to small farm holdings. Farming in hills of Uttarakhand is still being practiced by the farmers in their own traditional way with age old tools and implements. The wooden plough, popularly known as Nasooda, is quite common for tillage operations. Heavy wooden log is used for breaking the clods and leveling the field. Other very commonly used implements are *Danala* and *Damala* which are used for interculture operations in finger millets (*Mandua*) and for puddling operations, respectively. The frequency of break down of all these implements is very high leading to their less usefulness. In addition, hand tools namely *Kutla, Kassi, Spade, Daranti* and *Thamali* are commonly used by women folk to carry out multipurpose activities. These tools and equipment are made of locally available wood and do not have proper design, therefore, they are neither energy efficient nor help in achieving good soil tilth. Some of the reasons contributing to the use of traditional wooden tools and equipment by hill farmers could be their poor economic condition, availability of improved farm equipment and poor draft ability of hill animals (Singh, 2009). Thus for mechanization of hill agriculture, there is a need to introduce improved, properly designed, low weight and economical tools as well as equipment.

Role of Pantnagar University towards Hill Mechanization

Distribution of improved implements

The Farm Machinery and Power Engineering department, G. B. Pant University of Agriculture and Technology, Pantnagar through All India Coordinated Research Project on Utilization of Animal Energy took initiative of distribution of improved agricultural implements under Village Saturation Programme as one of its mandate. Under this programme improved animal drawn hill equipment were also distributed in villages (Table 1) namely Kamath Jhula and Patan in district Champawat and Jageshwar in district Almora. Further, in collaboration with UAE Scheme and government of Uttarakhand sponsored project on power tiller, 16 villages of 5 blocks located in Kumaon and Garhwal divisions were selected under VSP. Hand tools, animal drawn implements and power tillers suitable for hill farming were distributed after forming farmers' group. More than 200 farmers were benefited under this programme. Sizeable numbers of hill yokes, weighing only 3 kg, were also distributed for better draft ability of hill animals.

Table 1: Glossary of implements distributed under VSP

S. No.	Name of the implements	Number	Name of villages adopted
1	Animal drawn ZT	140	Chausala, Kwarali, Dhuwani, Pallidhar, Amoha, Buggisal, Dhura, Patha, Jageshwar in district Almora Gangole, Jankhanda ,Bundeladhek, Malladhek, Chauradhek, Modidhek , KamathJhula,Patanin district Champawat Dhari in districtPauri Ataal in districtDehradun
2	Pant hill yoke	140	
3	Harrow cum puddler	139	
4	Puddler	140	
5	Pant hill plough	140	
6	Danala	140	
7	Damala	140	
8	Kutla	345	
9	Thamali	345	
10	Hand hoe	345	
11	Sickle (Daranti)	345	

Feedback on the use of these equipment were collected from the beneficiary farmers. In general, the farmers were happy to use improved animal drawn implements and reported the increase in command area by 15-20 percent in hill region over their conventional implements. Less repair, maintenance and prolonged life werealso reported by the farmers in case of improved equipment. Pant hill yoke found its popularity amongst the farmers due to its light weight compared to their traditional yokes weighing 8-10 kg .

Front line demonstrations

Front line demonstrations were also carried out at farmers' field with a view to popularize the proven technologies like zero-till sowing. In hill region of Uttarakhand where mechanization is still in its infancy stage, the wheat is sown usually by broadcasting and thereafter, mixing is done by indigenous plough. In this method, the seed rate requirement is usually higher than the line sowing. Also the broadcasted seed does not reach up to the desired sowing depth resulting in their failure to germinate. Considering the advantages of line sowing and less turn-around time available between rice harvest and timely wheat sowing, the Department of Farm Machinery and Power Engineering, Pantnagar developed a tractor drawn zero-till ferti-seed drill for direct seeding of wheat crop after rice harvest. This drill has been successfully demonstrated in plain regions and the same has been adopted on a large scale by the farmers through out the country with its main concentration in Indo-Gangetic plains. Keeping in view the low draftability of hill bullocks, a light weight animal drawn zero-till drill, both one and two row, were developed and demonstrated in *at farmer's field in* hill region. Table 2 shows the details of demonstration carried out at farmers' field. During the field demonstration farmers showed their keen interest and participated in sowing operation. In general, higher yield was reported by the farmers but some reported less or equal yield also compared to their own practicebeside time advantage.

Table 2: Field demonstrations of animal drawn zero-till seed drill in hills

Year	Number of farmers covered	District	Area sown		Mean yield, q/ha
			Nali*	ha	
2002-03	04	Nainital	36.0	0.72	30.98
2003-04	05	U S Nagar	-	0.21	32.90
2004-05	04	Bageswar	72.0	1.44	27.95
2005-06	06	Nainital	90.5	1.84	33.15
2006-07	05	Bageswar	115.5	2.31	30.06
2007-08	15	Nainital	82.0	1.64	22.75

*1 Nali = 200 m^2

The demonstrations have also been carried out by the KVKs of the university (Table 3) located in different regions of Uttarakhand with a view to popularize these implements among the hill farmers.

Table 3: List of demonstrations of animal drawn hill implementsby various KVKs

District	Name of implement	Adopted villages	Area, ha	Number of beneficiaries
Bharsar	Pant hill Plough	Sainji Jandholi Kaljikhal	0.5 0.4 0.3	40 20 20
Chamoli	Pant hill plough, Paddy thresher - cum winnowing fan, Animal drawn zero-till drill, Danala, Damala	Langasu Kulsari Jalchaura Gwaldam Devrara	0.05 0.04 0.02 0.06 0.03	25 9 11 20 12
Rudraprayag	Animal drawn zero-till drill Danala, Pant hill plugh	Chaka Bansu	0.05 0.18	15 12
Jeolikot (Nainital)	Pant hill plough, Danala, Damala, Pady thresher, Animal drawn zero - till drill	Putgaon Sarna Simalkha	0.06 0.09 0.09	23 26 39

		Nathuakhan Sakuna Palra Chorlekh Janglia	0.06 0.05 0.01 0.01 0.01	24 30 37 24 41
Champawat	Pant hill plough, Danala, Damala, Pady thresher Animal drawn zero-till drill	Chami Jolari-toli Bheti-murari	0.5 0.4 0.4	50 33 38
Pithoragarh	Pant hill plough, Danala Damala, Pady thresher Animal drawn zero-till drill	Nakhet Suni Sintoli	0.15 0.11 0.11	36 33 34
Tehri	Pant hill plough, Danala Damala, Pady thresher Animal drawn zero-till drill	Hathwalgaon Kandikhal Nageshwar saur	0.2 0.2 0.2	49 43 31
Chamoli	Pant hill plough, Danala Damala, Pady thresher Animal drawn zero-till drill	Langasu Sakot	0.5 0.5	42 36

Production and marketing of implements

Availability of improved implements is one of the biggest hurdles for low level of adoption of improved implements for mechanizing agriculture in hills. Therefore, the Department of Farm Machinery and Power Engineering is actively engaged in production and marketing of improved hill implements through ICAR funded Revolving Fund Scheme. It is the main agency which is catering to the needs of hill farmers and others depending upon their demand. In general, the hill implements namely danala, damala, animal drawn zero- till seed drill, Pant hill yoke, Pant hill plough (*Nasooda & Kund*), manually operated paddy thresher cum winnowing fan etc are being produced and sold to the end users and government agencies. Besides this Research and Training Station of this university located in Pauri is also engaged in manufacturing and marketing of these implements and hand tools.

Strategy for Promotion of Mechanization

Though it is difficult to mechanize hill farming completely mainly because of natural terrain yet effort is required in this direction both by the farmers and the policy makers. The most appropriate technology for small and marginal farms is the mix approach of human and animal power. However, efficient and cost-effective equipment powered by battery/ small light engines will add towards the mechanizing the farming operations. Besides some of the following strategies could be adopted to mechanize hill farming:

- Small terraces should be converted into economical size, wherever possible, to make use of power tiller/ small size tractor operated improved implements.
- Compact, light weight, low-powered, multi-purpose and energy-efficient tools and gadgets should be promoted with adequate operator's safety and comfort.
- Introduction of technologically advanced and resource conservation equipment through extension and demonstration.
- Introduction of light weight and efficient animal drawn equipments matching to draftability of hill bullocks as these are part of the farming community.
- Government run program under SMAM like machinery bank/ custom hiring services must be promoted with full dedication.Government should strengthen the extension network to disseminate the knowledge and information about useful improved equipment by engaging agricultural engineers in line department.
- Agro- service centers should be established with proper repair and maintenance facilities of agricultural implements. Youth should be encouraged to establish these centers by providing financial assistance from the central/state government.

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BATTERY-ASSISTED FARM MACHINES FOR SMALLHOLDERS

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The mechanical power source has been adopted in farm operations, due to its higher efficiency which primarily run on fossil fuels. Use of fossil fuel increases the CO_2 emissions which has adverse effect on environment. Electric power is gaining importance due to its better efficiency and less impact on environment due to reduction of greenhouse gas emissions. Further minimizes these emissions even more, if renewable energy such as solar is being used to charge the batteries. Keeping this, IARI has developed seeder, weeder and cutter using electric power. DC motor with stored electric energy, i.e. batteries has been used for sowing, weeding and cutting operations successfully. The sowing, weeding and cutting operations with 250 to 350W brushed DC motor increased efficiency and helped in reducing drudgery of human beings significantly. The cost of economics of the 350W electric prime mover may be Rs. 78/ h if it is utilized for 450h in a year. For using domestic light, the cost may be Rs. 2.7 per h, if utilized for 3h per day. Based on field studies, a walk behind electric prime mover with 350W DC motor can be utilized for other unit operations like small ridge/furrow making, spraying and other stationary operations by retrofitting of suitable farm equipment.

Introduction

Net sown area is about 140 million ha in the country where Indian agriculture employs about 52% of total work force with a GDP contribution of 15% (2016-17), Mehta (2019). It is evident that about 92.39% farm power was available from animate power sources in year 1960-61, whereas, mechanical (tractor and diesel engine) was 5.73% in the year. In year 2016-17, the mechanical power increased about 81.5% and animate power decreased to 9.88%. The population of electric motors in the country is increased from 1.88% to 8.62% (Mehta et al., 2019 and Singh et al., 2010). The AC electric motors are primarily used for irrigation and agro-processing purposes as stationary source of power.

Higher workload on farm workers in operation of improved farm tools and equipment and even traditional methods of farm operations affected low output with less overall efficiency. These bottlenecks with these helped in increasing the adoption of mechanical and electric power source in completing the unit farm operations with reduced drudgery. The mechanical power source primarily runs on fossil fuels. The use of fossil fuel increases the CO_2 emissions which has adverse effect on environment. In future, it is, therefore, necessary to establish a bond between the opportunity of sustainable development of agricultural mechanization without neglecting the lack of energy and environmental degradation due to low availability of fossil fuels and its adverse effect on environment. Increasing fragmentation of land holdings, domination of small and marginal farmers, economical status of farmers, environmental conditions, topography, shortage of farm workers or their unwillingness etc are now a day's affecting agricultural mechanization. Considering the above facts, this paper attempts to focus on such innovative solution like electric prime mover for Indian agriculture.

Power consumption in different activities

As per secondary information, power consumption/metabolic rate of human beings in 20 activities/ operations (Walking in fields @ 3.86 km/h, Digging soil with spade, Making ridge in pulling mode, Fertilizer application by broadcasting, Fertilizer application by manual broadcaster, Seeding with manual seeder in wetland, Seeding with manual seeder in upland, Weeding with manual weeder, Weeding with cono-weeder in wet land, Spraying of pesticides, Harvesting with sickle, Rice threshing by beating, Rice threshing with pedal thresher, Maize dehusking-shelling with machine, Grain cleaning with hanging type grain cleaner, Winnowing in standing posture, Groundnut decortication using decorticator, Chaff cutter, Walking in puddle field, Pedalling at 50rpm at 60W power output, and Fetching water -Carrying 20-30kg head load) carried by human beings are worked out using energy expenditure rate as per standard formulas. Further energy value was converted to power in terms of watt (J/s). It is observed from Figure 1 that the power requirement varies between 151 W to 713W (ICAR, 2013., Sekhar et al. 2013., Singh, 2009 & 2010., Singh et al., 2012., Sharma and Singh, 2012., and Kumar

et al., 2010). Least power was consumption was in fertilizer application by manual broadcasting and maximum was in chaff cutting with chaff cutter.

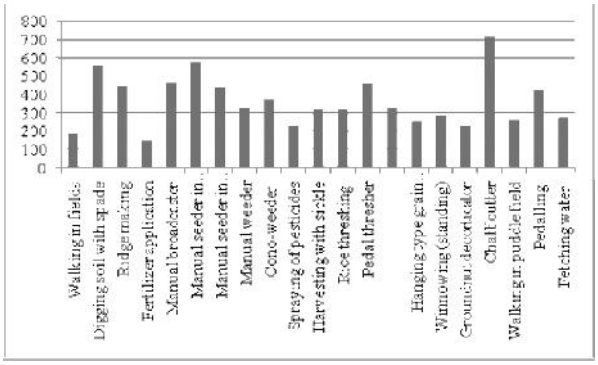

Fig 1. Power Consumption/ Metabolic rate in different farm operations based on physiological workload

It indicates that human beings instantaneous power is being utilized in carrying out these activities. It also further indicates the need of rest pause in performing the activities as per physiological workload on operator in the activity. Draft requirement for manually operated farm equipment (Khurpi, Kasola, Grubber hoe, Wheel hand hoe, Paddy weeder, Hand drill, Serrated sickle, Maize sheller and Groundnut decorticator) varied from 29N to 118N (Sharma and Mukesh, 2013 & Singh et al., 2018) while draft requirement of animal drawn equipment (desi plough, MB plough, disc harrow, 3-tyne cultivator, bakhar blade, seeding attachment, 3-row seed-cum-fertilizer drill, Local cart, Improved cart and Persian wheel) varied from 294N to 785N with a pair of bullock (Sharma and Mukesh, 2013).

Prospects of Electric Prime Mover in Agriculture

The energy conversion of efficiency of electric motors is considered about 90%. Experiments were conducted to see the effect of using electrical power in terms of emissions. Study found electric power as an appropriate source because of nonexistence of uncomplimentary materials such sulfur, nitrogen, polycyclic aromatics and air pollution (Lee et al. 2004).

Now-a-days, electric vehicles are found in transport activities in cities, zoos, airport, railway station, park etc.

Powering the device and vehicles with electricity offers some advantages not available in conventional internal combustion engine (where the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit) vehicles as electric motors react quickly, responsive and having better torque. Electric powered devices are often more digitally connected than conventional vehicles. Such device can also reduce the CO_2 emissions that contribute to climate change and smog, improving public health and reducing ecological damage. Further minimizes these emissions even more, if renewable energy such as solar is being used to charge the batteries.

The power source of electric prime mover is the battery or solar panel supplies the electric power to motor, necessary to move the electric Prime mover. This gives acceleration to this prime mover. When the electric Prime mover is idle there is no electrical current is being processed, means no consumption of energy. In agriculture sector, speed requirement of prime mover is low for motive and stationary work, particularly for small landholders and high-tech agriculture. Presently DC motors is available with gear reduction drive. Two types of DC motors are commonly available in the market as per need i.e. Brushed DC motor and Brushless DC motor. Brushless motors are having advantage of long life span, little or no maintenance and high efficiency than brushed DC motor. The lead-acid battery is being used to run DC motor and it increases the running cost of prime mover due to its limited life and battery charging time. These DC motors have potential to be adopted for developing electric prime mover for farm operations to reduce drudgery of farm workers with increased productivity and less impact on environment.

Super-capacitors associated with batteries have been presented as a promising solution (Redpath et al.,

2011). The super-capacitor characteristics, such as long time in cycles of operation (Tan et al., 2013) make them good options for applications that require a large amount of energy storage and supply in repeated quantities Moreover, the super-capacitors not only are able to be charged and discharged countless times, but they can also be stored with ten times more energy than the existing capacitors. Besides, they have the merit of a quick charging and discharging of energy and a longer life cycle (Reddy and E, 2011).

Research & Development

Singh et al. (2019 a) developed a battery-assisted four wheel weeder for weeding in wide row (more than 30 cm) crops. It consist of brushed DC motor, DMSC, battery, power transmission system, drive-wheels, front wheels, frame and swinging handle. The brushed DC motor (250W) was powered by two 12V-14Ah batteries. Weeding operation in field performed satisfactorily with sweep type tool up to 147N draft. The operator has to only guide the weeder up to 147N draft while they need to apply their muscle power beyond 147 N to prevent slippage. The average field capacity of this machine was found 0.0554 ha/h at speed of 2.52 km/h with 97.5% weeding efficiency. The efficiency of this weeder increased to 1.85 times than manual four wheel weeder. An operator of manual four wheel weeder cannot operate more than 4-5 h in a day due to physiological workload. It means overall efficiency of machine would be more than 1.85 times.

Singh et al. (2019b) also developed an electric powered two-row multi-purpose seeder for sowing spinach, coriander and wheat seeds with single metering roller. It consists of 24V, 350W DC geared motor, two 12V-14Ah batteries, power transmission unit, independent seeding units with vertical cell fed metering mechanism, swinging handle and frame . From field studies, output with electric powered seeder was 1130 m^2/h at speed of about 2.9 km/h with field efficiency of 90.3% for spinach, coriander and wheat seeds. The average draft requirement of machine was 106.1N. The developed equipment provided 2.5 times more output than manual operated seed drill with reduced drudgery by 2.6 times in terms of muscular force requirement.

ICAR-IARI (2019) reported development of a walk-behind e-power assisted single row offset rotary cutter for cutting spinach and coriander (Fig 3). The cut crop is laid in windrow and cut crop is lifted manually. It consist of 250W DC motor, two 12V- 12Ah batteries, power transmission unit, rotary blade with provision to lay crop in windrow, frame and handle. The cutting width was about 100mm with the rotary blade. The output with the cutter for cutting Spinach was 193.3 m^2/h at walking speed of 0.9 km/h while it was 172 m^2/h at speed of 0.8 km/h. The overall output with cutter including making bundle of spinach and coriander was 82.8 m^2/h and 80.9 m^2/h, respectively. The efficiency enhancement with cutter over manual cutting was of 2.56 times to manual cutting of spinach with sickle.

It is also assessed from the study that functional power for agricultural operations with 350W DC motor are about 214W by considering power losses in motor (15%), traction (20%) and 10% in power transmission as per standard formula. Three studies carried out on weeding, sowing and cutting clearly indicates that 350W brushed DC motor with 12V 12/14Ah batteries is sufficient for two row seeding, weeding and cutting row vegetable crops (spinach and coriander leaves). An additional set of two batteries will enable the farmers to enhance its continuity of operation to double. The life of batteries is almost three years and cost of 4 batteries will be around Rs. 6500. The major portion of expense is on batteries. The cost of operation will be reduced if its utilization is enhanced in various operations. The power from DC motor can also be successfully utilized for spraying, 30 cm size of ridge or furrow making in pulverized field, stationary uses like paddy threshing with loop type thresher, winnower etc and even domestic light. The cost of economics of the machine may be Rs. 75/ h if it is utilized for 450h in a year. For using domestic light, the cost may be Rs. 2.7 per h, if utilized for 3h per day. Solar panels can also be used for charging the batteries for mobile operations and continuous use of solar panels for stationary operations with batteries. This power source is suitable for smallholders.

Conclusion

The present study clearly indicates that the utilization of electric power in different farm operations has gained immense attention from the last few years. A 250 to 350W brushed DC motor has reduced drudgery with increased productivity of farm workers in sowing, weeding and cutting operations. The reduction of drudgery is mainly due to less consumption of metabolic rate of operator as major work is being done by electric motor. The cost of economics can be further reduced by utilization of the electric prime mover in various farm operations. The

electric prime mover certainly will be a more sustainable technology to reduce the drudgery of farm workers with increased productivity and less impact on environment. The main barrier of technology is the cost and life of batteries which can be overcome by increasing its utilization for other field operations. Future research can be towards use of super capacitor battery which has quick charging time, more power density, light weight and environmental friendly as compared to existing batteries being used in agricultural vehicles.

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CONSERVATION AGRICULTURE AN OPTION FOR SUSTAINABLE FOOD SECURITY

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In the present era, climate change has become emerged as a biggest challenge in front of agriculture development and food security. Climate change impacts agricultural productivity by modifying agricultural production systems worldwide. The World Bank recognized five principal factors through which climate change affects agricultural productivity. These includes: changes in precipitation, temperature, carbon dioxide fertilization, climate variability, and surface water runoff. Climate change may also affect different types of soil microbes and their interaction with plants, but its affectivity varies with soil category, microbes available in soil, soil environments and rate of natural fluctuations in weather/climate. Reducing risks to food security against climate change and the resource fatigue scenario is one of the major challenges of the 21st century before policy makers, researchers and farmers. Crop productivity is directly influenced by precipitation and temperature. However, to meet the future demand for food grain and sugar by the year 2050, the annual food grain and sugar production needs to grow to the level of 333 and 51 million tonnes, respectively. Farmers are regularly face adverse weather and environmental conditions that spell disaster for their produce. Extreme situations such as flooding and droughts constantly plague our farming community.

Intensification of the agricultural system through efficient resource use remains the only available option to enhance production with no additional land use, as competition for land and water is increasing from the non - farm sectors. To prevent the environments and its people from the harmful effect of changing climate, soil tillage is a very energy consuming process that releases large amounts of CO_2 from fossil fuels and from the oxidative breakdown of soil organic matter. Incorporation and retention of crop residues helps in building soil organic matter besides use of cover crops, compost and other agricultural by products. Beneficial microorganisms can protect the crop plants from diseases and pests, and recycle plant nutrients. Conservation agriculture (CA) system is a set of technologies including minimum soil disturbance, permanent soil cover through mulching, crop residue management and crop diversification inclusion of legumes in rotation. CA system provides opportunities to reduce the cost of production, saving of nutrients and water, improves soil health, improved productivity, increase crop diversification, efficient use of resources, and benefit the environment.

Keywords: Climate change, CA, food security, adapt and mitigation.

ECONOMIC AND ENVIRONMENTAL BENEFIT OF RESOURCE CONSERVATION TECHNOLOGIES IN INDO-GANGATIC PLAIN OF UTTAR PRADESH

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The Indo-Gangetic Plain has plentiful of natural resources, helps farmers to cultivate multiple crops during the year, high population density and relatively good infrastructure. The region is characterised by rice-wheat cropping system. The conventional method of crop production is mainly based on the intensive use of ploughs and disc harrows which required lot of energy. About 40 per cent of the land degradation worldwide is caused by conventional method of tillage. The intensive tillage causes degradation of soil organic matter resulting reduction in water holding capacity, which adversely affects supply of nutrients to plants. The burning of crop residues in agricultural field are causing pollution, Green House Gas emission and loss of valuable plant nutrients. Further augmentation in rice and wheat productivity growth and keeping pace with natural resources, more emphasis is needed on resource conservation agriculture. Zero/reduce till-surface residue management system has benefited the eastern Indo-Gangetic Plain and farmers are receiving higher productivity gain, good soil health and significant reduction in cost of cultivation. The objectives of present study were to find out the relative importance of various factors influencing adoption of resource conservation technologies (RCTs), and to analyse the economic and environmental benefit of RCTs in different agro-climatic zones of Uttar Pradesh.

Present study was based on the primary and secondary data. Primary data was collect from RCTs adopters and non-adopters sample farmers using pre-tested schedule. Uttar Pradesh is divided into nine agro-climatic zones. Out of these agro-climatic zones, eight agro-climatic zones were considered for present study. Total 160 RCTs adopters and 160 non-adopters were selected for the present study. For identification of relative importance of various influencing factors for adoption of RCTs was worked out by using binary logit model. The economic benefit of RCTs was worked out using economic surplus model. The environmental benefits were worked out by estimating reduction in carbon emission, reduction in irrigation water use. The cost of cultivation of wheat crop was based on CACP method. The Garrett Raking was used to rank the constraints associated with the RCTs adopters.

Results suggest that average age, education level, farming experience was higher for zero-tillage adopters as compared to non-adopters. The average size of family member was large in case of zero-tillage adopters (9.69) as compare to non-adopters (8.84). The average size of land holding for zero-tillage adopters was higher (3.89 ha) than non-adopters (2.82 ha). Per hectare cost of cultivation of wheat crop, zero-tillage adopter incurred Rs 6111 lower than the non-adopter farmers. It was due to reduction in input costs like human labour, machine labour, cost of seed, cost of fertiliser, cost of pesticide, cost of irrigation and cost of harvesting. Zero-tillage adopters received Rs 20671 per hectare more net income from wheat crop production as compared to non-adopter farmers. Benefit cost ratio in wheat production was higher (1.39) for zero-tillage adopters than non-adopters (1.02). Cost of production of wheat for zero-tillage adopters and non-adopters was found Rs 1258.47 and Rs. 1723.56 respectively. The major factors influencing adoption of zero-tillage in study area were education level, farming experience and land holding size were positively and significantly affecting the adoption of zero-tillage. The agronomic benefit from zero-tillage adoption was incremental yield of 8.63 and 7.20 quintal per hectare for wheat main and by-products as compared to non-adopters. Per hectare economic benefit due to adoption of zero-tillage was estimated to be Rs 21344 as compared to non-adopter Per hectare total carbon emission was reduced due to adoption of zero-tillage was estimated to be 25.12 Kg (reduction in carbon emission from ploughing and sowing of wheat crop was 21.57 kg and 3.55 kg from irrigation) as compared to non adopters. The zero-tillage adopters were using less irrigation water (570.91 m^3 per hectare) as compared to zero-tillage non-adopters. The agronomic and net economic water productivity for zero-tillage and rotavator adopters was higher as compared to non-adopters.

Most important reasons for adoption of zero-tillage by the sample farmers in the study area were reduction in ploughing cost, increase in crop yield, reduction in cost of cultivation, reduction in cost of cultivation and reduction in seed requirement. The most important reasons for not adoption of zero-tillage in the study area were high weed population density in agricultural field, not sure of profit and non-availability of zero-tillage machine at time. Most important conditions for adoption of zero-tillage in future were if farmers convinced of yield benefit, if custom hiring rate is low and if zero tillage machine is available on subsidy.

Government and manufacturers of zero-tillage should work together to popularise zero-tillage. From manufacturer side the efforts should be made to reduce the cost of machine. Manufacturers of zero-tillage machine should work in synergy with tractor manufacturer for improving complementarity, efficiency and adoption of these technologies on small and marginal Farms. Government should provide more subsidy/incentive on zero-tillage. While designing subsidy/incentives consumers' surplus and environmental benefits should be taken into account. Manufacturer should provide servicing facility to zero-tillage owners at their doorstep. For the purpose of this, manufacturer should trained young youth of the village and government should provide financial support with lower interest rate for operating service centres for zero-tillage. There is need to establish service providing centres/custom hiring centres by using IT tools (Apps) for zero-tillage. For the purpose of this, government should provide necessary training and financial support to agricultural graduates for opening of service centres. These centres should provide zero-tillage machine on hiring basis to the farmers of surrounding villages. Zero-tillage adoption in different agro-climatic zones of Uttar Pradesh depends on a variety of factors, including agro-ecological location and socio-economic characteristics. Thus, policies for promoting the adoption of these technologies, must take into account local contexts in order to select appropriate site-specific technologies.

BIOPROSPECTING AGRICULTURALLY IMPORTANT MICROORGANISMS (AIMS) IN INTELLECTUAL PROPERTY LANDSCAPE

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Intellectual property involves inventions, fictional and creative work, industrial designs for article, symbols, etc. utilized as a part of trade. Today, it is widely accepted that any new result of a man's brain work need to be secured as private property. All patentable inventions must satisfy essential criteria that are, the invention must be novel and not obvious, it must have some industrial use, and the description part of the patent application must enable a person skilled in the relevant area of technology to put the invention into practice. The Indian patent system is governed by the Patents Act, 1970 as amended by the Patents (Amendment) Act, 2005 and the Patents Rules, 2003, as amended by the Patents (Amendment) Rules 2006 effective from 5 May 2006.

During the late 1970s with the advancement in recombinant gene technology, patenting microbes came into the existence including the famous genetically engineered superbug which catabolizes petroleum oil. His claim on the superbug was previously rejected by the USPTO but later in a case of Diamond *vs*. Chakrabarty, US Supreme Court gave the verdict in the favor of A.M. Chakrabarty. In 1981, motivated by the decision given by US Supreme Court in Chakrabarty case, Japanese Patent Office and European Patent Office also started issuing patenting microbes. Under Indian Patent Act 1970, Amendment 2002, implemented form May 20, 2003 microbe's development can be patented in India.

Several PCT and US Patent have been awarded to our group for novel agriculturally important microorganisms. A *Trichoderma harzianum* strain useful as nematode inhibitor, fungicide and plant growth promoter and a process for the isolation have been patented in 2002 (US Patent No. 6,475,772). In 2004 PCT patent awarded to the synergistic fermented plant growth promoting biocontrol composition (PCT WO 2004-087618A1). Another PCT patent has been awarded in 2005 to synergistic bioinoculant composition comprising bacterial strains of *Bacillus subtilis* or *B. lentimorbus* from cow milk (PCT WO 03/020038A1). In the year 2007, US patent has been awarded to a synergistic fermented plant growth promoting, bio-control composition (US Patent No.7,297,659B2). Likewise, bacterial strains of accession no. NRRL B30486, NRRL B30487 and B30488 and method of producing the composition have been patented in 2006 (U. S. Patent No. 7097830 B2). US patent was awarded to the rapid composting of bovine dung using *Trichoderma* of Accession No. NRRL 30598 having ability to promote plant growth. The biocontrol potential of Agriculturally Important Microorganisms (AIMs) is mostly attributed to their bioactive secondary metabolites. However, low shelf life of many potential AIMs hinders their use in agriculture and is the main reason of low adoption by the farmers.

Under the present political, technological and socio-economical situation it is very complicated to build up our national system of IPR in according to those of developed nations. Patenting life forms bring with them imperious issues of pious and ethical values. Thus, it would be a great favour to our nation to file, document, keep and modify new microbes isolated from different parts of the country.

DOUBLING FARMERS' INCOME: SCOPE AND STRATEGY AT JHARKHAND

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Food security and doubling of farmer's income by 2022 is one of the top Government's agenda because in past strategy for development of the agriculture sector in India has focused primarily on raising agricultural output while production stagnates and prices were found unstable. The greatest challenge to the agriculture in the years to come is to provide adequate food to burgeoning population in order to combat with hunger and malnutrition. Previously agricultural production has been increased through better technology and varieties and enhanced use of fertilizers, irrigation and agro-chemicals. This strategy paid dividends as the country was able to address massive food shortage during mid- 1960s. Since the adoption of green revolution, India's food production multiplied 3.7 times while the population multiplied by 2.55 times. But this strategy did not explicitly recognize the need to raise farmer's income and did not mention any direct measure to promote farmer's welfare. Among all the states Jharkhand's farm household income is 45.3 per cent (Chand Ramesh, 2017). Jharkhand, the 28th State of the Indian Union is best known for its rich mineral resources. However, 78 per cent of the total population of 2.69 crore live in rural areas, largely dependent only on agriculture and allied activities.

For doubling the farmer's income it is very much necessary to have the adequate information on farmer's income but it is ironic that estimates of farmer's income are not published by The Central Statistics Office state wise. Though, most recent estimates of farm income were prepared by Chand et al. (2015) for the period 1983-84 to 2011-12. Further, he also reported that the rate of growth was 7.46 per cent a year, which is a great step towards achieving goal of doubling farm income.

In order to this some of the agriculture experts have produced calculations that agriculture will require annual growth of 14.86 per cent per year for five years to get farmer's income doubled (Chand, 2016). It was obvious that the purpose was to double the current income of the farmers or income for the agricultural year 2015-16 by agricultural year 2022-23 which requires annual growth rate of 10.4 per cent.

It is relevant to mention that the latest data on number of cultivators is available only up to the year 2011-12. Therefore, while calculating per cultivator income, it is assumed that farm workers would continue their withdrawal from agriculture at the rate observed during 2004-05 to 2011-12. Interestingly, even with gradually decreasing number of cultivators in agriculture sector, real income per farmer showed insignificant increase during 2011-12 to 2015-16.

No doubt, it's a difficult call for the Jharkhand government to feed more people with scarce water resources, recurring droughts, undulated lands and difficult access to energy. The agricultural technologies need a shift from production oriented to profit oriented sustainable farming system. For Doubling Farmers' Income (DFI) following measures have been identified as a value led enterprise given below:

1. Increase in agricultural productivity

Jharkhand state falls under the agro-climatic zone VII which has been further divided into three subzones. Despite good rainfall, the cropped area and cropping intensity are low. The cultivable area is estimated around 3.8 million ha but the net sown area is 2.56 million ha and only 12 per cent of cropped area is under irrigation (Jharkhand report, 2012). Thus, agricultural productivity can be increased by two sources v*iz.,* area and productivity. Due to rising demand for land for several other uses further expansion in area under cultivation is not feasible. While, there are some reports of decline in agricultural land since the year 2004-05. Therefore, agricultural output can be increased through improvement in productivity of per unit area.

- Apart from all these, there are several additional initiatives required for enhancing the agricultural productivity as elaborated below:
- Rain water harvesting, conservation and enhancing water use efficiency
- Adopting water conserving irrigation methods i.e. drip and sprinkler etc.
- Soil conditioning to increase soil water holding capacity
- Amelioration of acidic soils
- Screening, selection and development of acidic soil tolerant varieties.

2. Diversification towards high value crops

There is a great scope in Jharkhand to enhance farmer's income through high value horticultural crops such as cultivation of several fruits *viz.,* mango, banana, guava, papaya, tomato and minor forest produce are in abundance in Jharkhand. Scope also exists to raise the income by diversifying towards other allied enterprises like forestry. However there are various legal restrictions on felling of trees and setting of timber industry and transit permit for marketing of timber as a major deterrent to raise trees on private lands due to that farmers are not able to develop forest crops on their private land.

3. Increase in crop intensity

Scarcity of irrigation is said to be the main reason for low crop intensity in Jharkhand. However surprisingly, crop intensity on irrigated area, estimated as ratio of gross irrigated area to net irrigated area, is found to be 140 of our country, which is significantly different than crop intensity of this state. Therefore, meets 40 per cent of its non-fuel timber requirement from the import of wood and wood products. Through popularization of intercropping of rice with pulses, vegetable crops and short duration crops to maintain crop intensity would improve overall productivity of this subsystem.

4. Promotion of horticultural crops, post harvest and value addition

In Jharkhand to promote horticultural crops following areas need to be focused on high density orcharding, fruit based multitier cropping system and scaling up of technologies for rejuvenation of old and senile orchards. In non National Horticultural Mission districts, horticulture crops are proposed to be promoted. Fruit crops such as mango, Guava, Citrus fruits, Amla, Jackfruit and other minor fruits, spices such as garlic, ginger, and turmeric are to be promoted.

Apart from this, for promoting vegetable cultivation, quality vegetable seeds, compost and plant protection material should be available for the farmers at government stores. Likewise cultivation of flowers should be encouraged in districts having potential and govt. has set up plant resources centre, mainly for loose flowers, in four districts bulbous flowers. For demonstrative purpose tropical polyhouse for off season vegetable and floriculture can be an alternative and effective source for doubling farmer's income. Subsequently, to promote marketing of horticulture and vegetables and to minimize wastage, pack houses, market yards, grading and packaging centers, refrigerated vans and cold rooms have been proposed by the govt. of Jharkhand.

5. Secondary agriculture and Entrepreneurship skills

For doubling farmer's income solar energy is a viable option to support secondary agriculture in rural areas in place of electricity. As far as entrepreneurship skills are concerned empowerment of women and youth for sericulture, lac culture, bio-agent production, beekeeping, dairy, goatery, Piggery and fisheries etc are being implemented at several forums. The task of developing some model village on integrated farming system models like handloom, handicraft, pottery, carpet industry and cottage industry are already being run by KVKs in the state. This can also be a part of their family livelihood and these allied activities could be their secondary source of income.

6. Quality seeds

Quality seed is most critical for enhancing agriculture production as setting up of state seed corporation in the primary need. So it should be the primary responsibility of the SAU's to produce required quantity of breeder and foundation seeds of all promising varieties. State government should also ensure procurement of entire seed and timely distribution of seed among farmers. Subsequently, seed reserve at state/district level can also be established. For getting this mammoth target of doubling farmer's income, seed/varietal replacement of improved seed varieties should be given priority.

7. Fertilizer subsidy, soil fertility and fertilizer use

Without improvement of soil health status, agriculture productivity is tough to improve in Jharkhand. Soil testing is being neglected time and again by the farmer's that is why government is taking keen interest in making soil health card. Based on the need of the soil, it should be treated rationally. For that organic and bio fertilizer, neem coated urea (pellated urea), vermi-compost and farm yard manure production can be promoted.

8. Research and development

State government (Agriculture department), SAUs and KVKs should be supported generously to emerge as key players in rural transformation and wealth creation. The agriculture sector remains among the fastest growing ones in the Jharkhand. This is the need of the hour that SAUs should work in collaboration with government agriculture department and laboratories and farms should be modernized and upgraded by creating state of art facilities.

9. Plan and policy making

There are several flagship schemes and policies have been formulated which are very much necessary for doubling farmer's income till 2022. Government of India embraced new economic policies and economy wide reform in 1991. These reforms involved liberalization, deregulation and removal of excessive control and restrictions on private sector which created very favorable macro environment for the private sector participation in economic activities. In order to this government brought several reforms in 2002.

Particularly Jharkhand government have taken several developmental initiatives *viz.,* Jharkhand Opportunities for Harnessing Rural Growth Project (JOHAR), Tribal Sub plan (TSP), Schedule caste sub plan (SCSP), Pradhan Mantri Krishi Sinchai Yojna (PMKSY), Soil health card, National food security mission (NFSM), e-NAM, Pradhan Mantri Fasal Bima Yojna (PMFBY), Mission for Integrated development of Horticulture (MIDH) and Parmaparagat Krishi Vikas Yojna (RKVY-RAFTAAR) to raise output and reduce cost.

10. Shift of cultivators to non-farm jobs

The empirical evidence depicted that if same level of progress in various sources of growth, as experienced in the last 10-15 years, is maintained it can achieve 75 per cent increase in per farmer's income by 2022-23 over base year of 2015-16 with better price realization. This falls short of doubling the income (100 per cent increase) by 25 per cent. Thus, to double farmer's income by 2022 the progress in various sources of growth has to be accelerated by 33 per cent (Niti Ayog, 2017). This change could be across the board or more in some area and less in others with overall acceleration of 33 per cent. The details are presented in tabular form as given below.

Table: Sources of growth in farm income: Achievements and required growth rate for doubling farmer's income

S.No.	Source	Recent achievements		Required growth rate for DFI
		Period	Growth rate/change	
1	Crop productivity 70% segment	2001-2013	3.1	4.1
2	Livestock value added 30% segment	2005-2014	4.5	6.0
3	Improvement in resource use efficiency	2005-2012	2.26	3.0
4	Crop intensity (70% segment)	2001-2012	1 %age	1.3
5	Crop diversification towards fruits and vegetables (70% seg)	2003-2014	3.89	5.17
6	Better price realisation: Crops	Karnataka experience. Reforms	13% total (in real terms)	17.0
7	Shift to non - farm occupation	2005-2012	1.81	2.4

The low level of farmer's income and year to year fluctuations in it are a major source of agrarian distress and it is spreading and getting severe over time impacting most of the population of Jharkhand that is dependent on farming for livelihood. Therefore, respectable increase in the wages in farm sector will also attract youth towards farming profession and ease the pressure on non-farm jobs.

Conclusion

The ambition of the Government of Jharkhand has to be met coherently through productivity enhancement coupled with cost reduction, price realization and policy support. Income from a single crop or commodity will not fulfill the target of doubling farmers' income but it has to emulate from farm and non-farm sources. Diversification of activities which yields better remuneration (area specific) should be the ideal strategy. Most of the developmental initiatives and policies for agriculture are implemented by the state. As progress of various reforms related to market and land lease are also state subjects. Therefore, it is essential to mobilize state to own achieve the goal of doubling farmer's income. With proper coordination and efforts among centre, state and participation of farmers, the country can achieve the goal of doubling farmer's income. If concerted and well coordinated efforts are made by the Jharkhand government with the center the country can achieve the goal of doubling farmer's income by the year 2022.

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MAXIMISING FARM INCOMES THROUGH ENTREPRENEURSHIP DEVELOPMENT

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Agriculture is an important sector of Indian economy as it contributes significantly to the total GDP and provides employment to substantial chunk of the population. Indian agriculture has registered impressive growth over last few decades. It provides raw material to all industries and is simultaneously also a market for industrial products. It is also an important earner of foreign exchange. Thus significance of agriculture sector is unmistakably very high. Though present government has come up with many reforms and schemes of higher agricultural credit, higher allocation for irrigation projects, a crop insurance scheme and increased allocations for MGNREGA to dig farm ponds, it is still to be seen if farm incomes can be doubled by 2022.

Challenges and Issues: What is the Rural Scenario at present?

Shrinking Farm Land

There is continuous fragmentation of land due to ownership multiplication and division of joint families into smaller nuclear families, resulting in low per capita availability of land. The land man ratio in our country is becoming very narrow. Due to low land man ratio, more and more farmers and their children are finding themselves out of work. In view of shrinking land base and rampant unemployment, there is need to commercialise and diversify Indian Agriculture in such a way that one can generate more income per unit of area and time and create agro-based employment opportunities. For this to happen we need to convert agriculture into agri business. Another issue is that with liberalisation, privatisation and globalisation, the whole world has become like a local market where our farmers and their products will have to compete with multinationals in terms of quality and price. In this scenario, a shift in extension approach is demanded. Unlike crop production, developing entrepreneurship is not an activity but a chain of events and require functional linkages with various support systems. New commodities are perishable in nature and a farmer had to look for marketing channels unlike the established channels as in case of traditional crops of wheat, rice etc.

Unemployment

Increasing influence of education has also created a higher need for job amongst the rural masses. After finishing their education, rural youth line up in front of employment exchange for seeking jobs. Although they have an option of starting their own enterprise but this option is usually ignored by them and they join the long queue for rural youth in the villages itself; thus reducing the pulling factors for migration to nearby towns.

Poor Natural Resources and Climatic change

Poor quality natural resources, harsh agro climatic conditions, poor infrastructure, limited opportunities for rural industries, increasing cost of cultivation, non remunerative, market driven economy, quality of inputs, spurious seeds and natural calamities/ vagaries are the other challenges which are faced by rural population.

Agricultural Entrepreneurship

Farming as a profession looks dismal and grim. The youth of farm families are pushed by these towards seeking employment in cities and migrating. Entrepreneurship Development in Agriculture is an important way out to bring a transformation in our rural areas. Developing Agri-enterprises and making our farmers entrepreneurial is needed urgently to pave the way for evergreen revolution. In this context, it is imperative to focus on human domain in developing entrepreneurship efforts. The neglect of this aspect is proving detrimental to all other efforts directed at setting up agri-enterprises and fuelling entrepreneurial zeal among farmers.

Agriculture has to move from subsistence culture to Agripreneurship for higher profits.

- 1 Agri based micro enterprises can help in poverty reduction, employment generation, empowerment and enterprise development as an end in itself.
- 2 Regardless of the stage of economic development among the Asia-Pacific countries, small and medium enterprises (SMEs) are generally considered as major sources of employment generation.
- 3 Promotion of such enterprises, therefore, is generally regarded as part of an employment intensive industrialization strategy.

Entrepreneurs as the human capital can translate rural economic development. For converting a farm into an enterprise or business, the identity of the person managing it must change from a farmer to that of farm business operator or an agripreneur. There is a great need to make our farmers entrepreneurial. Physical, natural and economic resources are important for facilitating development of any nation but the most important ones are the human resources.

Capable, efficient and motivated human resources can bring about tremendous positive changes towards progress. No doubt it is equally true that inefficient people can wither away a whole empire and squander away its precious wealth and abundance. Several empirical studies have shown that the entrepreneurs as the human capital have made a large contribution to economic development than non human capital. Theodore (1970) after comparing the economies of several nations found that it is the quality of human resources which brings about transformation in a society. He contrasted small land area nations like Japan with large land area countries and concluded that it is the entrepreneurial spirit which makes all the difference in the output from the farmers.

Developing Agricultural Entrepreneurs

Developing motivated, entrepreneurial and efficient farmers requires focus on the human domain, which is the prerequisite to bring about rural transformation The characteristics of entrepreneurs can be developed through systematic motivational training. Many farmers who have been entrepreneurial have attained success and are able to maximize profits from their lands. There are cases of farmers who have also earned Rs 9 lakhs from an acre!!

A developing economy needs entrepreneurs who are competent to perceive new opportunities and are willing to incur the necessary risks in exploiting them. Entrepreneurship is usually described as the whole process of finding opportunities, mobilizing and acquiring resources, managing the production process and marketing the products. Entrepreneurs are architects of every conceivable material project and are motivated force behind development of any nation. Developing competent human force is of paramount importance in the present context and entrepreneurial zeal development is the first and foremost step to attain this goal. Increase in population, which is considered a liability can also contribute positively towards overall national development if entrepreneurial qualities are inculcated among the masses.

Entrepreneurship among farmers should be developed through systematic awareness spread programme. Awareness about market potential has to be systematically spread among the rural masses especially the farming community. Then comes the second step of motivation development. Prior to it, an environment of awareness and need has to be prepared. This awareness and motivation has to be developed not only in the farmers but also in the field level extension workers. Once they become aware about entrepreneurship and convinced about its need in agriculture, they will be able to provide some thrust towards commercializing agriculture, as they are the ones who are implementing government sponsored schemes.

Entrepreneurship development programme (EDP) for agriculture has to go via the existing system itself. EDP aims to develop entrepreneurship through motivation enhancement, providing support services and sustaining the efforts. Entrepreneurship development programme has been included in the mandate of KVKs. The staff of KVKs should be trained in entrepreneurship development in agriculture so that it reaches the ultimate users i.e., the farmers who can then avail of the opportunities already existing in the system.

Vocational training interventions can be given to school graduates and drop outs at various urban and rural centres using IT and this would prepare them better for getting jobs in the future. Training in manufacturing

activities reserved for the small-scale sector may also be included and emphasised to enable the young to be self-employed. Young women may be given different types of training inputs for income generation from their home as well.

Inculcating Entrepreneurial Competencies

The dimensions of entrepreneurial spirit inculcation include risk taking ability, hope of success, feedback usage, persistence, confidence, knowledge-manageability, achievement motivation, persuasibility and innovativeness. Crop planning all the year around as per the market demand is visualized to be critical in getting higher profits from the same piece of land. Value addition and primary processing are add ons for the farm incomes. Further, well developed inter linkages between agriculture and rural industry will be an effective mechanism of promoting rural transformation. While on one hand farmers get just a few rupees in the exchange of their produce, it is multinationals who are grabbing the major chunk of profits after selling it to the ultimate users. Whether it is potatoes, tomatoes and other perishable commodities, farmers are forced to sell their produce for very less amount while the ultimate consumer pays huge amount when it is processed and packaged after grading. Cases of Farukkabad and Ratnagiri are still fresh in our minds. Thus farmer led value addition ventures and marketing are needed for which entrepreneurial competencies must be inculcated among farmers.

Agricultural productivity is believed to be enhanced by the incorporation of strategic entrepreneurship skills. Farmers may be trained to be entrepreneurial to manage agriculture not as a way of life but as an enterprise and trained cadre of youth having capabilities for agri entrepreneurial endeavours. Individual's motivation, aspirations and entrepreneurial competencies trigger agripreneurship development whereas adoption of best practices, dodging of inhibitive factors and facilitative socio economic factors play sequential role in reaching agripreneurial success (Singh *et al* 2014).

Value Addition Agri- enterprises

India has made impressive growth on food production front, commonly referred to as primary agriculture. However, the area of secondary agriculture and its derivatives inter-alia food processing and value addition has not been addressed adequately. Under traditional system, the post harvest losses are quite high i.e. 25-30 per cent is lost before reaching ultimate consumers (Sinha, 2010).The estimated losses are 5-15 per cent in non-perishable, 20-30 per cent in semi-perishable and 30-50 per cent in perishable. Post-harvest activities have assumed significant importance as an integral part of the food production system, which aim at promoting best practices for post-harvest handling and management along the entire food supply chain, focusing on a broad spectrum of operations and stakeholders in traditional and modern marketing systems.

The proposition of food processing and value addition stands to offer the advantages such as maintaining quality (appearance, texture, flavor, and nutritive value); protecting food safety; reducing post harvest losses; enhancing the self life and providing high quality and nutritive finished food products to the consumers. Another important issue is how to increase the income of the share of farmers in comparing rupee which is average 20-25 per cent at present. This issue may be addressed considerably through processing and value addition of cereals, fruits, vegetables, milk, fish, meat, poultry, flowers etc. The strategic approach for a dynamic and remunerative food processing and value addition system calls for developing adequate infrastructure including storage facilities; creating awareness; imparting knowledge and sharpening skills of farmers and other stakeholders about safety standards; improving capacity utilization; developing appropriate and specific technology for proper handling and grading, packaging etc; developing effective and trained human resources for technology dissemination; and implementing capacity building initiatives for farmers, farm women and rural youth; promoting group and collecting mechanism involving producer's societies, farmers interest groups & self help groups; and developing efficient market linkages etc.

Women Entrepreneurship

Women play a significant role in agriculture, the world over. About 70% of the agricultural workers, 80% of food producers, and 10% of those who process basic foodstuffs are women and they also undertake 60 to 90% of the rural marketing; thus making up more than two-third of the workforce in agricultural production (FAO,

1985).Women's average contribution in over all farm production is estimated at 55% to 66%. Traditionally women have been playing a great role in post harvest upkeep of the farm produce. It is essential to build capacities of women to take up these agri enterprises and become economically self sufficient besides increasing farm profitability. A study by ILO has found that new techniques in agriculture, particularly those involving commercialization, "often shift economic control, employment and profit from women to men". The diversion of income from women causes increased suffering for families because studies have found that, in general, income controlled by women benefits families more than income controlled by men.

Rural women have been actively participating in retail trade and marketing. Asian women market foods such as vegetables; West African women distribute most major commodities; and Caribbean women account for nearly all local marketing. Through their marketing efforts, women provide valuable links among farmers, intermediaries & consumers. Rural petty trade serves to stimulate the production and consumption linkages in the local economy.

Conclusion

The food processing and value addition is an integral component of agriculture and contributes significantly economical and social development of the country. However, its potential has largely been in underutilized and as such there is a huge opportunity and scope to develop and promote this sector. Farm women individually or in group can tap this immense opportunity and potential of food processing and value addition. There is a pertinent need for developing an effective and efficient strategy incorporating the issues like development of appropriate, location specific & need based production and processing technologies; strengthening infrastructural facilities; dissemination of technologies to the farmers; implementing capacity building and entrepreneurial interventions; developing effective and meaningful marketing linkages etc. to tackle the multi-dimensional problems of rural poverty, increasing farmers' share in profit, creating employment and income generation opportunities and serve the interest of the consumers. Building entrepreneurial competencies of farm women and mobilizing women for group action to take up food processing and value addition agriventures for maximising farm profits.

AGRIPRENEURSHIP DEVELOPMENT-A SUSTAINABLE APPROACH FOR DOUBLING THE FARMERS INCOME

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India is among the developing countries of the world where agriculture sector is of prime importance. Agriculture is considered to be the back bone of our economy and the agrarian sector contributes substantially to the GDP i.e. 15.87% (Statistics Times, Feb, 2019) & 17.32% (Quora.com, April, 2019). The importance of agriculture can be determined from the fact that it provides employment to 58% of the population of our country. Today agriculture has achieved commercial importance and changed from subsistence farming to commercial farming, import oriented to export oriented sector and supply driven technology to demand driven technology (Mishra, et.al. 2013). Entrepreneurship in agriculture has gained importance in lieu of this changing scenario of Indian agriculture. Entrepreneurship is a process through which an entrepreneur recognizes and seizes opportunities, converts those opportunities into workable/ marketable ideas, and takes the risk of setting up an enterprise to produce a product or service which satisfies customers need (Gangwar, et.al. 2013). Entrepreneurship development in agriculture is termed as agripreneurship. Agri-preneurs are the entrepreneurs in agriculture. They can innovate new ways so as to attain maximum profit from a small piece of land. Entrepreneurship development in agriculture can be a way to help to meet the challenge of economic viability in agriculture so as to attain sustainable agriculture development. Sustainable agriculture consists of increasing the efficiency and diversifying the activities on a small piece of land so as to gain economic, social and environmental sustainability.

Agriculture has been the primary occupation of man since the time of the earliest civilization. Agriculture commenced some 10,000 years ago in the world, while in India it started around 9000 BC. With the commencement of agriculture man started to live a civilized life. The invention of agriculture is considered to be one of the greatest revolutions of human history. Agriculture is an important sector for the development of the economy of developing countries. Today, agriculture has achieved commercial importance and changed from subsistence farming to commercial farming, import oriented to export oriented sector and supply driven technology to demand driven technology. Indian agriculture is essentially monsoon and market dependent, and suffers frequent distresses posing threat to the welfare of farmers as well as interest in farming. Declining farm productivity and income have serious implications on rural prosperity and overall economy. Hence, increasing the real farm income, i.e. nominal (actual) income adjusted to inflation has become a priority for the state and policy planners. The Government of India, in its budget 2016–17 pro-posed to double the farmers' income by 2022 (marking the 75th year of Independence) by addressing the agrarian distress and crisis. Indian agricultural databases lack farmer income series. Nevertheless, it has been estimated from survey data that the farm income growth, currently hovering around 1%, has declined since 2011–12. The potential pathways integrating science and technology (S&T), institutions and policy to double the farmers' income are explored. Technology that promotes better re-sources use efficiency results in lower costs of production and boosts the net income. It has to be utilized through collective/community approach, right from planned production to value-added marketing for raising the income in rural areas and its application for better market connectivity and price realization. The recently initiated National Agricultural Marketing brings more than 500 markets on a single e-platform, integrating markets sans middlemen and enabling farmers to bid their products to sell anywhere in India. This integration will have operational meaning for the farmers only when the Agricultural Produce Market Committee (APMC) Act and Essential Commodities Act (ECA) are either revamped or done away with. This is very much evident in the difference in realization of the price potential between live-stock products not covered under these Acts, and the fruits and vegetables covered under the APMC. Further, it will not be suffice if commodities are delisted under the APMC, unless alternate marketing platforms are made available with attendant, scientific storage, processing and transport facilities where private can play a vital role. Agriculture plays a crucial role in sustainable development and in hunger and poverty eradication. The challenges faced by agriculture in sustainable development is in working out ways of bringing about a society that is materially sufficient, socially equitable, and ecologically sustainable and one that is not obsessed by growth only, but motivated by satisfying human needs and equity in resource allocation and use.

Entrepreneurship development

The entrepreneurship is a very old concept according to which anyone who runs business is called an entrepreneur. The more precise meaning of entrepreneur is; one who perceives a need and then brings together manpower, material and capital required to meet that need. Entrepreneur is one who understands the market dynamics and searches for change respond to it and exploit it as an opportunity. The word “entrepreneur” is derived from the French word “enterprendre” which

means “to undertake”. The Frenchmen who organized and led military expeditions were referred to as “entrepreneurs”. Around 1700 A.D. the term was used for architects and contractor of public works. In many countries, the term entrepreneur is often associated with a person who starts his own new business. Business encompasses manufacturing, transport, trade and all other self employed vocation in the service sector. Entrepreneurship has been considered as the propensity of mind to take calculated risk with confidence to achieve predetermined business objectives. The entrepreneur is the one who undertakes to organize, manage, and assume the risks of a business. In recent years entrepreneurs have been doing so many things that it is necessary to broaden this definition. Today, an entrepreneur is an innovator or developer who recognizes and seizes opportunities; converts those opportunities into workable/marketable ideas; adds value through time, effort, money, or skills; assumes the risks of the competitive marketplace to implement these ideas; and realizes the rewards from these efforts. A shift from agriculture to agribusiness is an essential pathway to revitalize Indian agriculture and to make more attractive and profitable venture. Agripreneurship has the potential to contribute to a range of social and economic development such as employment generation, income generation, poverty reduction and improvements in nutrition, health and overall food security in the national economy. Agripreneurship has potential to generate growth, diversifying income, providing widespread employment and entrepreneurial opportunities in rural areas.

Past strategy for the development in agriculture has focused primarily on raising agricultural output and food security. Since the green revolution occurred, India's food production multiplied 3.7 times while the population multiplied by 2.55 times which has made India not only self-sufficient in food at aggregate level, but also a net food exporting country (Niti ayog report;2018). Despite such achievements, farming income remained low, which is evident from the incidence of poverty and distress among farm households except from some cases experienced rise in income. The NSSO data on Consumption Expenditure Survey for year 2011-2012 reveals that more than one-fifth of rural households with self-employment in agriculture as their principal occupation were having income less than the poverty line. Vision of raising farmer's income by 2022 is possible to achieve by developing entrepreneurship through planned efforts. The myth that 'entrepreneurs are born and not made, 'no longer holds good. Unaware about the wide open opportunities for entrepreneurial career and increasing unemployed youth in most of the developing countries like India, this is by and large; entrepreneurship has not found the lace in the educational curriculum. In the present era development debate when there are ample opportunities and increasing demand of entrepreneurship, the short supply of entrepreneurs in the society is largely because of entrepreneurship element in the education system. Global changes have created economic opportunities for women who want to own and operate business. Women's economic independence has been recognized as the critical entry point for their integration in mainstream development. Entrepreneurship constitutes the driving force of today's market based economy. It can be a very powerful factor in changing the business environment of a country and its entire industrial sector. Social entrepreneurship can build strong extension activities and group entrepreneurship are yet to be given due attention required for the sake of the country's farmer and sustainable economy alleviation.

Why Agricultural Entrepreneurship:

Traditionally, agriculture is seen as a low-tech industry with limited dynamics dominated by numerous small family firms, which are mostly focused on doing things better rather than doing new things. Over the last decade, this situation has changed dramatically due to economic liberalization, a reduced protection of agricultural markets, and a fast changing, more critical, society. Farmers increasingly have to adapt to the vagaries of the market, changing consumer habits, enhanced environmental regulations, new requirements for product quality, chain management, food safety, sustainability, and so on. Agriculture can be sustainable when it not only produces a lot of high-quality food, but also generates income for poor people. That means rural development: improving transport, development of market facilities and linkages, improving (access to) information, participation of the rural poor in decision making, providing access to credit, and so on.

Indian agriculture sector is dominated by marginal farmers (62%), having land less than 1 ha due to fragmentation of land in India. At the same time the proportion of small, semi medium and medium farmers are 19%, 12% and 6% respectively. While as large farmers constitute only 1% of the total farmers in India. This means that fragmented land is only available with the farmers. The need is to get maximum production from the existing land available with us. To do that the need is to increase the efficiency of the land through various methods or diversify the activities on the farm through various agrienterprises attached to the farm. Agricultural entrepreneurship will thus help in reducing the burden of agriculture, generating employment opportunities for rural youth, controlling migration from rural to urban areas, increasing national income, supporting industrial development in rural areas, reducing the pressure on urban cities etc. and sustainable Development in Relation to Agripreneurship.

Increasing efficiency of the farm: Efficiency of a small piece of land/farm can only be achieved through Nutrient cycling, nitrogen fixation and pest- predator relationship, Reduction in the use of off- farm, external & non- renewable inputs, Improvement in cropping patterns, Soil fertility management, Water conservation, Biodiversity maintenance in and around the field.

Diversifying activities on the farm through establishment of agri enterprises:

The enterprises related to agriculture in which an entrepreneur can invest are called agri enterprises. These enterprises ensure maximum profitability when managed properly and can be used as best medicine for the solution of the various problems which our country is facing today which includes poverty, malnutrition, unemployment etc. Developing entrepreneurs in agriculture will solve all these problems. Asset reforms in respect of land, water, livestock, fisheries, and bio-resources; Support services and inputs like application of frontier technologies; agricultural Biosecurity systems; Supply of good quality seeds and disease free planting material, improving soil fertility and health, and integrated pest management systems; Timely, adequate, and easy reach of institutional credit at reasonable interest rates, and farmer-friendly insurance instruments; Use of Information and Communication Technology (ICT) and setting up of farmers' schools to revitalize agricultural extension; Effective implementation of MSP across the country, development of agricultural market infrastructure, and rural non-farm employment initiatives for farm households; integrated approach for rural energy, etc.

Conclusion

It is quite challenging to increase farmer's income by 2022 but through Development initiatives, Technology, Public-private model, Policy reforms are the supportive tools & by increasing area under fruits and vegetables, irrigation, power supply, quality seed production and advanced agronomic practices, artificial insemination. Livestock as well etc. can strengthen agricultural income sources. Progress of various reforms related to market and land lease are State Subjects. Therefore, it is essential to mobilize State and UTs to own and achieve the goal of raising economy in agrarian sector. If concentrated and well coordinated efforts are made by the Center and all the States and UTs, the country can achieve the goal of doubling farmer's income by 2022. (Report Niti Ayog , 2018). Agripreneurship can be a bright ray of hope and achieving this goal will reduce persistent disparity between farm and non farm income, promote inclusive growth and infuse dynamism in the agriculture sector. Respectable income in the farm sector will also attract youth towards farming profession and ease the pressure on no-farm jobs, which are not growing as per the expectations. It is believed that agripreneurship development will help the economy to leverage the identified strengths and to achieve tremendous growth in primary sector and to contribute for rural development. It helps the economy to achieve self -sustainability in food production. Further, it helps in achieving balanced economic growth. Agripreneurship Development is going to give excellent results at rural level. In this context, it is widely believed that sustainable agribusiness ventures can promote job-led economic growth in rural areas through harnessing science and technology for environmentally sustainable and socio-economic viable economic opportunities. Agri-preneurship in sustainable agriculture like natural farming, organic farming, eco-friendly agriculture etc. has -the potential to transform the face of rural India, the prime driver of our economy. Agriculture can a better positioned as a more profitable economic activity by integrating the same with processing, packaging and storage activities. Agripreneurship is the need of hours to make agriculture a more attractive and profitable venture. It is clear that there is a great scope for entrepreneurship in agriculture and this potentiality can be tapped only by effective management of agri elements such as – soil, seed, water and market needs. An individual with risk bearing capacity and a quest for latest knowledge in agriculture sector can prove to be a right agripreneurs. The agriculture sector has a large potential to contribute to the national income while at the same time providing direct employment and income to the numerically larger and vulnerable section of the society. Agripreneurship is not only an opportunity but also a necessity for improving the production and profitability in agriculture and allied sector.

LEGAL PROFESSION, OPPORTUNITIES AND CHALLENGES

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The Indian legal profession is one of the largest in the world, with over 1.4 million enrolled advocates nationwide. The legal profession, evolving as it has done from colonial India, has undergone a huge transformation since its independence. The efforts of the members of the bar to achieve excellence in all spheres of their practise through stiff competition is not only apparent in their every dealing with newer challenges due to technological and other developments, but also in the recognition earned by them in a globalized world. Historically, the members of the bar have provided leadership at a national as well as international level. The current potential is much higher.

The Advocates Act of 1961 amended and consolidated the law relating to legal practitioners and provided for the constitution of the State Bar Councils and an All-India Bar - the Bar Council of India as its apex body. The Bar Council of India is comprised of the Attorney General of India and the Solicitor General of India as its ex officio members, as well as one member elected from each of the State Bar Councils.

There were two options are available for obtaining the Law degree. After completion of 12th i.e. Five years LLB and after graduation i.e. Three years LLB. After obtaining the Law degree from the recognised university, the law graduates have plenty of opportunities to start their career.

Again, there were two options are available for thelaw graduates to opt their career. 1. Whether they want to go in Public Sector or Private sector. If the law graduates opt to go for public sector then they can go for judiciary i.e lower judiciary and higher judiciary, Assistant Public Prosecutor and Public Prosecutor, Research Scholars at High Court and Supreme Court, Law Officers, Assistant Professor and Professor and Commissioned officers in Army (JAG).

In the same manner, If the law graduates opt to go for private sector then they can go for one of the noble profession i.e. Advocacy. Advocacy is itself a wide area for practice in different-different field. An advocate can be a Senior Advocate, Advocate on Record, Attorney General of India, Solicitor General, Additional Solicitor General, Advocate General, Judges of High Court and Supreme Court through Collegium System, Public Prosecutor appointed by State. Apart from practice, an advocate can be a visiting faculty at Law Colleges and regular Faculty at Private Law Colleges.

Due to liberalisation and globalisation, LPO and KPO is also a good opportunity for law graduates. Corporates always welcome the law graduates for self-regulation of the organisation. Plenty of Law-Firms are in India to provide Legal Services and maintain the highest standard of professionalism. Young and Energetic Law graduates are being short-listed, by Law-Firms, from college campus to provide the good services to its clients.

In nutshell, the legal profession is always a noble profession and looks attractive, but what kind of person would make a great lawyer. Good communication skills are a given - both oral and written. A lawyer must also be fond of reading because you will need to do a fair bit of research to be effective at your job. However, the most important skill that you need to have is logical reasoning. You need to be able to be able to look at matters objectively and come to your own conclusions. If you are smart, presentable and not scared to voice your opinion, Law is definitely a career you should consider.

Judiciary

For those of you with an inclination towards public service and/or the trappings of state authority, the judiciary can be a worthwhile option. Not only is it a way to remain closely connected with the law throughout your professional life, but also one that offers the satisfaction of working for the good of society-an intellectually stimulating profession where you shall command the respect of the common man. There are exams for higher and lower level judiciary for judges in the district and session court. In High Court and Supreme Court, it is through the collegium system.

Research scholar/ Legal assistant (High Court and Supreme Court)

Fresh Law Graduates are appointed against non- gazetted posts generally equivalent to the post of Assistant in the Secretariat, such as Legal Assistants, Legal/Judicial Translators etc.

Law officer/government officer(PSUs)

Persons possessing requisite qualifications are recruited for Indian legal service against various posts– Legal advisors in Department of Legal Affairs and Legislative Counsel in Legislative Department. These officers can reach the level of Secretary to the Government of India with the passage of time according to their suitability.Public sector

undertakings(PSUS) trough CLAT Candidates applying for PG (LLM) programs can also apply to Public Sector Undertakings (PSUs) recruitment via CLAT.

Attorney General

The Attorney General for India is the GOI's chief legal advisor and its primary lawyer in the Supreme Court of India. He is appointed by the country's President as per Article 76 (1) of the Indian Constitution. He holds office during the pleasure of the President. He must be a person qualified to be appointed as a Supreme Court Judge. The Attorney General, like an Advocate General of a State is not supposed to be a political appointee, in spirit, but this is not the case in practice.

Solicitor General

The Solicitor General of India is subordinate to the Attorney General for India. He/She is the second law officer of the country, assists the Attorney General, and is himself/herself assisted by four Additional Solicitors General for India. Currently, the Solicitor General of India is Tushar Mehta. Like the Attorney General for India, the Solicitor General and the Additional Solicitors General advise the Government and appear on behalf of the Union of India in terms of the Law Officers (Terms and Conditions) Rules, 1972.

Professor/ teacher in Government law schools/Colleges

Those with good academic record, particularly holding LL.M, Ph.D degrees or published work of a high standard, can take up jobs in any University or Institute offering law courses to students.

Army (JAG)

They are recruited as commissioned officers in the legal branches of the Indian Army, Navy and Air force. They conduct courts of enquiry and court martial of erring service personnel as per law.

Public Prosecutor

A public prosecutor is a part of the state judiciary or judicial process, who acts as in-charge in case of litigation, appeal and other procedures related to law. The task of a public prosecutor is to assist in the court work by putting all necessary aspects related to the case.

Assistant public prosecutor for District

Section 25 of the Cr. P.C. deals with the appointment of an Assistant public prosecutor in every district for conducting prosecution in the courts of magistrate. Not more than 35 years of age can apply for the post of Assistant public prosecutor. The selection shall be made on the basis of departmental written and viva examination conducted by the respective State Public Service Commission.

Advocacy

The traditional career path is to “practice law” in the courts. But it is essential for any fresh graduate to learn the ropes under a Senior Counsel. To become a lawyer graduates have to clear an exam which is conduct by Bar Council of India. It is held twice in every year. It is an open book exam which is based on analytical skills and basic knowledge of the law. The excitement [about litigation] lies in the fact that you can actually see the result of what you do – when you are an associate in a law firm, copying and pasting standard formats written by someone else, a long time back, and changing names and particulars, ultimately you do not get to see the result – you cannot point at a merger between two business giants and say 'there, I did that'.

Politics

If the behind-the-scenes bit of government doesn't sound great to you, perhaps the front-of-house roles appeal more. Lots of Law graduates go into politics, whether that's as elected officials or in the array of roles supporting politicians, such as election agents. They are the people responsible for ensuring a political campaign doesn't break the law, and it's obvious why a Law graduate might be particularly well-suited to the role. Politicians have to be good and commanding speakers. When they speak, the entire world listens to them be it through Lok Sabha meetings or press conferences. Effective public speaking is required in law too. Lawyers who become advocates have the ability to persuade their points to others while speaking.

Indian legal services (ILS) through UPSC advocate having 10 years of experience

Advocate on Record' is an advocate who has cleared the AOR exam and is entitled under the Order IV of the Supreme Court Rules, 2013, framed under Article 145 of the Constitution to act, as well as to plead for a party in the Supreme Court of India. As per the rules also, no advocate other than an advocate on record shall be entitled to file an appearance or act

for any party in the Supreme Court of India. No advocate other than an advocate on record can appear and plead in any matter unless he is instructed by an advocate on record

Corporate:- law firms / In house council

You may work with a company/corporate entity as an in-house legal counsel, advising on legal matters related to its business. An in-house counsel plays an important role in drafting, vetting and negotiating contracts; ensuring and monitoring compliance with rules and laws; and handling legal disputes.

LPO/ KPO

LPO is a process by which in-house legal departments, law firms and other organizations outsource legal work from geographic areas where it is costly to perform, such as the US or Europe, to those where it can be performed at a significantly decreased cost, primarily India.

Writers /Editors

If one is familiar with the complexities of law and the procedure and is in a position to understand the intricacies of case law and has a flair for writing he/she is fit to be an author of law books / legal commentaries and a proper person to bring out law reports, produce law journals, take up all other journalistic assignments and compile law lexicons.

NGOs

A sizeable number of law school graduates join Non-Governmental Organizations (NGOs) that work for social causes. If you are passionate about socio-legal issues, then this is the right avenue for you. One may work with NGOs and Civil Society Organizations on issues based on environmental protection, gender concerns, caste discrimination, employment, working conditions, marginalization of various sections of the society, etc.

Remarks

Of course, once plenty of opportunities are available, then there are certain challenges as well. Legal profession requires hard work, patience and dedication. Every law graduates should remember three D's i.e. Dedication, Devotion and Determination, to be a successful professional. Legal profession provides everything in life what we can imagine. The very general quote for the advocates is "**SKY IS NOT THE LIMIT**". Last but not least, legal profession opens a door for politics. Most of the politicians in the world are from legal profession and contributed a lot for the development of world as a whole.

VALUE ADDED MAIZE PRODUCTS: CURRENT STATUS AND UTILIZATION

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Maize being an excellent cereal crop ensures better health and food security through the development of value added food products. It is known to be rich in carbohydrates, fats, proteins, antioxidants and some of the important vitamins and minerals. Each part of the maize plant (grains, leaves, stalk, tassel, and cob) has multiple uses. It is utilized to prepare various snack foods, infant foods, baked foods and traditional food items such as ladoo, halwa, kheer, chapati, sev, mathi, pakora and cheela etc. From a subsistence crop, it become a commercial crop as it provides raw material to various agro-based industries. It is used to make value added products such as corn starch, dextrin, corn syrup, corn oil, sorbitol and ethanol etc. Apart from these products, it also have significant application in manufacturing of industrial products such as corn flakes, cake mixes, candies, carbonated beverages and antibiotics etc. Roasted maize kernels are also known to be consumed as coffee substitute. Maize germ contains about 45–50% of oil that is used in cooking, salads and margarine. Maize kernel is preferred in poultry feed because of its easy availability. Corn has many non-food uses such as in the manufacturing of tires, spark plugs, paper products, biodegradable plastics, paper adhesives, cosmetics and tetrahydrofurfuryl alcohol resins etc. It provides ample opportunities to farmers to increase their income and standard of living. Still, there is need to utilize blue, red and purple corn in manufacturing of value added products as these corns have several health benefits due to presence of anthocyanin.

Keywords: Antioxidants, Anthocyanin, Biodegradable, Cereal, Gamma-Tocopherol, Maize

APPLICATION OF MARKER ASSISTED SELECTION FOR SUSTAINABLE PRODUCTION OF RICE

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Rice is one of the most ancient food crops and has been feeding large population of the world, probably more than any other cereal crop. Globally human consumption accounted for 78 per cent of total production of rice, compared with 64 per cent for wheat and 14 per cent for maize. Rice is the staple food for more than half of the world's population (> 3.5 billion people). In asian countries rice accounts for 90 per cent of global rice consumption and exceeding 100 kg per capita annually. Only in Asia, rice ensures the supply of 35-75% calories to more than one third populations. Overall, despite the observed variation in the Asian per capita rice consumption trend, total rice demand in Asia continues to rise. 700 billion more people will have to be fed in the next 30 years, based on the United Nations' 2010 population projections—the Asian population will reach nearly 5 billion by 2035 and 5.15 billion by 2050. Global rice consumption will probably rise from 439 million tonnes (milled rice) in 2010 to 555 million t in 2035 and Asia will account for 67% of the total increase, rising from 388 million tonnes in 2010 to 465 million tonnes in 2035. So, there is need to increase more rice production in order to feed the populated country. However, under unpredictable changing climate the production of rice is adversely affected by various abiotic stresses. The impending climate change is predicted to alter the cropping profiles of the agricultural landscapes, which is attributed to poor adaptation of varieties to various abiotic stresses. Abiotic stresses including drought, high and low temperatures, salinity, submergence, and oxidative stress contribute significantly to reduce crop yield. More than 50% crop damage has been reported due to these stresses worldwide (Li Y *et al.,* 2014). In Asia, submergence, drought and salinity plague tens of millions of rainfed rice lands each year. Prolonged submergence is a major constraint to rice production, affecting over 15 mha in South and South East Asia and causing an annual yield loss of over US$ 600 million.

Crop improvement to develop adaptive varieties and design allied technologies to realize optimal yield by breeding efforts through conventional methods as well as modern molecular techniques has a promise to increase yield as well as decrease crop losses due to various these stresses. Genotypic variation for abiotic stress has been observed in diverse range of rice germplasm including its wild relatives and this variability has been targeted by the breeders in developing stress-tolerant cultivars. Molecular marker technology facilitates the analysis and cataloguing of available germplasm, variability assessment, fingerprinting studies, phylogenetic analysis, development of marker based tagging, marker based selection of desirable genotypes and map based cloning of agronomically important genes etc., (Sumner *et al.,* 1998). The intervention of molecular markers in the breeding programme has opened the scope for gene/quantitative trait loci (QTL) identification and mapping and furthermore with the help of maker-assisted selection the identified QTL could be transferred in several mega varieties of rice. Marker used must be tightly linked to a gene/QTL (<5 cM) and must be polymorphic. Advances in QTL mapping help in the genetic analysis of complex traits and improve selection efficiency with the aid of MAS thereby, making it possible to enrich and improve existing variety. MAS/MABC which are based on pre-mapped single-locus traits, includes pyramiding; MARS which is recombination of favorable alleles from MAB projects to develop optimum genotypes for final testing are the molecular intervention which are useful for sustainable rice production.

To tolerate the submergence, a major quantitative trait locus designated as submergence1 (Sub1) was mapped near the centromere of chromosome 9 in Indica cultivar FR13A which is a highly tolerant rice variety which can survive upto 2 weeks of complete submergence (Xu and Mackill, 1996; Xu *et al.,* 2000). The submergence -1 (Sub1) locus representing a cluster of three ethylene responsive factor (ERF) genes: sub1A, sub1B and sub1C. Before the discovery of Sub 1 gene the farmers who experience flash floods every year cultivate tall and submergence tolerant local varieties that are mostly low yielding in nature. In some cases farmers even have high yielding but submergence susceptible landraces usually suffer from crop failure or massive yield reduction due to occurrence of flash flood. Identification of the SUB1 gene was the entry point for enabled marker assisted selection (MAS) for submergence tolerance. Popular varieties also are known as mega varieties which possessed high yielding and good grain quality was used as the recurrent parent in marker assisted backcrossing (MABC). Rice varieties namely, 'Swarna sub-1' and 'IR64 sub-1' has been developed by the International Rice Research Institute (IRRI), Philippines by introgression of Sub1 locus into widely grown Asian rice cultivar namely, Swarna and IR-64 using marker-assisted selection. IR64 Sub-1 was then used to transfer the Sub- 1 gene in mega rice varieties i.e. HUR 105 and Sarjoo 52. Beyond the Sub 1 varieties, the present day rice breeders paid attention to tolerance to stagnant flooding and tolerance to anaerobic germination under deep water and flash flood during seedling germination respectively. Rice breeding through gene pyramiding approach to develop the rice varieties tolerant to multiple stresses to enhance yield and quality to combat the future challenge of food and nutritional insecurity. Therefore, there is a need to

develop strategies providing long-lasting abiotic stress tolerance over a broad geographic area, promising for sustainable rice production in the future.

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PHYSICOCHEMICAL AND BACTERIOLOGICAL CHARACTERIZATION OF WATER FROM WELLS AND BORE WELLS NEARBY LANDFILL AREA OF THE WASTE DUMPING SITE OF AHMEDNAGAR (M. S.) CITY

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The impact of solid waste disposal on the groundwater can be judge by monitoring the concentration of potential pollutants in the vicinity of the landfill site. In the present study, groundwater quality within the periphery of the landfill site in Burudgaon at Ahmednagar was investigated. Physico-chemical and bacteriological analysis of water samples from 2 bore wells and 4 dug wells was carried out to determine the extent of pollution. The sampling sites around the landfill area were at a distance of 100m, 400m, 500 m, 1km and 2km. The study revealed that the groundwater quality does not confirm to the water quality standards as given by W.H.O. The effect of dumping of municipal solid waste on groundwater is clearly seen as high concentration of pH, EC, alkalinity, total hardness, total dissolved solids, BOD and COD. The MPN values are not in conformity with the W.H.O. standards. The total viable count and the presence of faecal coliform bacteria point towards the anthropogenic origin of the groundwater contamination. Presence of certain bacteria like *Moraxella* Group, *Enterobacter cloacae*, *Achromobactar dentirificans*, *Aeromonas veronii*, *Escherichia coli*, *Klebsiella pneumonia*, *Acinetobactar haemolyticus* and *Acinetobactar lwoffii* indicate the degree of water pollution rendering it unpalatable. Thus, the quality of groundwater in vicinity of the landfill site needs to be monitored on a regular basis. Furthermore, proper solid waste management practices should be employed for dumping of solid wastes.

Keywords: Landfill leachate, municipal solid waste, groundwater quality, microbial contamination.

Introduction

Ground water provides drinking water to the people and it contains over 90% of the fresh water resources, the quality of ground water is of paramount importance (Kurniawan, 2009). Water is said to be polluted when the water body is adversely affected by both the organic and inorganic contaminants (Oliver *et al*., 2011). In recent years the risk of groundwater pollution has become one of the most important environmental concerns, particularly in developing countries, where most of the landfills have been built without any sound engineering design such as engineered liners and leachate interception and collection system (Kurniawan, 2009)). The usual and most neglected cause of water pollution is uncontrolled dumping of municipal solid waste (Igbal and Gupta, 2009).

In developing countries, several unregulated landfills exist adjacent to large cities, releasing harmful contaminants to the underlying aquifer (Singh *et al*., 2009). In India, open dumping of solid waste in low lying areas is practiced in most of the centres which are managed by municipal agencies. In urban areas the groundwater is contaminated due to leachate from municipal solid waste disposal site and in rural areas, leachate from fertilizers used for agricultural purposes has contaminated the groundwater (Eldho, 2001).

Municipal solid waste is a growing menace in present times. Population increase has added the problem many fold (Arneth *et al*. 1989). Landfilling of municipal solid waste is a common waste management practice and one of the cheapest methods for organized waste management in many parts of the world (Longe and Balogun, 2010). Waste materials or the leachates so formed during the course of time may percolate to the ground water table. This may cause the pollution of ground water and ultimately affects the health of local inhabitants. Leachates are formed by slow decomposition of municipal solid waste (Arneth *et al*. 1989). A combination of physical, chemical and microbial processes in the waste, transfers pollutants from the waste material to the percolating water (Christensen and Kjeldsen, 1989). These leachates may run off in the nearby natural water resources such as ponds, lakes and rivers which percolates to ground water causing water pollution (Arneth et.al. 1989).

Supply of adequate fresh water in large quantity to meet the increasing population's demand and maintaining the quality is now a thing of concern (Elinge *et al*. 2011). Hence, contamination of ground water through the infiltration of leachates via the soil and rocks needs to be avoided. Monitoring of the water quality is very important for environmental safety. In a related study it was suggested that, constant natural water analysis of physical and chemical properties including trace of element contents are very important for public health studies (Kot *et al*. 2000). Keeping this in view the present study was undertaken to assess and understand potential contamination of groundwater near municipal solid waste (MSW) dumping site situated at Burudgaon, Ahmednagar.

Material and Methods

Study Area

The study was conducted in Ahmednagar city in Maharashtra State of India. Ahmednagar city is situated between 19°04' N to 19°08' N latitude and 74°44' E to 74°46' E longitude. It is district headquarter with 85.14 sq. km. area and 3,50,859 populations (2011 Census).

Dumping site at Ahmednagar

The landfill site at Burudgaon, is 15 km away from Ahmednagar city. The area of the landfill site is 2000 sq. meters and the waste dumped is 76 metric tons. The waste from different parts of the city is collected with the help of automobile vehicles such as trucks, truck tipper, bell vehicles, container placer, tractor trailer and also by manually operated vehicles such as pulling carts, dust bins and brought to the dumping site and is dumped in irregular fashion.

Satellite Image of Landfill Site

Sample Collection

In an attempt to study the degree of groundwater contamination 6 sampling sites (viz., dug well and bore well) near the landfill site were selected from where the water samples were taken. The samples were collected in one litre capacity sterile polythene bottles. Prior to collection, bottles were thoroughly washed and rinsed with sample to avoid any possible contamination during bottling. The sampling site details including location, distance from landfill site and type is given in Table 1. After sampling, the samples were marked according to their source and location and immediately transferred to the laboratory and stored at 4ºC in the refrigerator until further analysis.

Table 1. Location and Distance of Groundwater Sampling Sites

Sampling site	Sample Source	Distance from dumping site	Direction	Depth
1.	Bore well	1 km	South	150 ft.
2.	Well	2 km	South	48 ft.
3.	Well	400 m.	East	54 ft.
4.	Well	100 m.	North	48 ft.
5.	Bore well	500 m.	North-west	250 ft.
6.	Well	500 m.	West	42 ft.

Physico-chemical Analysis

Various physico-chemical parameters examined and estimated in groundwater samples includes pH, EC, turbidity, alkalinity, TDS, total hardness, calcium, magnesium, chlorides, sulphates, phosphates, nitrates and potassium. All these parameters were estimated according to the standard analytical procedures given by APHA (1998). Along with this BOD, COD and MPN were also estimated. Changes occur in coliform and E. coli content of the water on storage. Hence, prolonged storage was avoided and water samples were analysed within 2 hours of sample collection for total viable count and the bacteria were isolated.

Isolation and biochemical characterisation of bacteria

The total viable count (TVC) of the water sample was recorded by serial dilution and pour plate method using nutrient agar. Discrete colonies which developed were counted and the average for duplicate cultures was recorded as total viable count of bacteria in the sample. MacConkeys agar was used for the culture of enteric bacteria. Representative colonies of different morphological types were further sub-cultured on nutrient agar slants. The isolated bacteria were characterized morphologically and biochemically as described in the Bergey's Manual of Systematic Bacteriology, (8th Edn.).

Results and Discussion

Water quality characteristics may be classified into three broad categories: physical, chemical and biological. Hence, the impact of municipal solid waste landfill site on the ground water quality was investigated in the present study. The physico-chemical and bacteriological analysis of the groundwater samples gave varied results which are given in Table 2.

Table 2. Physico-chemical and microbial parameters of groundwater samples

Parameter	Unit	S1	S2	S3	S4	S5	S6
EC	$mScm^{-1}$	1.58	1.82	3.69	5.16	1.80	1.6
Turbidity	NTU	0.40	0.93	0.84	2.12	3.80	0.09
Alkalinity	mg/l	250	310	300	380	480	370
TDS	mg/l	2445	691	638	4644	1032	2940
Total Hardness	mg/l	940	450	460	1870	590	1340
Calcium	mg/l	9.40	3.40	4.60	12.40	22.40	5.70
Magnesium	mg/l	6.40	4.20	3.80	4.60	24.12	5.15
Chlorides	mg/l	8.13	4.80	9.20	13.20	11.36	9.20
Sulphates	mg/l	11.10	0.92	3.81	19.20	9.19	1.92
Phosphates	mg/l	0.19	0.23	0.18	0.16	0.21	0.20
Nitrates	mg/l	11.23	9.21	27.81	21.19	13.3	7.21
Potassium	mg/l	0.10	0.11	0.09	0.18	0.13	0.09
BOD	mg/l	25	24	32	33	35	23
COD	mg/l	98	96	102	105	94	109
MPN	c/100ml	All samples have coliform count above 16/100 ml					
Total Viable Count	TVC/ml	90	200	1365	392	560	6960

pH is one of the enlightening attributes of water quality. Since biological activities are pH specific, determination of pH is very important. In the present study, pH of the groundwater samples was in the range of 9.2 (S6) to 9.9 (S3) which is not desirable for drinking purpose. Higher pH suggests alkaline nature of the water samples, which may be due to the availability of nutrients. Maximum pH value of 9.9 exceeds the maximum permissible limit of WHO and Ministry of Work and Housing was from the sampling site nearest to the landfill site. Electrical conductivity (EC) measures the salinity and is indicative of the ability of the sample to carry an electric current. The EC of groundwater samples was in the range of 1.58 mScm-1 (S1) to 5.16 mScm-1 (S4). High EC (i.e. > 1mScm-1) of water indicates presence of higher soluble salts in the water.

Presence of calcium in water imparts hardness to water. In the present study the calcium content in groundwater samples was found to be in the range of 3.40 mg/l (S2) to 22.40 mg/l (S5). Maximum calcium content was found in a 250 ft. deep bore well which was 500 meters away from the landfill site. Calcium content was found to be well below the highest desirable limit given by WHO Magnesium along with calcium imparts hardness to water. Magnesium content in groundwater samples was found to be in the range of 3.80 mg/l (S3) to 24.12 mg/l (S5), which was within highest desirable limit of 30 mg/l given by WHO Chloride content was found to be in the range of 4.80 mg/l (S2) to 13.20 mg/l (S4), which was below the desirable limit of 200 mg/l given by WHO Sulphates are widely distributed in nature and natural waters. Sulphate content was found to be in the range of 0.92 mg/l (S2) to 19.20 mg/l (S4), which was below the desirable limit of 200 mg/l given by WHO.

It was observed that the sulphate content in the groundwater samples increased as the distance of sampling site from the landfill site decreased. Higher phosphate content in water leads to algal blooms. In the present study the phosphate content was found to be in the range of 0.16 mg/l (S4) to 0.23 mg/l (S2). Nitrate in the groundwater samples was found to be in the range of 7.21 mg/l (S6) to 27.81 mg/l (S3). Nitrate content was within the desirable limit of 45 mg/l given by W.H.O. at all the sampling sites. Calcium and magnesium ions in water impart hardness to water. Total hardness was found to be in the range of 450 mg/l (S2) to 1870 mg/l (S4). The total hardness exceeds the permissible limit of 500 mg/l given by WHO at sampling site S1, S4, S5 and S6. According to WHO highest desirable turbidity of water should be 5.0 N.T.U. in the present study turbidity of groundwater was found to be in the range of 0.09 N.T.U. (S6) to 3.80 N.T.U. (S5). It was found to be below the desirable limit given by WHO but was above the acceptable limit of 2.5 N.T.U. given by Ministry of work and housing (1975) at S6 which was 3.80 N.T.U. Total dissolved solids were found to be in the range of 638 mg/l (S3) to 4644 mg/l (S4). They were found to much above the maximum permissible limit of 1500 mg/l given by W.H.O. Mor et al. (2006) has reported the effect of municipal solid waste disposal on groundwater around a Gazipur landfill site at Delhi. The moderately high concentrations of Cl−, NO−3, SO4−2, NH4+, Phenol, Fe, Zn and COD in groundwater, indicates that its quality is being significantly affected by leachate percolation.

BOD points towards the amount of organic matter present in the water. As per Water Quality Criteria for Freshwater Classification (CPCB, 1979) 2mg/l of BOD is ideal. In the present study the BOD was found to be in the range of 23 mg/l (S6) to 35 mg/l (S4), which was very high indicating presence of organic matter and rendering the water to be not potable. COD is used to measure the amount of organic compounds in water. COD is a measure of total amount of oxygen required to oxidize all organic material into CO2 and water. It is observed that COD are always greater than BOD, which happens to be true in the present study. The COD was found to be in the range of 94 mg/l (S5) to 109 mg/l at (S6).

Similar observations are made by many researchers (Jeevanrao and Shantaram, 1995) who found that total hardness, alkalinity, BOD and COD were beyond the prescribed limit in the groundwater at both Amber pet and Golkonda solid waste landfill sites at Hyderabad. The effects of dumping activity on groundwater appeared most clearly as high concentrations of total dissolved solids, electrical conductivity, total hardness, chlorides, chemical oxygen demand, nitrates and sulphates. Leachate collected from the site showed presence of heavy metals.

The microbial analysis of the groundwater samples indicates that none of the water samples analysed met the WHO guideline limit. The MPN results showed that the Coliform count of the groundwater samples was found to be > 16/ 100 ml at all the sampling sites, which is above the desirable limit of 1/100 ml as per W.H.O and BIS standards. It is to be noted that the microbial count in the groundwater samples was variable. Fig. 15 shows the total viable count of the groundwater samples, which was found to be in the range of 90/ml (S1) to 6960/ml at (S6). The results imply that the groundwater sites around the municipal landfill site are not safe for drinking purpose in line with the microbial standard.

Depending upon their difference in colony characteristics 8 different bacteria was isolated. Gram staining was performed to observe the cellular morphology and gram nature of the bacteria. It was observed that all the isolated strains were gram negative rod shape bacteria. The results of biochemical test of the isolated bacteria are given in Table 3.

Table 3: Biochemical characteristics of bacteria isolated from groundwater sample

Test	**Amount /Well (mg)**	**I1***	**I2***	**I3***	**I4***	**I5***	**I6***	**I7***	**I8***
Ala-Phe-Pro-Arylamidase	0.03	-	-	-	+	+	-	-	-
ADONITOL	0.18	-	-	-	-	-	-	-	-
L-Pyrrolydonyl-ARYLAMIDASE	0.01	-	-	+	-	-	+	-	-
L-ARABITOL	0.30	-	-	-	-	-	-	-	-
D-CELLOBIOSE	0.30	-	+	-	+	-	+	-	-
BETA-GALACTOSIDASE	0.03	-	+	-	+	+	+	-	-
H2S PRODUCTION	0.00	-	-	-	-	-	-	-	-
BETA-N-ACETYL-GLUCOSAMINIDASE	0.04	+	+	-	+	-	+	-	-
GLUTAMYL Arylamidase pNA	0.03	+	-	+	+	-	-	+	-
D-GLUCOSE	0.30	-	+	-	+	+	+	-	-
GAMMA-GLUTAMYL-TRANSFERASE	0.02	-	+	-	+	-	+	-	-
FERMENTATION \GLUCOSE	0.45	-	+	-	+	+	+	-	-
BETA-GLUCOSIDASE	0.03	-	+	-	-	-	+	-	-
D-MALTOSE	0.30	-	+	-	+	+	+	-	-
D-MANNITOL	0.18	-	+	-	+	+	+	-	-

D-MANNOSE	0.30	-	+	-	+	+	+	-	-
BETA-XYLOSIDASE	0.03	-	+	-	-	-	+	-	-
BETA-Alanine arylamidase pNA	0.01	-	-	-	-	-	-	-	-
L-Proline Arylamidase	0.02	-	+	+	+	-	+	-	+
LIPASE	0.01	+	-	+	+	-	-	+	+
PALATINOSE	0.30	-	+	-	+	-	+	-	-
Tyrosine ARYLAMIDASE	0.02	+	+	+	+	+	+	+	+
UREASE	0.15	-	+	-	-	-	+	-	-
D-SORBITOL	0.18	-	+	-	-	+	+	-	-
SACCHAROSE\SUCROSE	0.30	-	+	-	+	+	+	-	-
D-TAGATOSE	0.30	-	-	-	-	-	-	-	-
D-TREHALOSE	0.30	-	+	-	+	+	+	-	-
CITRATE(SODIUM)	0.05	-	+	-	-	-	+	-	+
MALONATE	0.15	-	+	-	-	-	+	-	-
5-KETO-D-GLUCONATE	0.30	-	-	-	-	-	+	-	-
L-LACTATE alkalinisation	0.15	-	+	+	-	+	+	-	+
ALPHA-GLUCOSIDASE	0.03	-	-	-	-	-	-	-	-
SUCCINATE-alkalinisation	0.15	+	+	+	+	+	+	+	+
Beta-N-ACETYL-GALACTOSAMINIDASE	0.03	-	+	-	-	-	-	-	-
ALPHA-GALACTOSIDASE	0.03	-	+	-	-	+	+	-	-
PHOSPHATASE	0.05	-	-	-	-	-	+	-	-
Glycine ARYLAMIDASE	0.01	-	+	-	+	-	+	-	-
ORNITHINE DECARBIXYLASE	0.30	-	+	-	-	+	-	-	-
LYSINE DECARBOXYLASE	0.15	-	-	-	-	+	+	-	-
DECARBOXYLASE BASE	NA								
L-HISTIDINE assimilation	0.08	-	-	-	-	-	+	+	+
COURMARATE	0.12	-	-	-	-	+	-	+	+
BETA-GLUCORONIDASE	0.03	-	-	-	-	+	-	-	-
O/129RESISTANCE(comp. vibrio)	0.01	-	+	-	+	+	+	-	-
GLU-GLY-ARG-ARYLAMIDASE	0.05	-	-	-	+	-	-	-	-
L-MALATE assimilation	0.04	-	+	-	-	-	-	-	+
ELLMAN	0.03	-	-	-	+	-	-	-	-
L-LACTATE assimilation	0.18	-	-	-	-	-	-	-	+

The bacteria isolated and identified were *Moraxella* Group (I1), *Enterobacter cloacae* (I2), *Achromobactar dentirificans* (I3), *Aeromonas veronii* (I4), *Escherichia coli* (I5), *Klebsiella pneumonia* (I6), *Acinetobactar haemolyticus* (I7) and *Acinetobactar lwoffii* (I8). Presence of these bacteria suggests relatively recent faecal, sewage, soil or rotten plants contamination (Grisey et. al., 2010. The leachate may contain microbes some of which may be opportunistic pathogens and that these microbes are capable of producing toxins of public health concern. Microorganisms contaminating water resources via leachate percolation are a potential threat to aquatic ecosystems and public health.

The characterization and identification tests revealed the presence of the diverse organisms in the groundwater samples within the periphery of the landfill site. The frequency of appearance reveals that *Klebsiella pneumonia* was the highest prevalent bacterium which was isolated from all the sites except S4, followed by *E coli* isolated from three sites namely S3, S4 and S5. Increased population of bacteria such as *E. coli*, *Klebsiella pneumonia* have been reported from landfill leachate sites (Donnelly and Scarpino, 1984; Bakare *et al*. 2003). Other isolates like *Moraxella* spp., which was found at S3, *Enterobactercloacae* and *Achromobacter* were found at S4, *Aeromonas veronaii* was found at S5 and *Acinetobacter haemolyticus* and *Acinetobacter lwoffii* were found at S6.

The study points towards the possibility contamination of water bodies from the waste dumping site due to leachate percolation. Negative effect of Leachate percolation was seen on water quality parameters of the dug well as well as the bore well samples. pH and alkalinity of the samples were above the desirable limits. Total hardness and total dissolved solids were above the desirable as well as permissible limits at some sites. The BOD and COD of the samples were found to be very high. Presence of microorganism of public health implication was observed in the groundwater samples.

Conclusion

The study reveals the effect of dumping municipal solid waste in the study area due to which the quality of ground water within the periphery of the landfill site is deteriorating. Physical, Chemical and bacteriological tests of water quality are inter-related and must be considered together. The groundwater samples from the landfill site were analysed for the physico-chemical properties. Results show that some parameters exceed the desirable as well as permissible limit as prescribed by WHO., which confirm that groundwater samples within the periphery of landfill site is highly polluted and unfit for human consumption.

The MPN results confirmed the presence of faecal coliforms (>16) which indicates the presence of bacteria that can cause illness in human. The total viable count of the groundwater samples point towards the degree of groundwater contamination.

Presence of harmful bacteria like *Escherichia coli*, *Enterobacter cloacae*, *Achromobacter dentrificans*, *Aeromonas veronii*, *Moraxella* spp., *Acinetobacter haemolyticus*, *Klebsiella pnuemoniae* indicate the extent of pollution. Certain chemicals provide favourable conditions for the propagation of the above organisms. The biochemical tests confirmed the presence of bacteria found in intestines of humans and mammals which belong to the Enterobacteriacae family. Leachate is the prime factor for the propagation of these micro-organisms. Leachate generated from municipal solid waste landfill site affects the groundwater quality in the adjacent areas through percolation in the subsoil. Therefore, the quality of the groundwater needs to be regularly monitored and improved with adequate treatment.

Thus the need of the hour is to prevent further contamination of groundwater by proper remedial measures and developing a properly managed landfill site, so as to protect the surrounding environment and prevent health hazards to the people living in close proximity of the landfill site.

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Official Website of Ahmednagar District - www.amc.gov.in

http//www.wikimapia.org

Central Pollution Control Board Website - www.cpcb.nic.in

NAVGRAH VATIKA AND ITS IMPORTANCE

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In the current scenario, people are becoming more and more aware of the environmental problems and are actively trying to reduce their impacts on the environment by planting plants around and purchasing green products and moving towards green life style. With the emergence of large member of environmental problems all over the world there is a need to preserve and protect earths natural environment and finite resources. The forest and tree cover in state of Uttar Pradesh is around 9.26 per cent which is much below the national average of 23.4 per cent (Rupak Dey). Trees and plants help in maintaining oxygen balance, the important gas that enable us to breath. Better care of plants and trees are taken when they are related with religion.

Navgrah vatika represent the nine planets and they are used in religious ceremony. These plants also hold medicinal value. Navgrah vatika means garden of nine planets represented by bushes, grass and trees. According to Indian astrology the nine planets have effect on life on earth. These plants and trees of Navgrah vatika are planted in a particular direction to get the benefit of nine planets. They are a source of income and also keep the environment clean and green. Trees and plants help in maintaining oxygen balance the most important gas that enables us to breath. Plants maintain the ozone layer that helps protect earth life from damaging.

NAVGRAHA VANAM (PLANET TREES)

No	Star	Botanical Name	Sanskrit Name	Common Name
1.	Sun	Calotropis gigantea	Arka	Aak
2.	Moon	Butea monosperma	Palash	Dhak
3.	Mars	Acacia catechu	Khadira	Khair
4.	Mercury	Achyranthes aspera	Apamarga	Latjeera
5.	Jupiter	Ficus religiosa	Ashwatha	Peepal
6.	Venus	Ficus racemosa	Udumbara	Goolar
7.	Saturn	Prosopis cineraria	Shamee	Shami
8.	Rahu	Cynodon dactylon	Doorva	Doob
9.	Ketu	Imperata cylindrica	Darbhah	Kush

There are many advantages of having navgrah vatika near the home surrounding. According to Indian astrology the planets have importance and different solutions are catered accordingly to reduce the negative energy. It is believed that the planets have both negative and positive effect. Different plants are used to reduce the negatively of planets. According to description in Indian following names of plants Aak, Dhak, Khair, Latjira, Pepal, Gular, Shani, duruva and Khus are navgrah plants. Navgrah vatika should be established near the houses to obtain navgrah plants.

Where to make Navgrah Vatika?

It will not only increase the beauty of area but also increase the energy of vastu. It can be developed at:-

- Hotels
- Industrial areas
- Bungalows
- Farm Houses
- Universities
- Government garden
- Public parks

Directions for making Navgrah Vatika

Naugrah vatika can be prepared on a small piece of land near the house.

- Terraces
- Birds centuries

Advantages of Navgrah vatika

- Navgrah vatika is very important source of energy. As these plants represents different planets i.e. represent different celestial forces so this vatika is used to get the power of navgrah.
- The atmosphere surrounding will have less pollution with fresh environment and air.
- The birds will build habitat on the trees surrounding the home which will create lively and positive vibrates.
- The plants will be a source of shadow surrounding the house.
- Certainty of wood will be possible for religious purpose of botanical plants.
- The dry wood of the plants can be used for different purposes.
- Navgrah vatika creats positive energy.
- It gives person health and wealth.
- It protects from various disease.
- Removes Vastu defects.
- It gives fresh environment.
- Some of the planets have medicinal value.
- It adds aesthetic beauty to the surrounding.

It is well known fact that plants give flowers, oxygen, perfumes, medicine, fruits, vegetables yet were forgetting their importance. They add beauty, relax our mind and body, give perfumes and reduce many problems of our messy life. We need to make people realize the importance of Navgrah vatika comprising of bushes, trees and plants for healthy and happy living.

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एक दृष्टिपत्र –बदलते विश्व परिवेश में सतत कृषि विकास

अवधेश कुमार सिंह
अध्यक्ष
रायल विज्ञान सेवित सामाजिक–सांस्कृतिक संस्था, नई दिल्ली

बदलते परिवेश में कृषि का सतत विकास विश्व के लिए चुनौती है। यह चुनौती उन देशों के लिए और बड़ी है जिनकी जनसंख्या ज्यादा है और संसाधन सीमित। खाद्य उत्पादन का दबाव स्वाभाविक हो जाता है। विश्व की 7.7 अरब जनसंख्या से 17.71% लोग भारत में निवास करते हैं। भारत 1.37 अरब जनसंख्या के साथ केवल चीन से दूसरे नंबर पर है।जनसंख्या की वार्षिक वृद्धि चीन में 0.43% और भारत में 1.02% है। इस तरह भारत बहुत जल्ददुनिया का सबसे बड़ी जनसंख्या वाला देश हो जायेगा। इसके पास मात्र 2% जमीन तथा 4% पानी का हिस्सा है। पानी के इस हिस्से का 77% आज भी कृषि में प्रयोग हो रहा है, अतएव इसमें वृद्धि की संभावना बहुत कम है। सतत विकास के लिए तीन आयामों,सामाजिक, आर्थिक और पर्यावरण,की सीमाओं में जल मौलिक है। समग्रता में विकास हेतु खाद्य, ऊर्जा, स्वास्थ्य और व्यापारिक संबंधों के परिप्रेक्ष्य में पर्यावरण और जल आवश्यकता बन जाते हैं। इस चुनौती पर चिंतन हेतु रायल विज्ञान सेवित सामाजिक–सांस्कृतिक संस्था (RASSA) और पर्यावरण और सतत विकास संस्थान, (IESD) बनारस हिन्दू विश्वविद्यालय द्वारा संयुक्त रूप से आयोजितसंगोष्ठी का विषय बहुत प्रासंगिक तथा आवश्यक है,क्योंकि एक तरफ कृषि का सतत विकास जरूरी है तो दूसरी तरफ पर्यावरण को बनाये और बचाये रखने की चुनौती। आशा है कि यह सेमिनार हमें वह राह देगा जिससे दोनों चुनौतियों का सफलता पूर्वक निर्वाह हो सकेगा।

रासा एक बहुआयामी प्रॉफेशनल राष्ट्रीय समिति है। यह विज्ञान सम्मत दृष्टिकोण से सामाजिक और सांस्कृतिक उन्नयन के लिए कार्य करती है। इसका उद्देश्य है मानव और समाज का सतत विकास। इस उद्देश्य में कृषि का सतत विकास अंतर्निहित है। समिति का मानना है कि समाज में शैक्षिक और वैज्ञानिक उन्नति से ही आर्थिक संपन्नता संभव है। समिति प्रतिभा और विलक्षणता को उभारने, विविधताओं तथा प्राकृतिक संसाधनों के संरक्षण, संवर्धन और प्रबंधन, तथा शिक्षा, स्वास्थ्य और उद्यमशीलता के विकास के लिए समर्पित है। इसके मूल्योंऔर मान्यताओं में विश्वासरखने वाला कोई भी नागरिक इसका सदस्य हो सकता है। समिति का मुख्य कार्यालय दिल्ली में तथा आंचलिक कार्यालय लखनऊ, वाराणसीऔर जम्मू में कार्य कर रहे हैं। कई राज्यों में आंचलिक कार्यालय तथा बनारस में उद्यमिता विकास प्रशिक्षण केंद्र खोला जाना प्रस्तावित है। रासा के दो प्रकाशन "रासा जर्नल ऑफ साइन्स फॉर सोसाइटी" और दूसरा "राजर्षि संदेश"सेवा में समर्पित हैं। रासा ने कुछ गाँव चुने हैं, जिनमें विकास कार्य चल रहा है। यह आर्थिक तौर पर कमजोर बच्चों की फीस में अनुदान भी दे रही है। समिति ने चकिया में वन क्षेत्र में छोटे बच्चों को स्कूल भेजने की तैयारी में सहयोग करती है। गाँव–गाँव में इस तरह के काम को आगे बढ़ाने का प्लान है। साथ ही विश्वविद्यालय के शिक्षकों द्वारा माध्यमिक विद्यालयों मेंप्रोत्साहन लेक्चर कराने का प्लान है, जिससे बच्चे आसानी से अपने लिए आगे की पढ़ाई का रास्ता चुन सकें। रासा के अन्य कार्यक्रम हैं;किसानों को आपसी सहयोग तथा संगठन के लिए प्रोत्साहित करना, उचित राय देना कि वे अपने उत्पाद का प्रसंस्करण कर सीधे उपभोक्ता तक पहुँचा पायें ताकि उन्हें उचित मूल्य मिले। यह गाँव और शहर में समितियों के माध्यम से संभव है।इसका मानना है कि इन समितियों के माध्यम से खाद्य सामग्री गाँव से शहर में और शिक्षा, स्वास्थ्य तथा तकनीकी सेवा शहर से गाँव में पहुँचे तो दोनों जगहों में सही विकास संभव है। यह कार्य बहुत आसान नहीं है, लेकिन आपसी सहभागिता तथा खुद आगे बढ़ने की मंशा से पैदा होती उद्यमिता के नाते यह संभव है। रासा एक स्वच्छ, स्वस्थ, शिक्षित, समृद्ध, सुखी और सुरक्षित ग्रामीण परिवेश की परिकल्पना के साथ प्रयत्नशील है।

आज के सेमिनार के विषय की उपयोगिता बिना ज्यादा कहे भी दिखाई देती है। थोड़ा पीछे और आज की स्थिति देखें तो कृषि की प्रगति और उपलब्धि हिमालय की तरह ऊँची दिखाई देती है। जहाँ सन 1951 में 36 करोड़ जनसंख्या के लिए खाने भर अनाज पैदा नहीं हो पाता था, वहाँ आज 136 करोड़ के लिए देश आत्मनिर्भर है और निर्यात भी करता है। इन सत्तर सालों में जनसंख्या साढ़े चार गुना बढ़ी,लेकिन इसी अवधि में खाद्यान् का उत्पादन 51 मिलियन टन से बढ़कर 285 मिलियन टन हो गया। साथ ही फल,सब्जी, दूध, माँस आदि का उत्पादन भी कई गुना बढ़ा है। इस

प्रगति का पूरा श्रेय कृषि वैज्ञानिकों, किसानों और तकनीकी प्रसार प्रणाली को जाता है। आने वाले समय में उत्पादन और बढ़ाने की जरूरत है। खेती के क्षेत्रफल में बड़ा बदलाव हो नहीं सकता। पानी की उपलब्धता सीमित है। इसलिए यह जरूरी हो गया है कि फसलों का उत्पादन क्षेत्रीय जलवायु के मुताबिक हो तथा जिन क्षेत्रों में उत्पादकता कम है,वहाँ ज्यादा ध्यान दिया जाय। साथ ही सोचने का विषय है कि क्या पैदावार बढ़ने के बाद किसान और ग्रामीण अंचल उतना खुश,सुखी और संतुष्ट है, जितना होना चाहिए? नहीं तो क्यों नहीं है?आगे की राह क्या है? क्या असंतुष्ट और आर्थिक रुप से परेशान किसान से हम आशा कर सकते हैं कि हमें और ज्यादा पैदा करके देगा?उसने तो अब तक देखा है कि उसकी पैदावार और गरीबी दोनों साथ बढ़ी है।संबंधित प्रश्न और सुझाव जो मेरे मन में आते हैं वे निम्नवत विचार हेतु प्रस्तुत हैं;

1. सन 1951 की कुल 36.11 करोड़ जनसंख्या में से 29.87 करोड़ (82.72%) लोग गाँव में और 6.24 करोड़ (17. 28%) लोग शहर में रहते थे। आज जनसंख्या136 करोड़ हो गई। इसमें से गाँव में 90.50 करोड़ (67%) और शहर में 44.50 करोड़ (33%) लोग रहते हैं। 2001 से 2017 के बीच शहर और गाँव दोनों में लगभग 16–16 करोड़ की बराबर वृद्धि हुई। यह गाँव से शहर की तरफ पलायन का नतीजा है। पहले के दशकों में 5–7% बढ़ने वाली जनसंख्या की वृद्धि दर 15–18% हो गई। जनसंख्या वृद्धि और गाँव से पलायन दोनों बड़ी समस्या है। गाँव और शहर दोनों की हालत खराब है।जब तक गाँव खुशहाल और लोग संतुष्ट नहीं होंगे, बच्चों की शिक्षा और विकास का मौका नहीं होगा, इस परिस्थिति से निकल पाना मुश्किल होता जाएगा।

2. पैदावार बढ़ाने के क्रम में हम बहुत कुछ नुकसान भी कर बैठे हैं। मिट्टी, पानी और आबोहवासब खराब हो गई है। पीने का पानी गाँव तक में खराब है। खाने के अन्न, दूध, पानी, फल,सब्जी,अंडे, माँस, मछली सब रसायनों की अधिकता से प्रभावित हैं। इसके नाते शरीर पर होते प्रभाव और दवा खर्च परेशान करने के लिए काफी हैं।

3. कृषि में प्रयुक्त होने वालेआदानों जैसे खाद, बीज और पेस्टिसाइड वगैरह की गुणवत्ता प्रश्नों के घेरे में है तथा उसमें सुधार की सख्त जरूरत है।

4. मौसम परिवर्तन काफी परेशानी का सबब है। इस साल कई राज्यों में अतिवृष्टि तथा कुछ जगहों में सूखे की स्थिति और फिर सितंबर में इतनी ज्यादा वर्षा अधिक जनसंख्या वाले देश के लिए गंभीर बातें हैं।

5. पानी की कमी और खेती में जल–साँची वाली विधियों का उपयोग अत्यंत आवश्यक है।

6. हमारे किसानों की जोत छोटी है। उपयुक्त यांत्रिकीकरण की रह सुझानी होगी।

7. हमारी खाद्य–आत्मनिर्भरता बड़े लंबे परिश्रम का नतीजा है। एक सीजन के पैदावार में भी होने वाला नुकसान सीधे तौर पर किसान तथा देश दोनों पर बहुत खराब असर ला सकता है। आकस्मिक तौर पर संकट के समय प्लान के साथ तैयार रहना होगा।

8. कृषि शोध तथा कृषि विकास कार्यक्रम में सावधानी और निरंतरता की बहुत जरूरत है। इससे ध्यान हटना कुछ समय के लिए अच्छा दिखाई पड़ सकता है, लेकिन इसकी निरंतरता जरूरी है।

ये परिस्थितियाँ चिंतन माँगती हैं कि आगे की राह क्या हो कि समग्र, संतुलित और सतत विकास हो। कृषि शोध में पहले से भी ज्यादा गंभीरता की जरूरत है। जरूरत है कि समझदार लोग ग्रामीण इलाक़ों में किसानों के बीच काम करें। ग्रामीणों को संगठित होकर कार्य करने की प्रेरणा और प्रोत्साहन दें, ताकि उनके उत्पाद वहीं प्रसंस्कृत होकर उपभोक्ता तक पहुँचे और उनकी आमदनी बढ़े। जरूरत है कि विश्वविद्यालयों में पढ़ाई के स्तर में समानता और एकरसता आये और विभिन्न विषयों के कृषि वैज्ञानिक आपस में तथा पर्यावरण वैज्ञानिकों के साथ मिलकर काम करें ताकि नई विकसित तकनीकी कृषि के सतत विकास में सहयोगी हो जिसपर चलकर ग्रामीण परिवेश समृद्ध, खुशहाल और सुखी होगा और किसान देश के विकास में ज्यादा मनोयोग से सहयोग कर सकेगा।

THEME 1: CLIMATE SMART CROP AND LIVESTOCK PRODUCTION TECHNOLOGIES

CSPT: 1

ANTIBIOSIS EFFECT OF DIFFERENT MAIZE GERMPLASM ON THE BIOLOGY OF PINK STEM BORER, *SESAMIAINFERENS* (WALKER)

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Antibiosis is the adverse effect of the host plant on the biology (survival, development and reproduction) of the insects and their progeny is due to the biochemical and biophysical factors present in it. The present investigation was aimed to find out the antibiosis effect of twenty different maize germplasm on the biological attributes of pink stem borer, *Sesamiainferens*. Observations were recorded on the leaf injury rating (LIR) and biological attributes viz., larval weight and survival, pupal weight, percent pupation, larval and pupal period, adult emergence, adult female fecundity, egg hatching and growth index. Leaf injury rating showed that V-341 and WP-8 were moderately resistant germplasm whereas the rest of all the germplasm were susceptible. Among all the germplasm, WP-21, HKI-193-1 and E-63 showed antibiosis effect in terms of reduced larval and pupal weight, low larval survival, prolonged larval and pupal duration, less percent pupation and adult emergence, reduced fecundity and egg hatching and lower growth index of *S. inferens*. Thus, these germplasm were found least susceptible. Maize germplasm DC-2, HKI-193-2 and E-62 favoured the growth and development of *S. inferens* in terms of all biological parameters. Hence these germplasm were found highly susceptible. Screening parameters viz., larval and pupal weight, larval survival, leaf injury rating, percent pupation, larval and pupal period, adult emergence, fecundity, egg hatching and growth index can be comprehensively used to get a cue regarding the germplasm susceptibility level against *S. inferens*.

Keywords: Antibiosis, leaf injury rating, Maize germplasm susceptibility, Sesamiainferens.

CSPT: 2

SCANNING ELECTRON MICROSCOPY OF *TRICHODERMA* ISOLATES FOR ITS MYCOPARASITISM ACTIVITY AND EVALUATION OF ITS ENZYMATIC ACTIVITIES AGAINST *FUSARIUM OXYSPORUM* F. SP. *LENTIS*

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Lentil rhizosphere samples were collected from different environmental niche ofIndia, and 6isolates of *Trichoderma* were isolated and identified. Among 6 isolates, 2 isolates were identified as *Trichoderma harzianum*, 2 isolates were identified as *Trichoderma asperellum,* 1 isolate was identified as *Trichoderma viride* and remaining 1 isolate was identified as*Trichoderma hamatum*. These isolates were identified morphologically and molecularly by using ITS primers amplification by polymerase chain reaction and submitted to NCBI.All identified isolates with isolate 5595 collected from ITCC, New Delhi, were screened for their antagonisticactivity using dual culture method.*Trichoderma* isolates (ThL-4, TaL-2 and 5595) were found to be more potent antagonist against *Fusarium oxysporum*f. sp. *Lentis*. *Trichoderma* isolates (ThL-4, TaL-2 and 5595) were selected for further study of biocontrol potential and production of cell wall-degrading enzymes. The mechanism of action of *Trichoderma* spp. (5593, TaL-2 and ThL-4) was observed microscopically by using Scanning Electron Microscope (SEM) and found coiling and

super coiling structure of *Trichoderma* mycelium over *Fusarium* mycelium for controlling its growth. These selected *Trichoderma* isolateswere inoculated in media containing basal media and mycelia of fungal pathogens for cell wall-degrading enzyme production. It was found that *T. harzianum* secretes two major cell wall-degrading enzymes, i.e., chitinase and β-glucanase. Optimum production of both enzymes were found at 96 hrsof incubation. The role of *Trichoderma* isolates (ThL-4, TaL-2 and 5595) in inducing defense enzymes (Peroxidase, Polyphenol Oxidase and Superoxidase dismutase) in lentil exposed to pathogen*Fusarium oxysporum* f. sp. *Lentis*were observed.It was found that the biocontrol agent, *T. harzianum*(ThL-4 and 5595) induced higher levels of defense enzymes in lentil during pathogenesis by *F. oxysporum*. Therefore, it was concluded that plant defense enzymes play a vital role in mitigating pathogen-induced stress.

CSPT: 3.

EFFECT OF DIFFERENT COLOURED SHADE-NET V/S WITHOUT COVERED CONDITION FOR GROWING LEAFY VEGETABLE DURING SUMMER SEASON IN PLAIN CONDITION OF INDIA

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Leafy vegetables grown summer season viz., Palak and Coriander crops are very sensitive to erratic weathers and abiotic stresses, as it is not possible to grow quality gaps far vegetables purpose during this season under open field conditions of north Indian plains. Under such situation shade-net covering protects the crop substantially from intense solar radiations, warm winds, harmful UV rays unfavorably air thereby providing cooling effect to the crop as compared to open conditions during summer season. Thus for growing leafy vegetables successfully in summer season used the shade-net-covering is a viable solution. The shade-nest covered structure is used with 50% UV stabilized and shading intensity were fabricated with tent type design of GI pipes installed in 1200m^2 area with different colours *i.e* Red, Black, White and Green shade nets cover on separate in equal area at the CPCT-farm, IARI, New Delhi. The roof and all side of the shade-net were covered but the time to time front and back sides are kept open. The sowing of seeds of Palak and coriander was done on 25 March 2014 with row to row spacing 15x15 cm in double row along with the drip line. Recommended package practices were used with NPK fertilizer dose @ 150:100:100, providing ½ as basal and ½ fertigation with system. The results showed that shade nets with 50% solar intensity can decrease temperature up to 1-2 ^{0}C and increased 10-20% relative humidity during summer season. After the harvesting of the crop, it was observed that the red colour shade-net promoted earliness, quality yield. Economics of Palak per unit area as compared to other coloured shade-nets covering. However, green colour shade-net promoted more quality yield and economics in coriander as compared to other shade-nets. The open field condition gave very poor result on yield and quality of both leafy vegetables. It was concluded that the combination of red shade-net cover with Palak leafy crop and green shad-net cover with Coriander as leafy crop were found successful, economically and feasible to the farmers during summer-season in the plain conditions of India.

CSPT: 4.

LINSEED IN NORTH-EASTERN PARTS OF INDIA: AN INSIGHT INTO NAGALAND

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Flax or linseed is amongst one of the oldest cultivated crop plant and owing to its various uses is considered important in the oil-seed economy of country. Its cultivation has been reported from about 47 countries round the globe. Every part of linseed plant is useful and is utilized commercially, either directly or after processing. The seeds

are primarily used for extracting oil which then further is used for various industrial purposes. Seeds contain a significant amount of oil ranging from 30-55% depending upon the variety cultivated. The oil is edible and has a feature of drying quickly rendering its usefulness in manufacture of paints, varnishes, printing inks, soaps and water proof fabrics. As an edible oil linseed is used in certain parts of Madhya Pradesh, Bihar and Maharashtra. In India linseed is cultivated approximately over an area of 2.94 lakh ha with an average productivity of 525 kg/ha and producing 1.54 lakh tonnes annually. In the recent past linseed cultivation has been introduced in Nagaland on an area about 5.97 thousand ha giving production of 4.68 thousand tonnes and average productivity of 808 kg/ha. With the promises of better yields using minimum input, the cultivation of linseed holds a bright future in the north-eastern parts of India.

CSPT: 5.

ASSOCIATION OF SINGLE NUCLEOTIDE POLYMORPHISM AND HAPLOTYPES OF PROMOTER REGION OF MANNOSE BINDING LECTIN 1 GENE WITH CLINICAL MASTITIS IN INDIAN MURRAH BUFFALOES

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Mannose-binding lectin1 (MBL1)is a candidate gene involved in immune response system and plays an important role in the classical and lectin-activation pathways, which provide protection against various bacterial pathogens. Present study has been carried out to identify SNPs in the promoter region of MBL1 gene, haplotypes construction and their association with incidence of clinical mastitis in Murrah buffaloes. Genomic DNA isolated from 200 lactating Murrah buffaloes was amplified for the targeted sequence, PCR products were custom sequenced, edited and aligned with reference sequence of *Bubalus bubalis* (NCBI accession number KC415281). A total of eight novel SNPs: 154C>T, 235G>A, 252A>T, 265C>A, 268T>C, 282G>A, 431G>A and 551C>G were identified. Allelic association analysis showed that T allele of 154C>T, A allele of 235G>A, A allele of 252A>T, A allele of 265C>A , T allele of 268T>C, A allele of 282G>A, A allele of 431G>A and G allele of 551C>G had significant association with increased risk of clinical mastitis ($P< 0.01$). The relative risks of the alleles for clinical mastitis in Murrah buffalo were estimated with an odds ratio. A total of 17 haplotypes were constructed from the eight SNPs. Haplotype analysis showed that Hap15 (CAAATAAG) and Hap16 (TAAATAAG) i.e. the haplotypes containing all 8 "at-risk" alleles, were significantly associated with clinical mastitis ($P< 0.01$), whereas, Hap6 (CGAATAAC) and Hap8 (CGTCCGGC) were significantly associated with a lower risk of clinical mastitis in Murrah buffaloes ($P<0.01$). These findings suggest that Hap6 and Hap8 of MBL1 promoter region may be used as potential genetic markers after validation in larger population, for selection of Murrah buffaloes which are less susceptible to clinical mastitis.

Keywords: SNP, MBL1 promoter, Haplotype, Mastitis, Murrah Buffalo

CSPT: 6.

ENTOMOPATHOGENIC MICROBES: AN ECO-FRIENDLY TOOL IN IPM

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Microbial pathogens of insects are intensively investigated to develop environmental friendly pest management strategies in agriculture. The most successfully utilized insect pathogen is the bacterium, *Bacillus thuringiensis (Bt)* which is used extensively for management of certain lepidopteran pests. In India, mostly imported products of *Btkurstaki*have been used, which are expensive and there is an urgent need to develop aggressive indigenous *Bt*strains against various pests. Baculoviruses comprising nuclear polyhedrosis virus (NPV) and

granulosis virus (GV) have been successfully used as insect. NPV and GV formulations are used for lepidopteran pests like *Helicoverpaarmigera*(*Ha*-NPV) and *Spodopteralitura*(*Sl*-NPV) in India. Entomopathogenic fungi like *Beauveria bassiana, B. brongniartii, Metarhiziumanisopliae, M. anisopliae*var. *acridium, Lecanicilliums*pp., *Hirsutellathompsonii*and *Nomuraearileyi*are gainingimportance in the crop pest control. Actinomycetes have enzymes such as proteases and chitinase, actinomycetes have been studied as a natural controller of insects that cause considerable losses in agriculture. Additionally, the facilities for the industrial manipulation of cultures, and the diversity of metabolites produced make actinomycetes preferred for the control of pests.

Keywords: Microbial pathogens, pest management, Baculoviruses, entomopathogenic fungi and Actinomycetes

CSPT: 7.

GRAFTING IN VEGETABLE CROPS: A GREAT TECHNIQUE FOR ABIOTIC STRESS MANAGEMENT

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Environmental stress is the primary cause of vegetable crops losses worldwide, reducing average yields for most major crops by more than 50%. Climatic changes will influence the severity of environmental stress imposed on vegetable crops. Moreover, increasing temperatures, reduced irrigation water availability, flooding, and salinity will be major limiting factors in sustaining and increasing vegetable productivity. Grafting is a tool normally used in vegetables crops to improve production. Grafting is consists of the use of a vigorous plant to replace the root system of a cultivar of economic interst but that is sustable to one or more stress factors. The new root system is called trhe root stock and the upper part is the scion. The first record of the use of vegetable grafting is from the late 1920s in Japan, when Watermelon (*Citrullus lanatus* L.) plants were grafted onto Bottle gourd (*Lagenariasiceraria)* to prevent the fusarium wilt. The expension of grating is likely due to its ability to provide tolerence to abiotic stress such as drought, salinity, low soil temperature and flooding if appropriate tolerant rootstocks are used. Many aspect related to root stock and scion interaction are poorly understood, which can be loss of fruit quality, reduced production and most commonly incompatibility between rootstock and scion. The rootstock and scion cultivar must be chosen with care to avoid loss. Grafting of eggplants was started during the 1950s, followed by grafting of cucumbers and tomatoes in the 1960s and 1970s. Melons grafted onto hybrid squash rootstocks were more salt tolerant than the non-grafted melons.

Keywords: Environment, grafting, vegetables and stress

CSPT: 8.

MOLECULAR CHARACTERIZATION AND FUNCTIONAL GENOMICS ANALYSIS OF RICE (*ORYZA SATIVA* L.) GENOTYPE UNDER ABIOTIC STRESS

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Rice (Oryza *sativa* L.) is the second most important pillar of food security for the humankind, next to wheat. Rice is one of the most important staple food worldwide and model species for cereals. *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice) are the most cultivated rice.Along with maize (*Zea mays*) and wheat (*Triticum*), it provides more than 50% of all calories consumed by humans.Rice is considered a salinity-sensitive crop in the field as compared to other main cereal crops. Salt stress severely influences the morphology traits of the rice plant. So it is appropriate to study the physiological and biochemical changes under saline conditions. In order to explain adaption

to salinity several physiological parameters such as germination, plant height, leaf area, total dry matter, membrane injury index and relative water content, biochemical parameters like chlorophyll content, protein content, an antioxidant enzyme, proline content etc. were proposed to be investigated under saline and control conditions with an aim to choose tolerant varieties for saline conditions. So, to study about these changes or parameters will be helpful to select the salt tolerance or resistance variety of rice. Stress induces the expression of a large number of genes. The induction of these genes under stress is regulated through complextranscriptional networks. The process of genetic transformation, a major tool for crop improvement, utilizes transcription factors and promoters as one of its key elements. The better understanding of various signaling pathway related to stress and there molecular mechanism useful for genetic engineering approach. Genetic engineering approach would be useful to manipulate the osmoprotectants biosynthesis pathways for accumulating such molecules that act scavenging ROS, reducing lipid peroxidation, maintaining protein structure and function. Some genes in plant control ion transport through various types of cellular pumps and transporter-like Na^+/H^+ antiporter as regulation of Na^+ uptake and compartmentalization is a critically important mechanism for plant survival under salinity stress. Engineering plants for overexpression of gene encoding for antiporter is identified as an effective method for the developed salt-tolerantplant.

Keywords: Salt stress, Antioxidant enzyme, Transcription factors, Genetic engineering, ROS

CSPT: 9.

EFFECT OF DIFFERENT CANOPY ARCHITECTURES ON LIGHT INTERCEPTION, YIELD AND QUALITY OF MANGO CV. DASHEHARI

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To ascertain the maximum light interception with higher yield and better quality through plant canopy architecture manipulations, an experiment was conducted on 16 year Dashehari planted at 6x9 metre inter and intra row spacing with four canopy architecture management system, i.e., conical shape canopy architecture, flat top canopy architecture, open centre canopy architecture and natural canopy architecture (control) with four replications. There were significant differences among the evaluated canopy architecture in light distribution pattern and photosynthesis rate. The highest diffusion of light was observed in open centre of canopy architecture (8322 mol m^{-2} s^{-1}) where minimum light diffusion (4863 mol m^{-2} s^{-1}) was under natural canopy architecture. Highest photosynthesis (13.98 µ mol m^{-2} s^{-1}) was observed in open centre canopy architecture as compared to natural canopy architecture (8.1 µ mol m^{-2} s^{-1}). Better flowering and highest yield (78 kg/tree) was recorded in open centre canopy architecture followed by flat top canopy architecture (65.7 kg/tree), conical canopy architecture (61.5 kg/tree). The minimum yield (55.2 kg/tree) was recorded in natural canopy architecture. The maximum 'A' grade fruits (29%) were also observed in open centre canopy architecture whereas minimum 'A' grade fruits (12%) also observed in natural canopy architecture. Hence, open centre canopy architecture management system may be recommended for wide adoption to get higher yield and better quality fruit production.

Keywords: Mango, canopy architecture, light interception, photosynthesis, yield

CSPT: 10.

ULTRASTRUCTURE OF ANTENNAL SENSILLA OF *HELICOVERPA ARMIGERA* (HÜBNER) (LEPIDOPTERA: NOCTUIDAE)

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Helicoverpa armigera (Lepidoptera: Noctuidae) is a serious polyphagous pest of various field and horticultural crops. An important contributing factor in its notorious pest status is the development of resistance to insecticides, making the insect difficult to control. A complete knowledge on the morphological structure of *H. armigera*olfactory organs present in the antennal segment is necessary for the development of an efficient semiochemical-based control method. The olfactory sensilla are located particularly on the antennae and these can detect pheromones and plant volatiles that provide important cues for the insects in the search of their conspecifics for mating, aggregation or their host plants for feeding and oviposition. Disruption of inter- and intra-specific communication is the best effective control method against this pest. In this study, the antennal morphology and types of sensilla on the antennae of both sexes of *H. armigera* were examined using light and scanning electron microscopy. The antennal flagellum is packed with different types of sensilla distributed on the ventral and lateral surfaces of antennae and the dorsal surface is packed with scales. Six distinct morphological types of sensilla were identified on the antennae of both sexes: Sensilla trichoidea, sensilla cheatica, sensilla coeloconica, sensilla styloconica, sensilla squamiformia and bohm bristles. Of these sensilla, the most widespread are sensilla trichoidea suggesting that these sensilla are associated with olfactory function such as detection of sex pheromones and host-plant perception. Sexual dimorphisms in sensilla of *H. armigera*were mainly detected as the variations in their location, numbers and distribution of each type of sensilla. The possible functions of these sensilla were discussed in view of previously reported lepidopteran insects. The results of this study may provide valuable information for further study of their function and for related pest control by using pheromones and plant volatiles.

Keywords:Semiochemical, Sensilla, Communication, Pheromones, Plant volatiles, Host plant

CSPT: 11.

POSSIBILITY OF INDUCTION OF FLOWERING IN MANGO (*MANGIFERA INDICA* L.) CV. MALLIKA THROUGH CHEMICALS SPRAY UNDER HIGH DENSITY PLANTING

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The present investigation was conducted during 2014-2015 for one season on 'Mallika' mango under high density planting system (4m x 4m) at Nursery-Cum- Orchard of the Department of Horticulture, Ranchi Agriculture College, Kanke, Ranchi on 08 years old plants. Foliar spray of 1 and 1.5 % potassium di-hydrogen phosphate (KH_2PO_4)1 and 1.5 %, di-potassium hydrogen phosphate (K_2HPO_4) and the combinations of these four treatments with 1% potassium nitrate (KNO_3) and 1% thiourea (CH_4N_2S) including control (one without any spray) were considered. Each treatment replicated thrice and one plant was considered as a unit of treatment. Amongst the different chemicals used, treatment KH_2PO_4 1% + KNO_3 1% was most effective regarding the Panicle emergence and it was noted 5.67 days earlier in comparison to control whereas the flowering was recorded 4.66 days earlier with the treatment KH_2PO_4 1.5 % + KNO_3 1% than control. The highest percent (74.01) of flowering shoot was observed with K_2HPO_4 1.5 % and KNO_3 1% whereas the highest number (306.33) of hermaphrodite flowers, lowest sex ratio (2.21) and the maximum number (28.00) of fruits set (at marble stage) were recorded under the treatment KH_2PO_4 1% +

thiourea 1%. The highest number (3.13) of fruits retained per panicle (at harvest) and fruit yield (41.23 kg/plant) was found in trees treated with K_2HPO_4 1.5 % + KNO_3 1% spray.

Keywords: mango, potassium, thiourea, flowering, fruiting

CSPT: 12.

RE-STRUCTURING THE CELLULAR RESPONSES: CONNECTING MICROBIAL INTERVENTION WITH ECOLOGICAL FITNESS AND ADOPTIVENESS TO THE MAIZE (ZEA MAYS L.) GROWN IN SALINE SODIC SOIL

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Salt stress reduces plant growth and development. It is now becoming one of the most important threats to agricultural productivity. Rhizosphere microorganisms play key roles in modulating cellular responses and enable plant tolerance to salt stress but the detailed mechanisms of how this occur need in depth investigation. The present study elucidated the microbe-mediated re-structuring the cellular responses lead to ecological fitness and adoptiveness to the maize (*Zea mays* L.) grown in saline sodic soil. In this study, effects of seed biopriming by *Bacillus safensis* MF-01, *B. altitudinis* MF-15 and *B. velezensis* MF-08 on different growth parameters were recorded. Soil biochemical and enzymatic analyses were performed. The activity and gene expression of High-Affinity K^+ Transporter (*ZmHKT-1*) and antioxidant enzymes (*ZmAPX1.2, ZmBADH-1, ZmCAT, ZmMPK5, ZmMPK7,* and *ZmCPK11*) were studied. The expression of genes related to lateral root development (*ZmHO-1, ZmGSL-1* and *ZmGSL-3*) and root architecture were also carried out. Biopriming of plant with selected strains individually or in combination has been shown to confer better seed germination and vigour in the plant grown in saline sodic soil at 30 days of sowing. Results indicated that plants treated with consortia of two or three strains induced early production of adventitious roots in maize compared to plants primed with single strains and untreated control which was further confirmed by assessing the transcript level of *ZmHO-1, ZmGSL-1* and *ZmGSL-3* genes using qPCR approach. The uptake and translocation of Na^+, K^+ and Ca^{2+} significantly varied in the plants treated with the bioagents alone or in consortium. qRT-PCR analysis also revealed that the *ZmHKT-1* expression levels varied significantly in the maize root upon inoculation and showed manifold increase in the plants bioprimed with all the three strains in combination. Further, the activity and gene expression levels of antioxidant enzymes showed significantly higher in the root of maize subjected seed biopriming with bioagents individually or in combination. Our research indicated that *ZmHKT-1* expression could effectively enhance salt tolerance by maintaining an optimal Na^+/K^+ balance and increasing the antioxidant activity that keeps reactive oxygen species (ROS) at a low accumulation level. Interestingly, up-regulation of *ZmHKT-1, ZmHO-1, ZmGSL-1* and *ZmGSL-3* and genesencoding antioxidant regulate the cellular responses which could effectively enhance the adoptiveness and ultimately leads to better plant growth, and grain production in the maize crop grown in saline sodic soil.

Keywords: *Bacillus safensis*, *B. altitudinis*, *B. velezensis,* High-Affinity K^+ Transporter, Adoptiveness, Salt stress

CSPT: 13.

ISOLATION, CHARACTERIZATION AND MOLECULAR DIVERSITY OF PLANT GROWTH PROMOTING BACTERIA

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In view of increasing environmental contamination with the deterioration of soil health and due to use of chemical fertilizers for increasing crop productivity. In this context, plant growth promoting rhizobacteria (PGPR) are often considered as a novel and potential tool to provide sustainable benefit to agriculture. In the present study, rhizospheric sample were collected from experimental farm of V.P.K.A.S. (ICAR), Almora, Uttarkhand. A total of forty-five bacterial isolates were obtained from the rihzosphere, rhizoplane, endorhizosphere region of vegetables(Lahi, Onion, Garden pea) and screen for various functional PGPR traits(IAA production, Ammonia, HCN, Siderophore production, Phosphate solubilisation, Phosphatase activity) under In-Vitro condition. Finally, ten isolates were selected for biochemical characterization and molecular diversity. The effect of PGPR on vegetable seedling growth under paper towel bioassay. All tenisolate showed non-significant difference in percent germination in garden pea, while inoculation with LRs-1, LRp-10 and GRp-43 significantly increase tomato and capsicum root and shoot length 2.0 fold, over controlled sample. On the basis of biochemical reaction isolates LRs-3 and LRp-9 shows maximum diversity. The molecular diversity among the isolate is indentified using RAPD. The isolate ORp-5 shows maximum diversity among the isolates. To enhance the growth of vegetables, the result are quiet diverse and promising, which indicates, some of them showed can be further work out to prepare formulation or consortia with other potent bioinoculant. These isolate can be used as an effective bio-fertilizer. LRp-10 is the most promising isolate which can be developed as a bioinoculant to enhance the growth of garden pea and capsicum. From biochemical and molecular diversity, it is tentatively genera of pseudomonas species.

CSPT: 14.

EVALUATION OF DIFFERENT CONCENTRATIONS OF FLUORIDE ON GERMINATION AND GERMINATION RELATED PARAMETERS OF WHEAT (*TRITICUM AESTIVUM* L.)

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Wheat is the second most important cereal crop next to rice. Fluoride (F^-) is the anion form of fluorine. A lab experiment was conducted on germination papers in department of Plant Physiology, Institute of Agricultural Sciences, BHU, Varanasi during 2016-17 and 2017-18 to study the effect of different concentrations of fluoride i. e., 0 (T_1), 50 (T_2), 100 (T_3), 200 (T_4), 250 (T_5) and 300 (T_6) ppm fluoride on germination and germination related parameters i.e., germination per cent, germination index, coefficient of velocity of germination (CVG), mean germination time (MET) and germination energy (%) in wheat genotype HUW-234. Fluoride toxicity significantly reduce germination per cent, germination index, coefficient of velocity of germination and germination energy (%) while mean germination time increased with fluoride concentration. Present study revealed that enhanced fluoride concentration in germination medium caused reduction in germination and germination related parameters.

Keywords: Wheat, fluoride, germination percent, germination energy, germination index

CSPT: 15.

EFFECT OF *PSEUDOMONAS FLUORESCENS* (PBAP-27) AND FERROUS SULPHATE ON GROWTH OF PEACH CV. FLORDAPRINCE

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An experiment was conducted during the year 2014-15 and 2015-16 to examine the effect of *Pseudomonas fluorescens* (PBAP-27) and foliar spray of ferrous sulphate on tree height, tree spread, trunk diameter, extension of shoot growth and diameter of shoot of peach cv. Flordaprince. It was laid in a split plot design and the treatments comprised no inoculation (I_0) and inoculation (I_1) of *Pseudomonas fluorescens* (PBAP-27) as main plot along with four levels of foliar spray of ferrous sulphate 0.5%, i.e., F_0 (no spray: water spray), F_1 (single spray), F_2 (two spray), F_3 (three spray) as sub plot treatments. The results obtained from the investigation showed that the inoculation of *Pseudomonas fluorescens* (PBAP-27) and foliar spray of ferrous sulphate significantly increased tree height and canopy spread.

Keywords: Ferrous sulphate, Flordaprince, Peach, foliar spray and *Pseudomonas*

CSPT: 16.

CLIMATOLOGICAL RISK ASSESSMENT FROM RAINFALL TIME SERIES USING MARKOV CHAIN MODEL FOR OPTIMIZING RICE CROPPING WINDOW IN INDIAN SUNDARBANS

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Rice based cropping system is the general practice in Indian Sundarbans which faces highly variable rainfall throughout the year. The present research was conducted in Rangabelia island of Indian Sundarbans to identify a risk free cropping period for monsoon rice. Historical rainfall data (1984-2018) was analyzed using Markov chain model and probability of dry and wet spells were determined using 20 mm rainfall as threshold. The period from 25 Standard Meteorological Week (SMW) to 41 SMW was observed with minimum probability (0 – 12%) of occurrence of two consecutive dry weeks (2D). Climatological risk notably influenced productivity of monsoon rice (var. CR-1017) tested under five different sowing time (24, 25, 26, 27, 28 and 29 SMW) in 2016-17 and 2017-18. The early sown crops (24 SMW) faced less risk during vegetative [P(D): 4.6%, P(DD): 12.5%], reproductive [P(D): 16.6%, P(DD): 14.4%] and grain filling [P(D): 54.9%, P(DD): 48.5%] stages as compare to delayed sowing. Climatological risk increased with delay in sowing and consequently yield declined. The late sown crops experienced about 55% (reproductive stage) and 90% (grain filling stage) initial (D) and 48% (reproductive stage) and 85% (grain filling stage) conditional (DD) probability of getting dry spell. Early sown crop resulted in a yield advantage of 15 to 23% over the late sown crops. The period extending from 24 SMW to 46 SMW was proved to be the most favourable window for monsoon rice and successful inclusion of post monsoon crops to optimize the ricebased cropping systems in Indian Sundarbans region.

CSPT: 17.

EFFICACY OF BIOPESTICIDE AND CHEMICAL INSECTICIDES AGAINST GRAM POD BORER (*Helicoverpa armigera.)*

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Chickpea (*Cicer arietinum L.)* in commonly known as Bengal gram and locally as chana. Due to its polyphagous nature, the gram pod borer is also known as American cotton boll worm, corn ear worm, tomato fruit borer, tobacco bud worm, carnation worm, etc. It has been recorded feeding on 181 cultivated and uncultivated plants species belonging to 45 families. It is an established serious pest of gram in all the state of Indian union. The attack of this pest starts from vegetative stage and continue up to crop maturity. The yield loss in chickpea due to pod borer was reported as 10 to 60% in normal weather condition.

The field experiment was conducted at Research farm, JNKVV, College of Agriculture, Tikamgarh (M. P.), India during the *Rabi* season of 2017-18. Cultivar "JG-315" was sown in a plot size of 4.2 x 3.0 m^2 on 11th November with row to row and plant to plant distance as 30 cm and 10 cm respectively. Experiment area was conducted in a Randomized Block Design with three replications. Two applications of insecticides were given, one at 50% flowering and second at 15 day after first spray of chickpea. Weekly observations were recorded in each plot in one meter row length at three places in each plot.The results revealed that all the insecticidal treatments were found significantly superior to the Control. Profenophos 50 EC followed by Rynaxypyr 20 SC and NSKE 5% followed by Flubendiamide 39.35 SC were significantly superior and they were the best treatments as compared with other treatments. Significantly lowest pod (3.08%) damage was recorded in plot treated with Profenophos 50 EC followed by Rynaxypyr 20 SC following by NSKE 5% followed by Flubendiamide 39.35 SC (3.19%). Maximum grain yield (1706 kg/ha) was obtained from the plots receiving two sprays of Profenophos 50 EC followed by Rynaxypyr 20 SC followed by NSKE 5% followed by Flubendiamide 39.35 SC (1626.98 kg/ha)).

CSPT: 18.

EVALUATION OF FUNGICIDES, ESSENTIAL OIL AND PLANT EXTRACT AGAINST EARLY BLIGHT OF POTATO CAUSED BY *ALTERNARIA SOLANI*

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Potato (*Solanum tuberosum* L.) is known as a king of vegetable crop of Madhya Pradesh as well as India. India is the second largest producer of Potato after China The experiment was conducted at, JNKVV, College of Agriculture, Tikamgarh during Ravi season 2018-19. Seven treatments namely mancozeb 75% WP @ 0.25%, carbendizim 12% + mancozeb 63% WP @ 0.15%, eucalyptus oil, @ 5% neem oil @ 5%, onion extract @ 5% and garlic extract @ 5% against early blight disease of potato caused by *Alternaria solani*under the lab and field conditions.*In vitro* result revealed that the minimum radial growth (20 mm) was observed in mancozeb 75 % WP at 0.25 per cent concentration followed by eucalyptus oil (21.0 mm), onion extract (22.03 mm), carbendazim 12% + mancozeb 63%WP (30.53 mm), garlic extract (38.07 mm) and neem oil (60.0 mm). *In vivo* results revealed that mancozeb 75% WP @ (0.25%) was found most effective and recorded lowest disease intensity (21.73%) with significantly increased in yield over control (73.62%) followed by eucalyptus oil @ (5%), disease intensity (22.97%) and yield (68.86%), onion extract @ (5%), disease intensity (24.77%) and yield (47.52%), carbendazim 12% + mancozeb 63%WP @ (0.15%), disease intensity (25.07%,) and yield (39.31%), Garlic extract @ (5%),disease intensity (26.67%) and yield (15.4%) and Neem oil @ (5%), disease intensity (27.70%) and yield (2.38%) insignificantly. Overall results revealed that mancozeb is highly effective against early blight causing pathogen *Alternaria solaniin vitro* and *in vivo* condition.

CSPT: 19.

IMPACT OF CONVENTIONAL AND NEWER INSECTICIDES ON PREDATORY SPIDERS IN RICE ECOSYSTEM

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An experimental trial was conducted during *Kharif* season of 2016 and 2017 at the Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (India) to study the impact of conventional and newer insecticides *viz.,* Carbofuran 3% G @ 750 g a.i./ha, Thiamethoxam 25% WG@ 25g a.i./ha, Fipronil 5% SC @ 50 g a.i./ha, Lamda- Cyhalothrin 5% EC @ 20 g a.i./ha, Neem (Azadirachtin 0.15 % EC) @ 2000 g a.i./ha, Flubendiamide 20% WG @ 25 g a.i./ha, Chlorantraniliprole 18.5 % SC @ 30 g a.i./ha, Acetamiprid 20% SP@ 35 g a.i./ha, Dinotefuran 20% SG @ 40 g a.i./ha and Pymetrozine 50% WG @ 7.5 g a.i./ha on spiders population in rice ecosystem. Almost all the insecticidal treatments except Lambda-cyhalothrin 20% SP @ 20 g a.i./ha showed little effects on the spider population in rice ecosystem. Considering all the four observations taken after the insecticidal spray, Flubendiamide 20% WG @ 25 g a.i./ha was found to be least toxic recording maximum number of spider population per ten hills except untreated control and these can be included in the integrated pest management for the best control of insect pests. This is then followed by Chlorantraniliprole 18.5% SC @ 30 g a.i./ha and Fipronil 5% SC @ 50 g a.i./ha were safe to spiders and recorded the highest population during both *Kharif* season 2016 and 2017. As compared to all the insecticidal treatments, Lambda-cyhalothrin 20% SP @ 20 g a.i./ha found to be most toxic predatory spider fauna.

Keywords:Flubendiamide 20% WG, lambda cyhalothrin, rice, spiders

CSPT: 20.

POPULATION DYNAMICS OF SUGARCANE LEAF HOPPER (*Pyrilla perpusilla* Walker) AT VARANASI DISTRICT OF UTTAR PRADESH, INDIA

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The present investigation was carried out to study the population dynamics of *Pyrilla perpusilla* Walker at the Agricultural Research Farm of Institute of Agricultural Sciences, BHU, Varanasi. The studies revealed that the occurrence of leaf hopper commenced from 1st week of September and the absolute peak population of eggs (8.58 eggs/leaf), nymphs (25.59 nymphs/leaf) and adults (10.91 adults/leaf) were observed on 15thof October, 2017, when corresponding weather parameters were rainfall (00mm), maximum (30.7^{o}C) and minimum (21°C) temperature, morning (88%) and evening (71%) relative humidity, wind velocity (1.5km/h) and sunshine hours (8.1hours/day). Morning relative humidity showed significant positive correlation with eggs (r=0.78). Whereas, non-significant correlations were found between nymphs and weather parameters. Minimum temperature, showed highly significant positive correlation (r=0.18), and morning relative humidity showed positive significant correlation (r=0.27) with adults.

Keywrds: Population dynamics, Pyrilla perpusilla

CSPT: 21.

ENHANCEMENT OF ZERO TILL WHEAT PRODUCTIVITY, PROFITABILITY AND NITROGEN UPTAKE EFFICIENCY (NUPE) THROUGH NUTRIENT EXPERT, N SPLITTING AND LEAF COLOUR CHART (LCC) IN SANDY LOAM SOIL OF WEST BENGAL

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The adoption of zero tillage (ZT) technology in West Bengal has been significantly increased after the introduction of Zero till ferti-cum-seed drill.N management needs to be significantly improved under ZT to address the challenge of food security. In addition to site specific nutrient management based nutrient expert recommendation (SSNM-NE), N splitting especially foliage colour based precise N management (FC-PNM) is also important for satisfying crop N demand at proper time. An experiment was conducted at the instructional farm, Uttar Banga Krishi Viswavidyalaya during *rabi*, 2016-17 and 2017-18 with the objective to compare different N splitting including FC-PNM strategy under SSNM-NE and state recommendation of West Bengal in terms of agronomic impacts on zero till wheat cultivation. The highest grain yield and benefit-cost ratio (B:C) were found in SSNM-NE with 60% N top-dressing at crown root initiation (CRI) and 20% N top-dressing at late tillering (LT) (5.07 t/ha and 2.57, respectively for target yield 5.50 t/ha). SSNM-NE with 48% N top-dressing at CRI and wheat LCC reading based N top-dressing at LT (4.36 t/ha and 2.24, respectively for target yield 5.50 t/ha) also resulted good yield and profit and the lowest values were obtained in state recommendation with 37.5% N top-dressing at CRI and 37.5% N top-dressing at LT (3.80 t/ha and 2.05, respectively). In all the treatments, 25 kg N/ha was furrow placed at planting and N top-dressing was done always just before irrigation. Similar results were recorded for all the growth and yield attributes. NUpE was calculated highest in SSNM-NE with 60% N at CRI and 20% N at LT (0.52 and 0.59 for target yield 5.50 and 6.00 t/ha, respectively). Results showed that SSNM-NE with 25 kg N/ha basal application + 60% of recommended N top-dressing at CRI just before irrigation is beneficial for zero till wheat.

Keywords: Zero tillage, Nutrient expert, Nitrogen splitting, Leaf colour chart

CSPT: 22.

EFFECT OF MICRO-PLASTICS CONTAMINATION ON THE FRESH WATER FISH HEALTH AND THEIR ECOSYSTEM A-REVIEW

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The production of the plastic throughout the globe is increasing with the accelerating rate due to its durability and multipurpose utility. But due to lack of management practices these plastics are either dumped into the soil profile or thrown into the water bodies. These plastics due to various physio-chemical changes results the micro plastic of size less than 5 mm which is ultimate hazardous for the soil biota as well as aquatic life. These micro plastics have potential for the serious health issue which leads up to the mortality as they are the source of the toxins which provides the large surface area to various chemical present in the water bodies. Therefore, comprehensive studies are conducted on the source of the micro plastics in the fresh water it's types and the way they accumulate into the bodies of the fishes in the fresh water. It had been reported that accumulation of these micro plastics in the fishes cause certain mutagenic

changes such as behavioral change, cytotoxicity neurotoxicity, liver stress etc. From the recent reviewed literature, we concluded that fishes ingest these micro plastic by assuming their food or accumulate these from consuming from lower tropic organism. Some common studied micro-plastics in the fish's bodies are PE, PVC, PS etc. Our study assures that there is urgent requirement of monitoring the level of contamination of micro-plastics in waterbodies and its environmental concern on aquatic life and thereby its time frame based investigation on the accumulation of micro plastics by fisheries on fresh water rather than unfresh or muddy water and debate whether this accumulation suggests need of some regulatory legal rules to the bio-dynamics to the eco-system.

CSPT: 23.

INTERACTIVE EFFECTS OF LEAF GAS FILM AND ANTIOXIDANT ENZYMES IN RICE (*Oryza sativa* L.) UNDER SUBMERGED CONDITION

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Submergence causes a substantial yield loss in rice crop leading tofood insecurity and enormous rise in poverty all over the world. Some of the selected rice genotypes withstand and perform better under submergence condition. One of the best explanation for this submergence tolerance of the rice genotypes is due to the presence of leaf gas films on both adaxial and abaxial surfaces. The present study explored the relationship between leaf gas film and antioxidant enzymes for improving submergence tolerance in different rice genotypes. This study was conducted by taking ten rice genotypes grown in pots where one set of the 25-day old plants with leaf gas film (+LGF) remaining intact were submerged in 100 cm standing water while another set of plants were submerged after removing leaf gas film (-LGF) artificially. We analyzed the activity of three antioxidant enzymes namely –SOD, CAT and POX after de-submergence. The results revealed that the activity of these antioxidant enzymes increased with stress period and the enhancement of enzymatic activity was more in the plants submerged after removing leaf gas film. Among the ten genotypes studied, FR13A (tolerant) showed highest SOD activity (1.23unit mg^{-1} protein min^{-1}), CAT activity (25 $\mu mol_{H2O2reduced}$ mg^{-1}protein min^{-1}) and POX activity (34.45 $\mu mol_{tetraguaicolformed}$ mg^{-1}protein min^{-1}). Susceptible genotypes had higher H_2O_2 (%) as compared to tolerant ones in response to submergence stress. There was a faster rate of depletion in starch content in rice genotypes other than tolerant ones under submergence without gas film treatment which leads to greater mortality. Our observations noticed that the plants without leaf gas film had exposed to higher oxidative stress in submergence condition, which resulted in comparatively higher induction of antioxidant enzymes.

Keywords: leaf gas film, antioxidant enzymes, submergence tolerance

CSPT: 24.

RESPONSES OF RICE PLANTS UNDER DIFFERENTLY RECLAIMED SALINE SOIL

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Increasing global warming is leading to drastic changes in weather and climate, thus influencing the terrestrial and aquatic ecosystem. Altered weather conditions cause drought, flood, salinization of soil etc., that are indirectly influencing the livelihood of people. For feeding the exponentially increasing population, reclamation of

degraded land is attempted widely to utilize for agricultural purposes. The present study was conducted with rice (*Oryza sativa* L.) plants growing on reclaimed saline areas of Varanasi, Chandauli and Mirzapur districts. Six reclaimed sites were chosen on a salinity gradient. The reclaimed sites were categorized as least saline site (Rajatalab (RJT) and Beerbhanpur (BBN)), moderate (Mirzamurad (MZM) and Baraipur (BRP)) and highly saline sites (Dharahara (DHR) and Salempur (SLM)). Soil quality parameters and test weight were measured at each site. Total organic carbon, humic acid, ammonium nitrogen and available phosphate were low at sites with high soil salinity. Soil salinity differentially influenced rice test weight and damage was highest at sites with maximum salinity. The site having highest salinity (SLM) even failed to reach reproductive maturity whereas the other high saline site DHR maintained its yield due to organic manure amendment. Similarly, low saline site BBN showed reduced productivity in absence of manure application. Productivity of rice crop depended on nutrient condition of soil which was directly affected by soil salinity and agronomic practices. Nutrient management practices were found responsible for the rate of reclamation and productivity of rice. Sites amended with organic manure showed faster reclamation rate as compared to sole use of fertilizers.

Keywords: Saline soil, Agriculture, Reclaimed soil, Rice crop.

CSPT: 25.

EFFECT OF DIETARY SUPPLEMENTATION OF SEA BUCKTHORN LEAF MEAL ON EGG PRODUCTION PERFORMANCES IN COLOURED BREEDER BIRDS DURING SUMMER SEASON

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An experiment was conducted at Poultry farm of U.P. Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan (DUVASU), Mathura to study the effect of sea buckthorn (*Hippophae rhamnoides*) leaf meal (SBTLM) supplementation in coloured breeder (Chabro) on hen house and hen day egg production during summer season. Ninety farm borned coloured breeder hens and eighteen viable cocks in 1:5 sex ratio were randomly distributed into three treatment groups: Control (Basal), standard breeder diet (BIS, 2007); basal+0.5% and basal+1.0% SBTLM. The average egg production during 5th week were significantly higher ($P<0.01$) in basal diet+1.0%SBTLM supplemented group (72.86) as compared to basal diet+0.5%SBTLM and control or basal diet groups (56.67 and 62.3). However, during 11th and 12th week of experimental feeding, the weekly hen house egg production were significantly higher ($P<0.01$) in both the SBTLM supplemented groups than the control group. The overall egg production up to the 12th week of experimentation were significantly higher ($P<0.01$) in basal diet+1.0% SBTLM supplemented groups as compared to control group. During the experimental study period, there was no mortality in any treatment group. Hence, the hen day egg production per week and phase wise hen day egg production per week was equal to the hen house egg production per week and phase wise egg production per week, respectively. Hence, supplementation of 1.0%SBTLM leaf meal have beneficial effect during summer season may be due to it's anti-oxidative and anti-stress properties.

Keywords: Breeder, coloured chicken, BIS and SBTLM.

CSPT: 26.

LEAD ACETATE INDUCED HISTOLOGICAL CHANGES IN THE LIVER OF A FRESHWATER CATFISH *HETEROPNEUSTES FOSSILIS* (BLOCH.)

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Environmental pollutants such as metals, pesticides and other chemicals pose serious risks to many aquatic organisms. Accordingly a great deal of previous research has characterized physiological mechanisms of toxicity in animals exposed to contaminants. Lead is a non essential highly toxic metal widely distributed in environment. It is also discharged with water from lead mines, lead refining storage battery as well as plants for manufacture of tetra ethyl lead. The LC 50 value of lead acetate was calculated. The fish *Heteropneustes fossilis* were exposed for acute (24h, 48h, 72h and 96h), short (15, 30 and 45 days) and long (60, 75 and 90 days) terms to$1/5^{th}$ of LC50 values of lead acetate. After acute, short and long term, fish from the control and treated group were examined for histological changes in the liver. Hepatocytes of liver exposed to lead acetate were irregularly shaped with vacuolated cytoplasm and enlarged nucleus. The cell membrane of most of the hepatocytes were ruptured and fused with those of adjacent cells forming wide intracellular space.

Keywords: Liver, Histology, Lead acetate.

CSPT: 27.

ETHNO-VETERINARY PRACTICES USED FOR TREATMENT OF SURRA (TRYPANOSOMIASIS) DISEASE OF CAMEL BY THE R*aika pastoralists* OF MARWAR REGION OF RAJASTHAN

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The camel is practically symbolic for western arid region of Rajasthan. This animal has the immense contribution to livelihood of the *Raika* pastoral community who has a long relationship with this animal. *Raikas* followed their own traditional practices in all aspects of camel rearing including healthcare practices since time immoral. Therefore, the present study was designed to document and appraise ethno-veterinary practices followed by the *Raika* pastoral community for treatment of important camel disease like trypanosomiasis also known as Surra disease of Camel. *Raika* of Marwar region doing treatment of their camel disease through their traditional knowledge because lack of facility and migration life of *Raika.* A total 120 *Raika*pastoralists were interviewed from the six villages of Pali and Jodhpur district of Marwar region of Rajasthan on an open-ended interview schedule to document the ethno-veterinary practices. A participatory validation of the identified ethno-veterinary practices had been done through QuIK (Quantification of Indigenous Knowledge) method was used. Thus, 21 key informants were identified for participatory validation of camel trypanosomiasis. Four criteria or parameters, viz. Availability, Easy in preparation, Quickness in recovery and Lower side effect, were selected to appraise comparative and relative effectiveness of the identified ethno- veterinary practices. Data collected from the key informants on several criteria were subjected to one-way analysis of variance. Duncan's Multiple Range Test (DMRT) was followed to identify the most effective practices among the identified practices. The *Raikas*were using total four ethno-veterinary practices for treatment of Surra diseases of Camel. Use of fruit of *Withaniacoagulans (stock) Dunal* was found to be most effective among the four identified practices to control camel trypanosomiasis (surra).

Keywords:Raika pastoralists, Camel, Rajasthan

CSPT: 28.

MANAGEMENT OF SOIL FOR CLIMATE RESILIENT AGRICULTURE

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In recent few years, climate change has turn up as one of the major environmental problem all over the world. Countries like India, depends largely on agriculture for their social and economical needs. Climate plays an important role in agriculture. The negative impact of climate change is witnessed by all over the world but India, being a developing country where agriculture is monsoon dependent, is facing lot of pressure of climate change "Climate resilient agriculture" is one initiative started by the "Indian Council of Agriculture" (ICAR) with the project titled "National Initiative on Climate Resilient Agriculture (NICRA)" in 2010-11 to deal with the various challenges emerging due to climate change. Soil health is one of the crucial property that can resolve the resilience of crop production under changing climate scenario. Since many of the soil factors are related to loss in crop production which needs to be corrected for sustainable food security. Among all the factors land degradation is one of the major threats towards food security in India. Soil degradation is also one of the major cause for loss in soil organic carbon (SOC). Nutrient mining is also one major environmental hazard which needs to be improved. Indian agriculture is largely being affected by the deteriorating quality of soil. Many efforts has been made to build up soil carbon, improving soil water holding capacity, controlling nutrient mining and to control soil loss due to erosion, all of which build resilience in soil. There are many possible soil management prospective such as Integrated Nutrient Management (INM), soil-test based fertilizer application, conservation agriculture, precision agriculture and crop diversification can be adopted to mitigate the loss of crop production and management of soil from adverse climate change and increase crop production to a large extent. However, there are various challenges which needs to be overcome for the future development in the approach of climate resilient agriculture.

Keywords: Resilient, Precision agriculture, INM

CSPT: 29.

ESTIMATION OF COMBINING ABILITY AND GENE ACTION FOR YIELD AND ITS CONTRIBUTING TRAITS IN OKRA [*Abelmoschus esculentus*(L.) Moench]

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Analysis of variance for combining ability revealed mean sum of squares due to line × tester effect was significant for all the characters under study during both the years except for fruit diameter and stem diameter during the first year and for days to 50 per cent flowering and average fruit weight during the second year, which indicated the importance of both additive and non-additive genetic variances in the expression of these characters. The estimates of σ^2gca / σ^2sca indicated predominance of non-additive gene action for most of the characters during both the years. EC169400 and IC117351 were identified as consistent best general combiner for fruit yield and other components. Over the both years consistently, cross combinations *viz*., IC117245 × VRO 6 for fruit yield per plant, IC117245 × VRO 6, IC117351 × Arka Anamika and EC16400 × Arka Anamika for number of fruits per plant, EC169430 × Parbhani Kranti and EC169408 × Arka Anamika for plant height, EC169435 × Parbhani Kranti for 100 seed weight, IC093655 × Arka Anamika for number of seeds per fruit, EC169430 × Parbhani Kranti for primary branches per plant, IC093655 × Parbhani Kranti for inter-nodal length, EC169435 × Arka Anamika for fruit length showed specific combining ability effects of higher order. These crosses have been identified as best hybrids for improving fruit yield per plant and could be further evaluated to confirm their stable superior performance.

Keywords: Combining ability, fruit yield, gene action, GCA, okra and SCA

CSPT: 30.

INFLUENCE OF ENVIRONMENTAL EFFECT ON THE POPULATION DYNAMICS OF BROWN PLANT HOPPER, *Nilaparvata lugens*(Stal) AND WHITE-BACKED PLANT HOPPER, *Sogatella furcifera*(Hovarth) IN VARANASI REGION

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Population dynamics of Brown Plant Hopper (BPH) and White Backed Plant Hopper (WBPH) were studied in Varanasi region of India in K*harif* 2017 and 2018. Experiment was conducted on 100 m^2 unsprayed field and BPH and WBPH population were counted from 10 randomly selected rice hills. Relative humidity, temperature, rainfall were also recorded. BPH population appeared during second fortnight of July and reached to its peak during second fortnight of September in 2017 and 2018. However, the incidence of WBPH commenced from first fortnight of August and attained peak population levels during second fortnight of September in both years. The correlation analysis showed that BPH population has significantly positive correlation with morning RH, evening RH and average RH. Further non-significant positive correlation with minimum temperature, maximum temperature, average temperature and a non-significant negative correlation with rainfall was observed. The WBPH was being passed through the same weather regime as BPH. The correlation analysis of certain abiotic factors with WBPH revealed that the population also showed positive significant correlation with average RH and a positive non-significant correlation with evening RH, morning RH, maximum temperature, minimum temperature and average temperature. However, the population showed negative non significant correlation with rainfall. Thus temperature relative humidity and rainfall were observed to influence plant hopper population during the two different rice growing seasons.

Keywords: Abiotic factors, brown plant hopper, population fluctuation, white-backed plant hopper

CSPT: 31.

VALIDATION OF HLK EFFECTOR BASED DNA MARKER FOR DIAGNOSIS OF *Ralstonia solanacearum* INFECTING SOLANACEOUS VEGETABLES

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Ralstonia solanacearum (Solanaceous wilt pathogen) is the second most important bacterial plant pathogen. Detection and identification of associated pathogens are of prime importance for disease management which emphasizes the need for efficient diagnostic tests and specific detection tools. Molecular techniques are most specific, highly sensitive time saving, less laborious and can simultaneously detect and identify the plant pathogens. A multi-gene family encoding HLK effectors one of the virulence determinants is well conserved in all *Ralstonia solanacearum* strains indicating their role in fitness of the pathogen was identified for development of specific DNA marker for diagnosis. The primer set (*hlk1*Fand *hlk*1R) was designed based on sequence alignment of *hlk1 effector* genes from 15 different bacterial strain sequences downloaded from NCBI data base and primer oligonucleotide were synthesised. The PCR conditions were optimised to amplify the specific fragment of HLK1 effector gene sequence. The primers were able to amplify size of 203 nucleotides with annealing temperature of 57 °Cfor *Ralstonia solanacearum* which was further validated for detection across the isolates of wilt pathogen from different host including eggplant, chilli, potato, cluster bean, marigold and ginger. To check the specificity of primers to *Ralstonia solanacearum* the amplification attempts were made with four bacterial species (*Psuedomonas putida biovar 4*,

Psuedomonasaurigenosa,*Xnathomonasoryzae, Bacillus cibi*)andtwo fungal species (*Fusariumoxysporium* and *Alternariasolani*). We were unable to amplify DNA from above mentioned microorganisms which further validates the specificity of primers to *Ralstonia solanacearum*. The diagnostic tool developed will be helpful to assess bacterial survival, dissemination and disease outbreaks for effective management of bacterial wilt in solanaceous crops.

CSPT: 32.

LINE X TESTER ANALYSIS FOR ESTIMATION OF HETEROSIS AND COMBINING ABILITY IN LINSEED (Linum usitatissimum L.)

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The present investigation consisted of 6 lines of diverse genotypes of linseed and 3 testers having broad genetic base and wider adaptability, which were crossed as per line x tester analysis (Kempthorne, 1957) in Rabi season to generate 18 crosses. These 18 crosses were evaluated along with 9 parents and 3 checks viz: Neelum, Allahabad Local and T-397 in RBD having three replications. The data were recorded on ten characters to study the heterosis and combining ability. The significant mean sum of squares for all the 10 characters indicated the presence of substantial amount of variability. *Per se* performance for seed yield and its components depicted that cross EC12082 x EC41656 was found to be best. Estimates of heterosis (ha) showed that the highest average heterosis, heterobeltiosis and economic heterosis for seed yield per plant was observed by cross EC12082 x EC41656. Analysis of variance for combining ability showed significant differences for all the characters. The parents EC10077, EC 41528, and EC 41656 were good general combiner for seed yield and most of the traits. Highest positive sca effect for seed yield per plant was depicted by the cross EC12082 x EC41656.It can be concluded from the present study that cross A-238(196) X EC-41528 was found best as it showed positive significant economic heterosis for seed yield per plant along with positive significant economic heterosis for number of capsules per plant, 1000 grain weight and biological yield per plant. The parents A-202(183) and EC-41528 were good general combiner for seed yield and most of the traits. Therefore, these parents either can be used to constitute a composite variety or can be used as parents for development of superior single cross hybrids.

Keywords: Heterosis, Combining ability, Seed Yield and Linseed (*Linum usitatissimum*L.)

CSPT: 33.

ASSESSMENT OF SUITABLE SOWING DATES AND VARIETIES FOR MITIGATION OF LINSEED (*Linum usitatissimum* L.) WILT INCITED BY *Fusarium oxysporum* f. sp. *lini.* (Bolley) Synder and Hansen

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Field experiments conducted during 2016-2017 for the management of wilt of linseed (*Linum usitatissimum* L.), eleven varieties namely, Jeevan, Sweta, Parvati, Surbhi, NDL-2004-05, Kiran, RLC-92, Indira Alsi, Dipika, Shekhar including susceptible cultivar Chambal were sown in the month of October, 2016. Out of 11 varieties, the

maximum initial plant population (537.67 and 516.33/ plot) was noted with Shekhar followed by NDL-2004-05 respectively. Susceptible check Chambal has average initial plant population of 490.67/plot after germination. The minimum percentage of wilting was recorded in cultivar RLC-92 (5.47 per cent) followed by Jeevan (07.61 per cent) and Indira Alsi (07.85 Per cent), respectively but all were at par statistically. Maximum per cent of wilting was recorded in susceptible cultivar Chambal (70.87 Per cent) followed by Sweta (61.64 Per cent) and Shekhar (61.50 per cent). Maximum seed yield of 996.29 kg/ha was recorded in cultivar RLC-92 followed by Dipika (914.07kg/ha) and NDL-2004-5 (909.62 kg/ha), respectively, which was significantly higher over others. Linseed cultivar Chambal was sown in 7 different dates starting from 10 October, 2017 to 9 December, 2017 of 10 days intervals. Maximum wilting of plants (66.66 Per cent) were noted in 1st date (10-10-2017) of sowing which decreased with delayed sowing and minimum (14.31 Per cent) was recorded in December sown (09-12-2017) crop. Significant difference in wilting percentage was noted in crops sown on different dates. Maximum yield of 582.95kg/ha was noted in crop sown on 19-11-2017 followed by crop sown on 09-11-2017 (434.81kg/ha) and 30-10-2017 (414.81kg/ha), respectively.

CSPT: 34.

PHYTOTOXIC EFFECTS OF A NOVEL MOLECULE 6-(4, 7-HYDROXY-HEPTYL) QUINONE FROM THE LEAVES OF THE MILK WEED *Pergularia daemia* ON THE COTTON BOLLWORM *Helicoverpa armigera* (Hub.) AND THE TOBACCO CUTWORM *Spodoptera litura*(Fab.)

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Over the past several decades the indiscriminate use of chemical pesticides has led to the disturbances of whole ecological balance. Due to their extreme persistence and bioaccumulation these chemical pesticides has created serious threat to the environmental pollutants that adversely affect the health of livestock as well as human beings. The present study the effects of crude extracts and an isolated compound from the leaves of milkweed, *Pergularia daemia* (Forssk) Choiv. on the antifeedant activity against two important lepidopteran insect pests, *Helicoverpa armigera* (Hub.) (Lepidoptera: Noctuidae) and *Spodoptera litura* (F.)*(*Lepidoptera: Noctuidae) were studied. Maximum antifeedant activity was recorded in ethyl acetate crude extract against *H. armigera* (70.3%) and *S. litura* (71.82%) at 1% concentration. Ethyl acetate crude extract was further subjected to column chromatography, which was performed using hexane as initial solvent and then by increasing the polar strength using ethyl acetate. Fractions collected at hexane and ethyl acetate (80:20) yielded 6-(4,7-hydroxy-heptyl) quinone, a novel compound which showed significant antifeedant activity against *H. armigera* (80.22% at 2000 ppm) and *S. litura* (68.31% at 2000 ppm). Ecotoxicological test was assessed to analyze the potential toxic effects against freshwater copepod *Mesocyclops pehpeiensis* (***Crustacea*: *Copepoda***) for 24h using effective fraction. *P. daemia could* be complemented and eco-friendly pesticide/insecticide for integrated pest management tactics.

Keywords: Botanical pesticides, Medicinal plants, Plant-derived compounds.

CSPT: 35.

POTENTIAL SOURCE OF RESISTANCE TO *YELLOW VEIN MOSAIC VIRUS (YVMV)* AND *ENATION LEAF CURL VIRUS*(ELCV)DISEASE IN OKRA (*Abelmoschus esculentus*L. Moench)

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Forty four hybrids of okra [*Abelmoschus esculentus* (L.) Moench] were developed by crossing between eleven lines and four testers during rainy season of 2017 at Vegetable Research Centers of G. B. Pant University of Agriculture and Technology, Pantnagar. Fifty nine (15 parents + 44 hybrids) genotypes were used for screening against *Yellow vein mosaic virus*(YVMV) and *Enation leaf curl virus*(ELCV)in open field condition and studied for disease resistance and associated yield traits during rainy season and summer season of 2018. The disease pressure of both YVMV and ELCV was high in rainy season crop because of high humidity and rainfall along with more multiplication of whiteflies. Among the parents one parent namely 2015/OKYVRES-4 was found completely resistant/immune for YVMV disease while, rest of the parents were found susceptible to this disease. For ELCV, genotype 2015/OKYVRES-4 was found susceptible whereas, other fourteen parental genotypes showed symptomless carrier. Among the hybrids 11 F_1 crosses (using parents 2015/OKYVRES-4 as a tester) were found completely resistance reaction against both YVMV and ELCV disease, whereas rest of 33 F_1 were found susceptible to YVMV and symptomless to ELCV disease. Summer season crop was more producible for marketable fruit yield than rainy season crop due to low incidence of disease.

CSPT: 36.

BIOLOGY OF PINK BOLLWORM, *Pectinophora gossypiella* (Saunders) ON COTTON AND ITS ALTERNATE HOSTS

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Cotton is the most important commercial crop grown in India for fiber, fuel and edible oil under diverse agro-climatic conditions. Pink bollworm, *Pectinophora gossypiella* (Saunders) is emerging as a serious pest of cotton in India. In addition to cotton, has an host range of other Malvaceous plants. Generally the pest activity will be observed during late crop season after first picking of cotton. But from the past three years, I'ts incidence was recorded from early flowering stage. Present study on biology of Pink bollworm *Pectinophora gossypiella* (Saunders) was carried out in the Department of Entomology, College of Agriculture, PJTSAU, Hyderabad during 2018-19 under laboratory conditions at room temperature of 25±2°C and relative humidity of 70±2 per cent. For the study, field collected larvae were reared up to adult emergence and fresh adults were kept for egg laying on three hosts, Cotton (*Gossypium hirsutum*), Bhendi *(Abelmoschus esculentus)* and Indian Abutilon (*Abutilon indicum*). Results revealed that shortest life cycle of 41.25±2.05 days was on Bhendi fruits and longer period of 47.25±2.50 days on Bt cotton bolls. However it was 42.75±1.98, days on Abutilon and 44±2.10 days on non Bt cotton bolls. Highest fecundity was recorded on bhendi fruits (142.5±10.9 eggs) and lowest on Bt cotton bolls (135± 10.7) which was 137.5±10.6 and 137.5±10.5eggs on non Bt cotton and abutilon respectively. Minimum larval period of 18±1.40days on bhendi and maximum of 25.5±1.42 on Bt cotton was observed where it was 21±1.50 and 20±1.45 days on non Bt, and abutilon. Pupal period ranged from 7.0±0.80 to 7.5±1.00 days and adult longevity ranged from 9±0.74, to 10±0.75 days on all the hosts. Present study revealed that bhendi was the most preferred host with short life cycle, high fecundity and short larval period followed by Non Bt cotton compared to Bt cotton and Abutilon.

CSPT: 37.

SCREENING OF A WHEAT RIL POPULATION FOR HEAT TOLERANCE ON THE BASIS OF SUSCEPTIBILITY INDICES AND TOLERANCE INDEX

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High temperature during grain filling stage has become a major determinant of wheat yield to a great extent. The present investigation was undertaken to determine response to terminal heat stress of 167 RILs of wheat derived from HUW 234 × HUW 468, sown under timely and late conditions at Agricultural Research Farm, BHU, Varanasi during *rabi* season 2018-19. The RILs were screened and identified tolerant genotypes on the basis of Heat Susceptible Indices value (<0.5) and tolerance index (least difference between both conditions) forplot yield as this is one of the most important trait for studying the heat tolerance ability of RIL population. Therefore ranking of genotypes have been given on the basis of two indices calculated for plot yields *viz.,* heat susceptibility index and tolerance index. Out of the top 20 ranked genotypes on the basis of these 2 criteria, 15 genotypes *viz.,* 23, 29, 42, 55, 56, 57, 59, 67, 69, 70, 104, 120, 123, 148 and 151 were found to be common. Therefore, these genotypes may have potential to be utilized in the future breeding programme for improving yield under heat stress environment.

CSPT: 38.

GENETICS AND STABILITY OF MULTI-FLOWERING TRAIT IN GARDEN PEA, AND ITS POSSIBLE CONTRIBUTION IN YIELD IMPROVEMENT

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The inflorescence trait, number of flowers per peduncle/node is among one of the major yield attributes that has played a significant role in genetic improvement of legumes. Multi-flowering i.e. bearing more than two pods on a single node, is a rarest trait reported in *Pisum*. However, development of three or more pods per node, while maintaining the pod size over one and two, appears an attractive option to increase the yield. In order to obtain a more comprehensive understanding of flower and pod formation on a single node, we have utilized different cross progenies by involving five different parents capable of producing one to five flowers on a single node. The F_1s and parents were grown at normal row to row spacing of 30 and plant to plant spacing of 10 cm whereas, all F_2 s were space planted at 60×30 cm so that to observe the plants individually. Data was recorded on more than 1200 plants and segregation was recorded for single, double and multi-flowered plants, and compared by Chi-square ($\times^2$) test. The plants were found to segregate in the ratio of 3(double flower):1 (triple flower) in two crosses 'VRP-386 × VRP-500' and 'VRPM-501 × VRP-386' indicating the monogenic recessive inheritance of multi-flowering. However, in other three crosses viz., 'N0-17 × VRPM-901', 'VRP-500 × N0-17' and 'VRPM-501 × N0-17', the plants were found to segregate in 12 (double flower): 3 (single flower):1 (triple flower) indicating effect of dominant epistasis. Further, the one of the multi flowering parent 'VRPM-901-5' was found most promising for pod yield per plant (208g) and were significantly superior to the double-podded cultivars PC–531 (120g) and VL-8 (126g) as well to the single podded genotype NO-17 (60g) over the study period of four years, indicating potential of multi-flowering in yield improvement of garden peas.

CSPT: 39.

WASTEWATER TREATMENT USING ALGAE AND SUSTAINABLE USE OF BIOMASS

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Many types of chemical dyes used in textile industries are very harmful to the aquatic life. The dye itself and breakdown products from dye are the primary toxic product for the aquatic life, they cause aesthetic pollution, eutrophication, perturbation and increase in BOD and COD in aquatic life. Three types of textile wastewaters (Acid Yellow dye, Acid orange dye and Basic pink dye) has been used for wastewater treatment and microalgal (*Chlorella pyrenoidosa* and *Scenedesmus obliquus*) biofuel production. Nitrogen content in textile wastewaters is very less, hence urea is used as nitrogen source in wastewater. Optimal growth condition (Urea-0.4g/L, wastewater- 40%(v/v)) is developed through Response surface methodology (RSM). The biomass productivity for chlorella sp. is 1.2-1.5 g/L/day and for Scenedesmus sp. is 0.76-0.96 g/L/day in textile wastewaters. The reduction efficiency of COD, Nitrate-N Ammonia-N, Phosphate-P, and Dye(color) removal for Chlorella and Scenedesmus sp. is 80-90%, 75-85%, 90-98%, 65-74% and 60-75% respectively. Harvesting (flocculation method) is optimized using RSM in which chitosan is used as flocculent. The flocculation efficiency is maximum for alumina but chemical flocculants further cause a problem in purification hence chitosan or starch can be best flocculating agent having the flocculation efficiency 80-90%. Biodiesel is produced by in-situ transesterification method. The lipid productivity of *Chlorella pyrenoidosa* and *Scenedesmus obliquus* are 0.45-0.60 g/L/Day and 0.35-0.48 g/L/Day respectively. Similarly, the biofuel production efficiency for of *Chlorella pyrenoidosa* and *Scenedesmus obliquus* are 0.35-0.45 g/L/Day and 0.38-0.42 g/L/Day respectively. Techno-economic evaluation of the process has been done which showed that cost can be reduced up to 90% when we scaleup the process from 100INR/L to 30INR /L. The Net Energy Ratio (NER) is 1.2 (greater than 1). Hence, this technology can be used for sustainable and economic wastewater treatment and biofuel production process.

CSPT: 40.

IMPACT OF SOME INSECTICIDES OF NEWER CHEMISTRY OF MOLECULES AGAINST *S. dorsalis* (Hood) AND COST BENEFIT RATIO IN LATERITIC ZONE OF WEST BENGAL

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The present investigation was conducted in agricultural farm of Palli Siksha Bhavana, Visva-Bharati, Sriniketan, West Bengal in 2018 with objective impact of some insecticides of newer chemistry of molecules against *S. dorsalis* and Cost: Benefit ratio of chilli fruit production in different treatments. Experiment was carried out in randomized block design (RBD) with 13 treatments including untreated control *viz*., T1 : Emamectin benzoate 5% SG, T2 : Ethion 50% EC,T3 : Profenofos 50% EC, T4 : Thiomethoxam 20% WG, T5 : Cyantraniliprole 10.26% OD,T6 : Diafenthiuron 50% WP, T7 : Spiromesifen 22.9% SC, T8 :Imidacloprid 17.8% SL, T9 : Buprofezin 25% SC, T10 : Fipronil 5% SC, T11 : Lamdacyhalothrin 5% EC, T12 : NSKE (5%), and T13: (control). Results on bioefficacy of different insecticides revealed that pre-treatment count of insect population was higher than the post treatment count. However, among the treatments, the order of efficacy after first spraying in terms of reduction of thrips population over control was T4 (96.16%)> T8 (92.93%) T1 (92.39%)> T6 (91.24%)> T5 (88.96%)> T3 (87.74%)> T11 (87.34%)> T10 (87.19%)> T9 (85.01%)> T2 (82.52%) T12 (80.46%)> T7 (76.18%) while after second spraying

it was T4 (76.39%)> T1 (70.58%)> T6 (69.86%)> T8 (69.66%)>T5 (65.46%)> T3 (65.14%)> T11 (63.40%)> T10 (61.99%)> T9 (60.62%)> T2 (58.56%) T12 (53.46%)> T7 (47.17%).Results on fruit yield indicated that all the treatments produced significantly higher yield than the untreated control. Analysis of incremental cost-benefit ratio revealed the superiority of T4 treatment (5.81:1) over other treatments.

Keywords: Bioefficacy, Newer chemical, insecticides, Chillithrips, C: B ratio

CSPT: 41.

BIOTECHNOLOGICAL APPROACHES: IMPORTANCE AND USE IN INSECT PESTS MANAGEMENT

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To meet the demand of overgrowing populations of world, billion dollars have been used to increase the production of food crops. But due to insect pest attack, about 40 % of crop is lost every year in developing countries. Now days, the synthetic insecticides are widely used for insect pest management. Over the years the widespread use of insecticides has led to development of resistance in insects, a reduction in beneficial insect populations and many harmful effects on humans and the environment. Due to these problems, researchers develop some eco friendly management strategy using the biotechnological approaches which utilizes various tools and techniques of engineering, molecular and plant biotechnology. The application of transgenic technology includes genetically modified insect-resistant varieties (GM crops) by genetic engineering. Crops expressing Cry toxins derived from *Bacillus thuringiensis* (Bt) have been planted globally, and have an important role in pest control. In addition to Bt genes, some other new genes have been developed which are used as biological weapons for the control of insect pests. Proteinaceous insect toxins (scorpion toxin, mite toxin, trypsin inhibitor, protease inhibitor, alpha-amylase inhibitor), hormones (eclosion hormone, diuretic hormone) and metabolic enzymes (juvenile hormone esterase) introduced into NPV (Nuclear Polyhedral Virus) and GV (Granulosis Virus) genome virus which are used as bio pesticides without any harmful effects. Biotechnology can have a positive impact on increasing food security by decreasing the insect attack and can contribute to the sustainability of modern agriculture.

Keywords: Biotechnology, genetic engineering, molecular biology, biological weapons, bio pesticide

CSPT: 42.

NANOTECHNOLOGY: THE MOST PROMISING NEW TECHNOLOGY IN PEST MANAGEMENT

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Traditional methods used for pest management are now becoming ineffective due to over use of chemical pesticides which have adverse effects on animals, humans and environment. Therefore worldwide scientists are now adapting the environmentally safe, green technologies; nanotechnology. Nanotechnology is helpful to meet the food security challenges; targeted delivery of pesticides, enhance the seed germination and plant growth, foster crop yield, improve food quality, control of pestiferous insects that destroy crops and their products in the field as well as in storage. The potential uses and benefits of nanotechnology are very vast. These include management of insect pests through the formulations of nanomaterials-based insecticides called nanopesticides. In technical terms, the word "nano" means 10^{-9}, or one billionth of something and the name nanopesticides; though it is made up of nanometer

sized particles. Nanopesticides are consisted of organic ingredients (e.g., active ingredients, polymers) and/or inorganic ingredients (e.g., metal oxides).A number of formulation types have been used including nanoemulsions, nanocapsules, nnanogels, nanospheres and products containing immaculate engineered nanoparticles, like metals, metal oxides, and nanoclays. Nanoencapsulation is currently the most promising technology for protection of the crop plants against insect pests. Nanoparticles only start working effectively after they are placed in a desired location that means they must remain inactive until the active compound is released. As compared to other pesticide formulations, nanoformulations are used to increase the solubility of poorly soluble insecticides and protect the active ingredients from premature degradation. Thus there is a great scope to exploit nanotechnology in pest control programmge.

Keywords: nanotechnology, nanopesticides, active ingredients, encapsulation, solubility.

CSPT: 43.

DIRTY PANICLE DISEASE OF RICE: AN EMERGING THREAT FOR PROFITABLE CULTIVATION UNDER CHANGING AGRO-CLIMATIC CONDITIONS OF MADHYA PRADESH, INDIA

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Rice (*Oryza sativa* L.) is the staple food of majority of people living in Indian subcontinent. Grown in 160 million ha with 493 million tons milled rice production, it provides 27 percent dietary energy, 20 percent dietary protein and 3 percent dietary fat.Productivity of rice is often adversely affected by biotic-stressors that include blast, bacterial blight and sheath blight. Recently, it is realized that due to climatic variations, frequent and continued rainfall particularly near harvest growth stage, glume discoloration or dirty panicle has emerged as major threat. It is a complex due to infection of several microorganisms on glumes and kernel that leads with development of inferior seed setting with lower sowing seed quality of the produce. The discoloration leads to consumer's non-preference and poor marketability with altered seed germination, seed emergence, vigour, viability and test weight.Status of rice diseases determined in 42 rice varieties, 19 Jawahar Rice Hybrids, 111 Jawahar New Plant Type Lines, 23 Land races revealed the incidence upto 27.0 percent in Kharif 2017 and 2018. Incidence was maximum in 4th week of September when the average temperature was 27.42 C, average relative humidity was 83 % and rainfall 21.0mm.Analysis of discolored seeds revealed the association of 17 mycoflora as detected by Standard Blotter and Agar plate method. *Alternaria alternata, Fusarium moniliformae, Curvularialunata, Helminthosporiumoryzae, Aspergillus niger* were predominant. Studies reveled that discoloration ranged from ashy grey to black, dark brown, light pink to dark red and light brown shades in infected seeds.

CSPT: 44.

PHENOPHASIC STUDY OF RICE VARIETIES UNDER DIFFERENT CROP GROWING ENVIRONMENT

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A field experiment was conducted during kharif season of 2018 on the topic entitled “Phenophasic study of rice varieties under different crop growing environment” at N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The experiment consisted of nine treatment combinations comprised of three crop

growing environment viz. July 15th, July 25th and August 04th and three varieties viz., NDR-97, NDR-2064 and BPT-5204. Results reveal that higher days taken to all phenophases from tillering to physiological maturity were recorded in crop growing environment of July 15th followed by July 25th. Among the varieties, BPT-5204 recorded higher days taken to physiological maturity followed by NDR-2064. Maximum accumulated thermal unit (*2203.1°C* days) was taken in crop growing environment of July 15th followed by the July 25th (2089.8°C days). Among the varieties, maximum accumulated thermal unit in variety BPT-5204 (2367.2°C days) followed by NDR-2064 (2113.7°C days). Maximum thermal use efficiency of (0.51g/m^2/°C days) was recorded in July 15th at *Physiological Maturity* followed by July 25th (0.475g/m^2/°C days). NDR-2064 possess maximum TUE of 0.535g/m^2/°C days at *Physiological Maturity* followed by BPT-5204 (0.505g/m^2/°C days). The variety of rice NDR-2064 was found suitable for higher growth, yield attributes and yield. Crop growing environment of 15th July and variety NDR-2064 possess congenial weather and harvested maximum growth, yield attributes and yield of rice. Relationship between Accumulated Thermal Unit (ATU) v/s Dry matter accumulation and CGR under crop growing environment of 15th July of transplanting and dry matter accumulation and CGR under NDR-2064 variety of rice were developed. Trend line indicated that increase in ATU, increased the dry matter and CGR linearly in both crop growing environment (15th July) and as well as in rice variety NDR-2064.

CSPT: 45.

STUDIES ON ACCUMULATED THERMAL UNIT OF RICE (*Oryza sativa* L.) CULTIVARS UNDER VARYING CROP GROWING ENVIRONMENT

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A field experiment was conducted during *kharif season* of 2018 on the topic entitled "Studies on the thermal unit of rice (*Oryza sativa L.*) cultivars under varying crop growing environment." in sandy loam soil of N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The experiment consisted of nine treatment combinations comprised of three transplanting dates *viz*.July 15th, July 25th and August 04th and three varieties viz., NDR-97, NDR-2064 and BPT-5204. Results reveal that different phenophases of rice markedly varied with only dates of transplanting but also different weather variables which ultimately create the different crop growing environment to harvest the yield accordingly. Highest Growing Degree days (GDD) was recorded in growing environment of July 15th (2158.5 ^{0}C) transplanting at all the phenophases followed by July 25th (2059.7 ^{0}C) and August 04th (1934.5 ^{0}C) transplanting while among the variety BPT-5204 (2223.5 ^{0}C) recoded highest GDD due to occurrence of long duration .Variety NDR-2064 found suitable for higher productivity (48.70 q/ha) followed by BPT-5204(46.69 q/ha) and NDR-97 (32.44 q/ha). Highest heliothermal unit was recorded in date of transplanting on August 04th at vegetative stage (8973.5 ^{0}C hrs.) and reproductive stage (13004.9 ^{0}C hrs.) which was superior over July 15th at vegetative stage (8295.0 ^{0}C hrs.), reproductive stage (12765.7 ^{0}C hrs.) and July 25th at vegetative stage (8262.4 ^{0}C hrs.), reproductive stage (12553.0 ^{0}C hrs.). Highest photothermal unit was recorded in date of transplanting on July 15th at vegetative stage (22075.1 ^{0}C hrs.) and reproductive stage (28492.2 ^{0}C hrs.) which was superior over July 25th at vegetative stage (21143.7 ^{0}C hrs.), reproductive stage (28011.9 ^{0}C hrs.) and August 04th at vegetative stage (17775.9 ^{0}C hrs.), reproductive stage (23600.7 ^{0}days hrs.). Highest thermal use efficiency (TUE) was recorded in crop growing environment of July 15th (0.554 gm^{-20}days) transplanting at all the stage followed by July 25th (0.510 gm^{-20}days) and August 04th (0.509 ^{0}days) transplanting while among the variety NDR-2064 (0.593 gm^{-20}days) recoded highest TUE followed by BPT-5204 (0.551 gm^{-20}days) and NDR-97 (0.466 gm^{-20}days).

CSPT: 46.

PRODUCTIVITY AND ECONOMIC FEASIBILITY OF LATERAL ARRANGEMENT AND DRIP FERTIGATION IN AEROBIC RICE

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The experiment entitled "Productivity and economic feasibility of lateral arrangement and drip fertigation in aerobic rice" was conducted at the Instructional-cum-Research Farm, I.G.K.V, Raipur, (C.G.) during *kharif* season of 2018. The soil of experimental field was clayey (*Vertisols*) in texture, locally known as "*Kanhar*" which was low, medium and high in available nitrogen, phosphorus and potash, respectively. The trial was laid out in strip plot design *viz.,* horizontal strips consist 3 lateral arrangement and vertical strips consist 4 nutrient management with 12 treatment combinations. The treatments consisted of 3 lateral arrangement M_1- lateral at 25 cm (1LPH/0.3 metre spacing), M_2- lateral at 50 cm (2LPH/0.3 metre spacing) and M_3- conventional practice and 4 nutrient management of N_1- 50 % RDF, N_2 – 100 % RDF, N_3 – 150 % RDF and N_4– STCR- based fertilizer recommendation. Aerobic rice variety Indira aerobic -1 was used for trial. The sowing was done on 20th June, 2018 at 20 cm of spacing and harvesting of crop was done on 7th October, 2018. The results revealed that the all the growth parameters like plant population (m^{-2}), plant height (cm), number of leaves $hill^{-1}$, dry matter accumulation $hill^{-1}$ (g), number of tillers (m^{-2}), leaf area $plant^{-1}$, leaf area index, crop growth rate (g m^{-2} $plant^{-1}$ day^{-1}), relative growth rate (g g^{-1} $plant^{-1}$ day^{-1}), yield attributing characters *i.e..*, total no. of panicles m^{-2}, total number of grains $panicle^{-1}$, Test weight (1000 grain weight in gm), sterility percentage, grain yield t ha^{-1}, straw yield t ha^{-1}, water use efficiency, gross return and net return were significantly higher under lateral arrangement at 25 cm (M_1). However, lowest value of all these parameters was obtained in conventional practice (M_3). Similarly, all these characters were also higher among nutrient management with application of STCR based fertilizer (N_4). Remarkably, lowest values were obtained with application of 50 % RDF (N_1). B:C ratio was recorded higher under lateral arrangement at 50 cm (M_2). In respect to nutrient management, B:C ratio was observed highest with the application of STCR- based fertilizer (N_4). However, lowest B:C ratio was observed under conventional practice (M_3) and application of 50 % RDF (N_1) for lateral arrangement and nutrient management, respectively. The maximum uptake of NPK was recorded with lateral arrangement at 25 cm (M_1). Among nutrient management, the maximum NPK uptake was observed with application of STCR- based fertilizer (N_4). The lowest uptake of NPK was recorded under conventional practice (M_3) and application of 50 % RDF (N_1) for lateral arrangement and nutrient management, respectively. The interaction between lateral at 25 cm (M_1) with application of 150 % RDF (N_3) gave significantly highest grain yield but it was statistically similar with lateral at 25 cm (M_1) with N_4 and lateral at 50 cm (M_2) with N_3,N_4treatments.

CSPT: 47.

COLOUR POLYMORPHISM IN *Spodoptera exigua* (Hub.)

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Polymorphism is the appearance of "forms" or "morphs" showing variation in colour and number of attributes within a single species. In Lepidoptera, polymorphism can be seen in different stages as well sexes of insects like among the larvae or adults and also between individuals in a population and geographically isolated populations. It can be polyphenism between generations flying at different seasons of the year (seasonal polymorphism). The experiment conducted on *S. exigua*at Department of Entomology, College of Agriculture, PJTSAU, Hyderabad during December 2017 to January 2018 (Temperature, 20 to 25°C and RH, 54 to 55 per cent), pale green to yellow in

color during first and second instars, but acquired pale stripes during third instar. While at fourth instar stage, larvae were somewhat darker dorsally having a dark lateral stripe. Larvae during the fifth instar stage were quite variable in appearance, showing color polymorphism, tending to be green, black, pink or yellow color with or without stripes dorsally or ventrally on the body. Colour polymorphism was clearly observed in the fifth instar of *S. exigua* fed with chickpea leaves recording about 34 morphs with a range of colours i.e., green, black, pink and yellow being dominant with combination of colours. Present results might be due to the competition for food because of high population density feeding on a definite quantity of food.

CSPT: 48.

DAIRY AND ANIMAL HEALTH: INNOVATIONS AND CHALLENGES AHEAD

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Livestock plays a vital role in Indian economy and farming system. About 20.5 million people depend upon livestock for their livelihood. India ranks first amongst the livestock production which is around 512.05 million. It also provides employment to about 8.8% of the Indian population Livestock sector contributes 4.11% GDP and 25.6% of total Agricultural GDP. The milk production is around 176.3 million tones ranking first amongst the milk production in the world. Around 46 per cent of the milk is consumed in the form of liquid milk, 47 per cent as traditional dairy products and 7 per cent as western dairy products. Although India is one of the world's leading milk producers, yet the northern parts of the country are facing acute shortage of milk supply. Also, maximum numbers of farmers are doing this business but still lack of complete knowledge, mismanagement, lack of facilities and lack of modern technology are some of major obstacles in front of this business. In order to achieve greater profitability, quality standards are to be improved. Milk quality testing should be improved to eliminate peculiarities among society level and union level testings. Apart from these Business development services should be provided so as to enhance production. Various challenges are present in the sector like shortage of feed, marketing, pricing and regarding health conditions. Indian dairy research and development holds immense potential for the future. The focus is on the development of value-added products. Government has also taken certain initiatives for the development and growth of dairy sector. In future, dairy sector is going to emerge as the most sustainable and profitable sector. India has always shown an up-trend in plan allocations for the development of dairy sector. Increasing preference for a healthy lifestyle is expected to grow the Indian dairy industry.

CSPT: 49.

PRINCIPAL COMPONENT ANALYSIS FOR AGRO-MORPHOLOGICAL TRAITS IN GERMPLASM OF INDIAN MUSTARD (*Brassica juncea* L.)

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Indian mustard (*Brassica juncea*L.) is the second most important oilseed crop of the world as well as India. It comprises of several economically important species, which yield edible roots, stems, leaves, buds, flowers and seeds condiment. Total 70 Indian mustard germplasm accessions from ICAR-NBPGR, RS, Jodhpur were evaluated for 11 quantitative characters for determining the pattern of variation relationship among individuals and their characteristics. Principal component analysis was utilized to examine the variation and to estimate the relative contribution of various traits for total variability. There are six axes which accounted for 82.12% cumulative variance of the total variability for eleven agro-morphological traits. PC1 accounted 25.32% of the total variability contributed

by the traits like days to 50% flowering, days to maturity, plant height and siliqua length. PC2 accounted 18.71% of the total variation and the traits *viz.,* number of secondary branches, number of siliqua per plant, test weight and seed yield per plant contribute to the variation. Component 3 had the contribution from the characters like number of primary branches per plant, length of main branch and number of seeds per siliqua which accounted for 12.73% of the total variation. Days to 50% maturity, number of secondary branches per plant, number of siliqua per plant and test weight had contributed 9.51% of the total variation in PC4. PC5 and PC6 accounted 8.60% and 7.10% of the total variability respectively and contributed by the traits like length of main branch, siliqua length and test weight. Thus, the results revealed vast genetic variability exists in the germplasm lines which could be used for various breeding programmes for improvement in yield.

CSPT: 50.

BIOLOGY OF PINK BOLLWORM, *Pectinophora gossypiella* (Saunders) ON COTTON AND ITS ALTERNATE HOSTS

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Cotton is the most important commercial crop grown in India for fiber, fuel and edible oil under diverse agro-climatic conditions. Pink bollworm, *Pectinophora gossypiella* (Saunders) is emerging as a serious pest of cotton in India. In addition to cotton, has an host range of other Malvaceous plants. Generally the pest activity will be observed during late crop season after first picking of cotton. But from the past three years, I'ts incidence was recorded from early flowering stage. Present study on biology of Pink bollworm *Pectinophora gossypiella* (Saunders) was carried out in the Department of Entomology, College of Agriculture, PJTSAU, Hyderabad during 2018-19 under laboratory conditions at room temperature of 25±2°C and relative humidity of 70±2 per cent. For the study, field collected larvae were reared up to adult emergence and fresh adults were kept for egg laying on three hosts, Cotton (*Gossypium hirsutum*), Bhendi *(Abelmoschus esculentus)* and Indian Abutilon (*Abutilon indicum*). Results revealed that shortest life cycle of 41.25±2.05 days was on Bhendi fruits and longer period of 47.25±2.50 days on Bt cotton bolls. However it was 42.75±1.98, days on Abutilon and 44±2.10 days on non Bt cotton bolls. Highest fecundity was recorded on bhendi fruits (142.5±10.9 eggs) and lowest on Bt cotton bolls (135± 10.7) which was 137.5±10.6 and 137.5±10.5eggs on non Bt cotton and abutilon respectively. Minimum larval period of 18±1.40days on bhendi and maximum of 25.5±1.42 on *Bt cotton was observed where it was* 21±1.50 and 20±1.45 days on *non Bt, and abutilon. Pupal period ranged from 7.0±0.80 to 7.5±1.00 days and adult longevity ranged from 9±0.74, to 10±0.75 days on all the hosts. Present study revealed that bhendi was the most preferred host with short life cycle, high fecundity and short larval period followed by Non Bt cotton compared to Bt cotton and Abutilon.*

CSPT: 51.

DEVELOPMENT OF INDIGENOUS RHIZOBACTERIAL BIOFILM TO PROMOTE GROWTH AND INDUCTION OF DEFENSE AGAINST BACTERIAL WILT OF CHILLI

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Biofilms is well organized, cooperating community of microorganisms. Microbial cells affix to the surfaces and develop a biofilm that represent commixed group of microorganisms in which cells stick to each other within a self-engendered matrix of extracellular polymeric substances (EPS); however, their utility as biofertilizers cum

biocontrol agent has not been plenarily explored. The present investigation was geared towards in vitro development of biofilms utilizing fungal mycelia (*Trichoderma viride*) as matrices and *Bacillus subtilis* as partners. The Indigenous rhizobacterial isolates from different geographical regions were evaluated for the growth promotion and protection of *Capsicum annuum*L.(Chilli) against wilt disease caused by *Ralstonia solanacearum*. The total number of 48 rizobacterial strains was assessed against *R. solanacearum*. The maximum antagonism was recorded by few strains and GC-MS analysis revels series of chemical compound were involved in antagonistic behavior of these stain, which are identified at molecular level as *Bacillus subtilis*. Growth promotion activities were assessed by screening siderophore (60% were found positive), HCN, ammonia, IAA and P solublization and Two best isolates were selected for developing Biofilm and is confirmed by using confocal microscopy. Rhizobacteria based biofilm treated seeds showed enhanced germination, shoot length, root length, dry weight, total chlorophyll, total biomass of chilli plants and reduced diseases incidence and had positive effect on biochemical parameters as compared to uninoculated control. The results indicated that the specific activity of defensive enzymes *viz*. peroxidase and polyphenol oxidase was significantly up-regulated from zero hours onwards after inoculation of *Ralstonia solanacearum.*Biofilm based biofertilizers obviates the desideratum of developing combi- formulation of fungal and bacterial biocontrol agents which is cumbersome.

CSPT: 52.

PERFORMANCE OF NORMAL AND THERMO TOLERANT *Trichogramma japonicum* ON THREE MAJOR PESTS OF PADDY

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Rice (*Oryza sativa,L)* being the staple crop of South India, cultivated throughout the state of Telangana is infested by paddy stem borer, *Scirpophaga incertulas* and pink stem borer, *Sesamia inference* in normal rice and rice-maize cropping systems. Studies on evaluation of parasitic efficiency of two strains of *Trichograma japonicum i.e,* thermo-tolerant *T. japonicum and*normal *T. japonicum* against two lepidopteran pests was conducted at Indian Institute of Rice research station, Rajendranagar, Hyderabad during 2016-17. Results revealed that thermo-tolerant *T. japonicum* preferred *Sesamia inferens*over *Scirpophaga incertulas* whereas normal *T. japonicum* preferred *S. incertulas*over *S. inferens.* Average number of parasitized eggs by thermo-tolerant *T. japonicum* was high 156.80±4.23 and 111.80 ±4.26 on *S. inferens* and *S. incertulas* when compared to 82.20±2.10 and 96.20 ± 2.28 by normal *T. japonicum* on same hosts. Maximum adult emergence from parasitized eggs by thermo-tolerant *T. japonicum* was high as 15.80 ±2.86 in *S. inferens* and 9.40±2.19 on *S. incertulas* when compared with 9.80 ±1.64and 7.80 ±1.64 by normal *T. japonicum* on same hosts respectively. In particular high female progeny emergence of 69.83±5.41 and 68.13±8.14 per cent was recorded on *Sesamia inferens*and *Scirpophaga incertulas*, compared to 31.48±6.50 and 32.22±11.38 per cent by normal *T. japonicum* on same hosts respectively. Fecundity of thermo-tolerant *T. japonicum* was high as 65.00±5.24 on *S. inferens*and 48.00±5.70 on *S. incertulas* when compared with 31.80±9.73 and 35.40±2.30 by normal *T. japonicum* on same hosts respectively Thus results clearly gives an idea of exploitation of thermo-tolerant *T. japonicum* more in rice-maize cropping system for the management of *Sesamia inferens* when compared with *S. incertulas* in normal rice conditions.

CSPT: 53.

EFFECT OF WATERLOGGING CONDITION ON GROWTH, PHYSIOLOGY AND YIELD CHARACTERISTICS OF SOYBEAN GENOTYPES (*Glycine max* (L.) Merrill)

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Waterlogging is one of the environmental stresses that affect the growth, physiology and yield attributes injured due to the anaerobic environment. The objective of above investigation was to study the variation in Growth, physiological and yield characteristics in soybean genotypes/varieties. The genotypes/varieties were grown under excess moisture condition and recommended cultivation (Control). The experiment was carried out at the research of Plant Breeding & Genetics, RAK College of Agriculture, Sehore (M.P.) during 2014 seasons. A total of 25 soybean genotypes/varieties were grown in complete randomized block design with three replications having 5 rows 40cm apart with 3meter row length of every genotype. Water logging was created at 20 DAS, 40 DAS and 60 DAS in event of no rains after planting by applying water level about 5 cm above the soil surface. The mean data of the all characters viz. plant height, number of branches/plant, number of nodules/plant , dry weight of nodules/plant, ascent of sap in (%), transpiration rate in (mmol H_2O m^{-2} s^{-1}),harvest index (%) and yield (q/ha.) were computed for statistical analysis as per the standard procedure given by (Panse and Sukhatme 1989). The results revealed that soybean could grow and produce grains even under water logging condition. The significant differences were observed among the genotypes for major growth physiological and yield attributes except number of branches, number of nodules and ascent of sap in the year. Further the result revealed that high magnitude of characters like plant height, dry weight of nodules, transpiration rate harvest index and yield per hectare were found in genotypes/varieties RVS2007-7, JS2069, RVS2007-3, RVS2001-4 and JS2059 in the year as compare to control. Hence these genotypes/varieties were found suitable under waterlogged condition.

CSPT: 54.

VEGETABLE FARMING IN HILLS: A PROFITABLE VENTURE IN HIMACHAL PRADESH

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Vegetables are the major source of natural minerals, vitamins, roughages and form an important component of humans' diet. The demand for vegetables in the country is continuously increasing due to increase in total population and purchasing power of the people. Agriculture provides direct employment to 62 per cent of the working population of Himachal Pradesh. About 88 percent land holdings are marginal and small and growing of foodgrain crops are not profitable. Therefore, farmers are diversifying their cropping pattern towards vegetable crops. The diversification of agriculture towards vegetable crops increases income and employment in rural areas. Vegetables production is such an enterprise that gives higher tonnage per unit area in less time than cereals, provides better nutrient food value and leads to higher per unit area return. The present study has been undertaken in Nagrota Bagwan block of Kangra district to analyse the cost and returns and break even analysis of major vegetable crops. The farmers of this block grow vegetable crops on commercial scale; therefore Nagrota Bagwan block was purposively selected. Three stage random sampling technique was used to select a representative sample of 60 vegetable growers from the block. The B-C ratio was found to be greater than one for all kharif and rabi vegetable crops. It was emerged from the

analysis that all vegetables have shown a positive margin of safety. Among the kharif vegetables grown cucumber (89%) has shown the highest margin of safety whereas cauliflower (92%) among rabi vegetables. Break-even analysis revealed that vegetable cultivation is a profitable venture for the farmers of the study area.

CSPT: 55.

BIOTIC AND ABIOTIC STRESS MANAGEMENT FOR SUSTAINABILITY

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Environmental stresses biotic as well as abiotic show negative impact upon nature. Abiotic factors like high temperature, wind, salinity, acidity, drought, flood, metal toxicity and biotic factors including insects, fungi, bacteria and other disease causing organisms are the sole reason behind ill effect on biodiversity. More than 80 percent potential loss in yield occurs due to stress in farming. These stress factors interact with genetic construct of organisms altering the physiological & biochemical functions like transcription, translation& metabolism. Plants do have some resistance mechanisms to combat with stress like oxidative burst, detoxification and phytoalexins. There are some techniques used for sustainability are manipulation of flavonoids metabolism, transcription factors, ABA dependent pathways. For improvement of crops both qualitative & quantitative evaluation of data is required. For testing results model plant methods are employed. Several new techniques like Mass spectrometry (MS) used for metabolite profiling along with nuclear magnetic resonance (NMR) to study metabolites. Breeding of new varieties based on genomics can improve crop yield as well as environment.

Keywords: Environmental stresses, Biodiversity, Phytoalexins, Model plant, Mass Spectrometry

CSPT: 56.

RAPID GENERATION OF PURE ELITE INBRED LINES (DOUBLE HAPLOID) BY USING CRISPR/CAS9

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Based on 2015, Revision of World Population, the world population will reach 9.7 billion in 2050. Feeding the increasing population with nutritional security with challenges, changing climate, limited land and water. The yield of crops needs to be increase. Double haploids (DH) and genome editing using CRISPR/Cas9 are two powerful game changing technologies in crop breeding by rapid generation of pure elite inbred lines with desired traits. In vivo haploid induction for double haploids, has become popular for crop breeding, particularly in maize. Utilizing haploid inducer mediated genome editing (IMGE) approach, developed double haploid lines with desired traits within 2 generation. Using CRISPR/Cas9 for development of haploid inducer (HI) line in maize such as CAU5 are very popular. Nowadays, maternal haploids are created by pollinating with HI lines. Its chromosomes cab be doubled spontaneously in nature or by artificial chromosome doubling by treatment of mitotic inhibitors such as colchicine, generating double haploid lines. A gene responsible for haploid induction in maize is MATRILINEAL highly conserved in cereals, which encodes a pollen specific phospholipase A protein in pollen cytoplasm are required for successful sexual reproduction. By CRISPR/Cas9, create frame-shift mutation by insertion of 4bp(CGAG) adjacent to amino acid 380 present on fourth exon of MATRILINEAL(MTL) gene. The mutated gene codes for truncated protein, predicted that loss of C-terminal lipid anchor domain in truncated protein which causes altered membrane composition, disrupted intracellular signaling cascades or altered chromatin confirmation leading to failure in fusion of sperm/egg cell and sperm /central cell but haploid embryo formed. Chromosome can be doubled by artificial or spontaneous methods for double haploids. This approach should greatly accelerate future breeding via rapid generation of double haploids in only 2 generation as compare to repeated backcrossing at least 6 generation for 99.28% background purity.

Keywords: CRISPER/Cas9, Haploid Inducer, Double Haploid, IMGE.

CSPT: 57.

GENE THERAPY FOR LIVESTOCK

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Gene therapy means that new genetic material (DNA) is introduced into specific cells of the animal to compensate for abnormal genes or to make a beneficial protein.For the DNA to enter a cell it needs a carrier called a vector. Certain viruses are often used as vectors because they can transfer the new gene by infecting the cells. The viruses are modified so they can't cause disease.Scientists have cured diabetes in a large animal for the first time using gene therapy. After a single treatment session, involving a few simple injections, they recovered their health and no longer showed symptoms of the disease.The treatment delivers two functional genes that allows to sense and respond to changes in blood sugar levels. These are delivered in viral "vectors" by near-painless injections. Once in the bloodstream, the vectors are absorbed into the animal's muscle cells where the genes integrate or combine. The results show that the gene therapy works and is safe in large animals.The increasing number and variety of induced and naturally occurring animal genetic disease are beneficial for identifying new genes that cause disease, for understanding the cellular and molecular mechanisms of genetic diseases. Participation of veterinarians in these investigations is important because they have the knowledge and skills in animal physiology, pathology, medicine, and surgery that helps them to investigate important aspects of the treatment of genetic and gene-influenced diseases in animals. So our main objective is to find approaches that can help us in creating a healthier livestock with easy and economical means to get greater output in Food production. Moreover such an innovative study will help us in understanding the concept if climate change and genetic mutation and ways to get beneficial outcomes.

CSPT: 58.

IN SITU CONSERVATION OF OLD TEA SEED JATS IN NORTH EAST INDIA

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Tea is a cross pollinated, self incompatible and highly heterozygous plant. Before 1949 tea industry of India was only use the tea seeds for tea propagation purpose. After the development of vegetative propagation technique in tea sector, most of the old seed grown sections of tea estates of N.E India are uprooting extensively without thinking the importance of genetic variability. Old seed *jats* are the gold mine of Indian tea gene pool system. Tocklai has initiated a scheme under the umbrella of Tea Board, Government of India, "*In situ* conservation of old seed *jats*and seeds production" in the year of 2009 to avoid the rapid loss of exclusive old seed *jats*as a first and foremost priorities. It is highly essential to conserve the genetic loss of tea germplasm. *In situ* conservation plays a major role in the conservation of tea germplasm and its availability. It aims to maintain target species and the collective genotypes that represent under evolution. *In situ* conservation of tea seed *jats*has developed theoretical and methodological focus and achieved significant on-the-ground progress in the last 10 years. Tea growing regions summaries on *In situ* seed *jats*conservation activities are presented and recommendations are made for future action. Till date Tocklai has covered about 21 tea estates under *In situ* conservation program with estimated area about 8.5 hectares. This study reviews evidence regarding the rate of evolutionary change in both biotic and a biotic trait for tea plants and their wild relatives, placing these processes in a realistic context in which old seed *jats*is continue to exist. It identifies areas of evolutionary plant breeding research that would contribute to a deeper understanding of these processes as the basis for making them more useful for tea sustainability and development.

Keywords: Germplasm,*In situ* conservation, Seed *jats*, Tea, Variability, Plant gene pool

CSPT: 59.

LINE X TESTER ANALYSIS IN SWEET SORGHUM (*Sorghum bicolor* L.)

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Sorghum (*Sorghumbicolor* L.) is one of the most important forage crops grown and ranks first among the cereal fodder crops because of its high yield potential and palatability. Sweet sorghum is a crop with high biomass production, high brix percentage and low water requirement. However, it has not been studied much as a fodder crop. The palatability and quality of forage will increase by increasing the sugar content of sorghum stalk. Improvement in sweetness, leafiness and juiciness can be achieved by developing hybrids in sweet sorghum with high fodder yield combined with superior quality. Combining ability analysis helps in identifying the best parents that can be used to produce superior hybrids. The estimates of specific combining ability are useful to select the best crosses with regard to their performance. This study comprised of four lines, twelve testers, fourty eight crosses and three checks. 48 Sweet sorghum hybrids were developed by crossing four lines with twelve testers in line x tester fashion to study the combining ability effects and gene action governing the fodder yield and its component traits. The results revealed that non-additive gene action was predominant for most of the traits under study indicating that improvement of these traits is possible through heterosis breeding. Results indicated that line 185A and testers RSSV138-1, RSSV466 and RSSV404 as good general combiners for yield and yield contributing traits viz., plant height, number of leaves per plant, leaf length and leaf breadth. Hence, these can be used further as parents in developing hybrids. Based on *sca*effects, 185A x RSSV466, 185A x RSSV138-1, PMS71A x RSSV138-1 and PMS71A x RSSV404 were identified as promising crosses with high positive significant effects for yield and yield contributing traits. After further evaluation these cross combinations could be used in forage sorghum improvement programme.

CSPT: 60.

SUSTAINABLE CROP PRODUCTION UNDER WATER STRESS CONDITION

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Agriculture is the backbone of Indian economy as its single largest contributor to the GDP employs two-thirds of the national workforce. In India, more than 85% of the water used for irrigation purposes; water shortage aggravated by climate change will be felt in crop production that directly affecting the significant portion of the population in the region. According to UNDP 2006 report, 2.5 billion people will likely be affected by water stress and water scarcity by the year 2050 in South Asia. Therefore, agriculture and horticulture are highly sensitive to the consequences of water stress condition and small or marginal landholder farmers belongs to tropics and subtropics parts will be affected more. To mitigate these consequences, development of production system that improved water use efficiency, crop management practices like mulching with crop residues and plastic materials, growing crops on raised beds under excess water condition are feasible. Resilience strategies such as rainwater harvesting and recycling through farm ponds, percolation ponds for recharging of open wells, bore wells and injection wells for recharging groundwater are followed for enhancing water storage at farm level. Moreover, the introduction of water-saving technologies like direct-seeded rice, zero tillage and other resource conservation practices, which also reduce GHG emissions along with saving of water that would be effective towards fostering stability in agricultural production against increased climate variability.

Keywords: Agriculture, water stress, climate change

CSPT: 61.

HEAT STRESS AND ITS FOOTPRINT ON VEGETABLE

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Availability of quality vegetables with affordable price is an urgent need to ensure nutritional security of the growing population. Today, vegetable growers are facing problems mainly due to the effect caused by the change in environmental condition; especially problem arises due to extreme heat stress *i.e.* upsurgence of temperature beyond a threshold level for a period of time; that results in several physiological and anatomical distortions in vegetables. In cool-season leafy vegetables such as palak and spinach, at above 25^0C temperature, early bolting occurs and leaf succulence decreases quickly. At the same temperature peas become tough, lose the tenderness and enzymatic conversion of sugar to starch occurs while in radish and carrot, the root becomes tough and bitter before reaches its edible size. In thermosensitive crops like cauliflower high-temperature exposure leads to riceyness, leafyness, loose curd formation and yellowing of curds. In fruit vegetables like tomato, at 40^0C lycopene pigment is destroyed resulting in no red color development. To counter these effects, plants itself follows various adapting strategies such as escape mechanism (rolling of leaf blades, reducing leaf size, wax covering over leaf surface); avoidance mechanism (leaf abscission, leaving heat resistant buds) and tolerance mechanism (leaf orientation, transpirational cooling, alteration in membrane lipid composition). Besides, crop management practices such as the selection of proper method and date of sowing; growing heat resistant/tolerant cultivars, *etc*. are followed by vegetable growers to counter its adverse effects. Chemical mitigation strategies such as exogenous application of GA_3 and ethylene to improve seed germination, salicylic acid for thermo-tolerance capacity, *etc* are also very feasible towards heat stress. In spite of various strategies, vegetable growers are still facing problems to grow quality vegetables under heat stress. Therefore any research programme that may mitigate rising heat stress will be a positive step.

Keywords*:* Heat stress, threshold level, thermosensitive, bolting, resistant, thermotolerance

CSPT: 62.

STUDIES ON INDUCTION OF SOMACLONAL VARIATION IN SUGARCANE (*Saccharum officinarum*) AND VALIDATION OF MUTANT USING MOLECULAR MARKERS

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The present investigation reports the study induction of somaclonal variation in Sugarcane (*Saccharum officinarum*) and validation of mutant using molecular markers in variety Co261. Sugarcane is a perennial grass of the family Poaceae, primarily cultivated for its juice from which sugar is processed. Sugarcane yields are declining due to varietal degeneration and susceptibility to biotic and abiotic stresses. Smut of sugarcane is one of them, the disease can cause significant losses in cane tonnage and juice quality. As development of superior sugarcane varieties through conventional hybridization program is time consuming and has the problem of transfer of undesirable characters/traits into the newly developed hybrids/variety. In this connection, attempts were made to introduce genetic variability in sugarcane by *in vitro* culture techniques and mutation breeding. Induction of somaclonal variation is one of them which is described as the genetic variability present among cultured cells, plants derived from such cells or progeny of such plants. The treatment, MS medium supplemented with 3 mgl^{-1} 2,4-D found most suitable for callus induction and multiplication. The callus on application of EMS become pinkish brown in colour, shoot regeneration from callus cells was high in MS medium supplemented with 3 mgl^{-1}BAP gave dark gray or brown and sticky callus. Molecular

analysis of somaclonal mutants showed by primers polymorphism of DNA bands on validating with molecular markers *viz.* RAPD and ISSR markers gave 100 per cent polymorphism by two RAPD primers named OPA-01 and OPA-02 showed that out of 17 DNA samples of mutants considered, all were showing variations but one DNA sample was showing similarity with mother plant.

CSPT: 63.

EFFECT OF HEAVY METAL STRESS DURING SEEDLING GROWTH STAGE IN RICEBEAN [*Vignaum bellata* (Thunb.) Ohwi and Ohashi]

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Ricebean [*Vigna umbellata* (Thunb) Ohwi and Ohashi] is a leguminous crop which is mainly grown under limited management inputs for its ability to produce huge quantity of nutritive green fodder as well as high content of protein in seed. The exposure of plants to toxic levels of heavy metals triggers a wide range of physiological and metabolic alterations. The present experiment was undertaken to study the physiological and biochemical effects of equimolar concentrations of copper and lead on seedling growth in ricebean variety Bidhan 1. For this purpose, solutions of 50,100 and 200µM Cu and Pb supplemented in the form of $CuSO_4.5H_2O$ and $Pb(NO_3)_2$ were used. The results indicated no remarkable change in germination percentage of seed under either of the stresses, although the speed of germination showed variation and the effects of lead was found to be more drastic than copper at equimolar concentration. Summarizing the data on seedling growth it might be concluded that the effects of lead was found to be more drastic than copper at equimolar concentration. Under moderate to high intensity of metal stresses the leaf Proline content also decreased in the present experiment. The mild and medium stress treatments induced much higher activity of guaiacol peroxidase (GPOX) and ascorbate peroxidase (APX)in the leaf which then decreased somewhat as the intensity of stress increased. The leaf superoxide dismutase (SOD) activity on lead at its highest concentration was found to be detrimental for SOD activity for this variety of ricebean. Overall results indicated that the presence of lead in the growing medium was found to be more detrimental as compared to copper at equimolar concentrations.

CSPT: 64.

PURIFICATION AND CHARACTERIZATION OF ANTIMICROBIAL COMPOUNDS EXTRACTED FROM SOIL BACTERIA *Burkholderia seminalis* ISOLATED FROM DROUGHT AFFECTED REGION OF INDIA

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To meet the problems of antibiotic resistance developed in microbes, search for novel antimicrobial compounds from diverse natural resources has always been a challenge. The present study was designed to screen and isolate antimicrobial compounds from rhizobacteria. To study antimicrobial activity, 52 bacterial strains were isolated from various soil samples collected from 13different location of Uttar Pradesh. Among the 52 isolates, $A_2$9 (*Burkholderiaseminalis*) showed promising antimicrobial activity against selected pathogenic microorganism.*viz Fusarium oxysporium*, *Aspergillus niger, Microsporum gypseum,Trichophyton mentagrophytes*, *Trichoderma*

harzianum, Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus Klebsiella pneumonia and *Shigella boydii*. Crude extract of *Burkholderia seminalis* was purified in different solvent *viz* ethyl acetate, acetone, methanol and ethanol. Compounds in the extract were separated by thin layer chromatography (TLC). On the basis of spectral data, including IR spectroscopy, proton nuclear magnetic resonance (1H NMR) and mass analyses, the isolated compound was identified as $C_7H_{10}O_2N_2$ (hexahydropyrrolo [1,2-a]pyrazine-1,4-dione) showing strong antimicrobial activity. Treatment of selected pathogen with the purified compound resulted in significant growth inhibition. *Burkholderiaseminalis* was also positive for chitinase and cellulose activity. Results from the present study demonstrate the significance of the purified compound $C_7H_{10}O_2N_2$ (hexahydropyrrolo [1,2-a]pyrazine-1,4-dione) isolated from *Burkholderiaseminalis* as a potent biocontrol agent and the bacterium as a plant growth promoter.

Keywords: Rhizobacteria, Hexahydropyrrolo [1,2-a]pyrazine-1,4-dione, *Burkholderia seminalis*

CSPT: 65.

PHYSIOLOGICAL AND BIOCHEMICAL APPROACH OF COLD TOLERANCE IN GREEN GRAM

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Biotic and abiotic constraints seriously affect the productivity worldwide. The broadly recognized benefits of legumes in cropping systems-biological nitrogen fixation, improving soil fertility and broadening cereal based agro-ecologies are desirable now more than ever. Plants response with changes in their pattern of gene expression and protein products when exposed to low temperature. Thus ability to adapt has an impact on the distribution and survival of the plant and on crop yields. Many species of tropical and subtropical origin are injured and killed by non-freezing low temperatures and exhibit various symptoms of chilling injury like chlorosis, necrosis or growth retardation. Conventional breeding methods have met with limited success in improving the cold tolerance of plants involving inter-specific or inter-generic hybridization, genome sequencing. Among legumes, mung bean has acceptable intrinsic tolerance mechanisms, but many agro-physiological characteristics of the Vigna species remain to be explored. Mung bean has a distinct advantage of being short-duration and can grow in wide range of environment. Cold tolerance comprises multifaceted responses at the molecular and physiological and plant canopy levels. In low temperature, adaptation of physiological and biochemical processes may gradually lead to improvement of cold tolerance in plants. Greater understanding of physiological and biochemical mechanisms regulating cold stress will contribute to an evolving profiles of genes, proteins and metabolites responsible for mungbean survival. Some low temperature inducible genes have been isolated from plants. Most appear to be involved in tolerance to cold stress and expression of some of them are regulated by C-repeat binding factor/dehydration responsive element binding (CBF/DREB 1) transcriptional factors. We focus on abiotic stresses in legumes in general and mung bean in particular and highlight gaps that need to be bridged through future mung bean research. Recent findings largely from physiological and biochemical fronts are examined, along with a few agronomic and farm-based management strategies to mitigate stress under field conditions.

Keywords: Low temperature, Physiological mechanism, Biochemical mechanism, Mung bean, Odisha.

CSPT: 66.

ISOLATION AND CHARACTERIZATION OF PLANT GROWTH PROMOTING RHIZOBACTERIA AND THEIR EFFECT ON SEED GERMINATION AND VIGOUR INDEX OF BARLEY

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Plant growth-promoting rhizobacteria are free-living soil bacteria that aggressively colonize the rhizospheric region of plants and enhance the plant growth by direct or indirect mechanisms, when treated to seed or crops. In the present study we have investigated the efficiency of PGPR, whether they could increase seed germination rate as well as vigour index of barley seedling. 10 rhizobacterial strains were isolated from the rhizospheric region of various plants. All the rhizobacteria were screened for their plant growth promoting traits on the basis of biochemical screening, out of 10 rhizobacterial strains, 5 strains produced IAA in tryptone yeast medium , the range of IAA varied from 151.3 - 318.69 µg/ml, 3 isolates were found to induce phosphate solublizing activity by forming a clear transparent halo zone ranged from 0.5-1.5 cm, 7 isolates produce positive result for voges-Proskauer , 3 isolates showed positive result for methyl red production and all the 10 isolates were found to produce positive result for catalase activity & ammonia production. Barley plants/seeds were treated by all the rhizobacterial strains. Through pot trial method it was observed that the three isolates R4, R9 & R10 showed the increased percentage of seed germination and higher vigour index. Root and shoot length of individual seedling was measured to determine the vigour index. Seed inoculation by PGPR significantly enhanced seed germination and seedling vigour of barley.

Keywords: Rhizobacteria, Rhizosphere, Seed germination, Vigour index, PGPR

CSPT: 67.

CADMIUM TOLERANCE AND CHANGES IN PHYSIOLOGY OF GROUNDNUT [*Arachis hypogaea* L.] SEEDLINGS

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Among different non-essential heavy metals, cadmium is considered as a major toxic trace pollutant for humans, animals, as well as plants. Increasing concentration of cadmium in soil has posed a serious threat to sustainable agriculture and human health worldwide. In plants, cadmium is one of the most readily absorbed and most rapidly translocated heavy metal. It may cause a variety of toxicity symptoms like chlorosis, wilting, growth reduction and sometimes cell death also. The present experiment has been designed to study the physiological basis of cadmium tolerance at seedling growth stage in groundnut. For this purpose, seedlings of thirteen groundnut [*Arachis hypogaea*L.] genotypes were raised in sand culture using modified Hoagland solution and were exposed to cadmium stress by supplementing 300 µM cadmium. All the genotypes showed reduction in total dry weight of the seedling when subjected to cadmium treatment and on the basis of reduction in dry weight the tolerance indices (TI) were calculated. The STI of thirteen genotypes ranged from 65.72% to 93.81% in the present study. Among all the genotypes, ISK-2014-04 (TI= 93.81%), ISK-2014-12 (TI= 92.86%) and TG-51 (TI= 89.44%) were found to be the most tolerant, while the genotypes, ISK-2014-02 (TI=65.72%), ISK-2014-14 (TI= 66.91%) and ISK-2014-15 (TI= 67.45%) were found to have much lower STI and were considered to be the most susceptible to cadmium stress. Further physiological studies showed that the three tolerant genotypes recorded lower reduction in leaf chlorophyll content under cadmium treatment. The tolerant genotypes also registered much higher increase in proline content,

super oxide dismutase (SOD) and guaiacol peroxidase (GPOX) activity in their leaves under cadmium treatment compared to the susceptible ones. But the genotypes exhibited varied response to cadmium stress in respect of catalase (CAT) activity in leaf.

Keywords: Heavy metal, chlorosis, proline, guaiacol peroxidase, super oxide dismutase

CSPT: 68.

ISOLATION OF THERMOACIDOPHILIC A-AMYLASE THROUGH METAGENOMIC APPROACH

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Amylases (E.C.3.2.1.1) are compounds that catalyzes the hydrolysis of internal α-1,4-glycosidic linkages in starch and in low molecular weight products, such glucose, maltose and maltotriose units. There are many mesophilic amylases are used in the starch, dietary industries, fermentation, textiles and paper industries. The characteristic pH of starch slurry is around 4.5, and the ideal pH for the most industrial α- amylases is roughly 6 to 7.The Industries have to cool the slurry and increase the pH to achieve the ideal active conditions for mesophilic amylases, which increases the production cost. The idea is to use the thermoacidophilicα-amylase instead of mesophilic counterparts. In the present study we had isolated the α-amylase gene from hot springs of Uttrakhand which have 82 percent sequential similarity with the Bacillus sp. strain BI-19 and *Bacillus licheniformis* strain XL-1 alpha-amylase genes which are acidophilic as well as thermophilic in nature. The Bacterial community was isolated by Metagenomic approach and the isolation of α-amylase gene was through PCR amplification by the degenerate primers synthesized from the multiple sequence alignment (MSA) data of thermoacidiphiles strains which are already present in NCBI database.

Keywords: Thermoacidophile, Hot springs, Metagenomics, α-amylase, MSA, PCR.

CSPT: 69.

EFFECT OF MICROBIAL CONTAMINATION ON CHILLI SEEDS

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Chilli is an important commercial crop and India is the largest consumer and exporter of chilli peppers. But its production and productivity are hampered by many diseases of fungal, bacterial, viral and nematode origin. Majority of the pathogens attacking chilli crop are seed-borne in nature. Seed borne fungal pathogens cause enormous economic losses to chilli growers all over the world by preventing germination, inducing seedling mortality as well as morphological disorder and reducing seedling vigour. Three fungal seed borne pathogens and one bacterium were artificially inoculated by immersing the seed in fungal culture filtrate and bacterial suspension for over 30 minutes. The treated seeds were subjected to germination test carried out by paper towel method. After 8days of incubation they were observed for percentage of germination, seedling length and various abnormalities in germination and seedling vigour. The process was repeated for three varieties of chilli seeds released by Odisha University of Agriculture and Technology namely Utkal Ava, Utkal Rashmi and Utkal Ragini. The percentage of normal germination in the test varieties varied from 22% to 68% and rest exhibited different abnormalities. The abnormalities were categorized into three groups namely rudimentary shoot, rudimentary root and both rudimentary root and shoot or no germination at all. Seeds with different abnormality categories were incubated for microbial growth. Seeds with rudimentary shoot

revealed microbial association to an extend of 40.9%, of which maximum representation was by *Colletotrichum capsici* (11.36%) followed by *Fusarium pallidoroseum* (6.81%). Association of *Ralstonia solanacearum* and *Rhizoctonia solani*were to an extend of 4.54% each. Seeds with rudimentary root showed microbial association in 38.2% seeds, among which the association of *Colletotrichum capsici*was highest followed by *Fusarium pallidoroseum* and similar was the trend in seeds with rudimentary shoot and root. The study revealed that *Colletotrichum capsici a*nd *Fusarium pallidoroseum* are the most important pathogens rendering abnormalities in chilli seed germination.

CSPT: 70.

EFFICIENCY OF DIFFERENT COMPANION CROPS TO DEBAR THE ARTHROPOD COMMUNITY IN BRINJAL ECOSYSTEM

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Modern agriculture stresses on the injudicious application of broad spectrum toxic molecules to crops for higher productivity which essentially disrupts the ecological balance, results in the pest resistance and evolution of newer pest biotypes. Companion crops are those crops which are grown with the main crops in synchronization with their growing season to debar herbivory and for additional economic benefit. However, the main aim of growing companion crops to debar herbivory in brinjal ecosystem is mainly based on the plant's inherent characteristics of emitting several secondary metabolite molecules which debar the arthropod complexes and calls in the predators of the pests. In order to investigate the efficiency of different companion crops to debar the arthropod community in brinjal ecosystem two field experiments were conducted at Regional Research Station, New Alluvial Zones , Nadia, West Bengal during the period April,2017 to July,2017 (Summer) and October,2017 to February,2018 (Winter). Brinjal crops were grown in combination with seven different companion crops viz Brinjal, Turmeric, Cumin, Coriander, Onion, Tomato and Marigold in a Randomized Block Design. Population data of the Jassids, Epilachna beetle and *Tetrastichus* sp. were taken from the main crops during the fruiting period. Results so obtained in Summer brinjal crop 2017, revealed that the jassids population was least when the brinjal was grown in combination with turmeric (1.261) and highest when grown as sole brinjal (2.652). *Epilachna* beetle population is least when brinjal is grown with the marigold (0.612), while highest *Epilachna* beetle population is the highest in the tomato brinjal crop combination (2.064). However, the *Tetrastichus*sp predator population was least in the brinjal onion combination cropping (0.986) and was noticed to be highest in the sole brinjal cultivation(1.424). During summer brinjal cultivation with the companion crops, brinjal grown in combination with marigold showed highest yield (78.33 t/ha) , while brinjal grown with coriander showed lowest yield (28.167 t/ha). Pest population count during Winter season (2017-2018) revealed that the Jassid population was highest when brinjal is grown with turmeric (1.030) while least when the crop is grown as sole (2.672). *Epilachna* beetle count showed highest population count in brinjal -cumin and brinjal-tomato combination (1.217) while lowest population of *Epilachna* beetle was seen when brinjal is grown with coriander and turmeric as companion crops(0.612). Population of *Tetrastichus*sp count showed highest count in sole brinjal grown crops (0.958) while least population could be seen when brinjal is grown in combination with onion and tomato as companion crops (0.612). However, the yield of fruits showed highest in brinjal-marigold combination (71.33 t/ha) and least yield of 33.5 t/ha was obtained when brinjal is grown with the companion crop onion. Thus it could be concluded that brinjal grown with the companion crop was the most effective which debarred pest herbivores and resulted in the highest yield. However, brinjal grown with the companion crop onion was seen to be least effective and resulted in the least yield of brinjal.

Keywords: Brinjal, Companion crops, insecticides, herbivory, secondary metabolites

CSPT: 71.

SEX MANIPULATION IN CUCURBITACEOUS VEGETABLES THROUGH PLANT GROWTH REGULATORS

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Sex exploitation is certified to alter the ratio of male to female flowers within the individuals. A wide range of variation in sex forms ranging from primitive hermaphrodite to gynoecious advanced sex form is observed in cucurbitaceous vegetable crops. Sex manipulation in cucurbitaceae crops is regulated by hormonal, genetic and environmental factors. In regularly, female sex expression is promoted by low temperature and short photoperiod, which may influence the level of endogeneous hormones (ethylene, auxin and GA) which in turn influence the sex expression. Growth regulators can alter the sex ratio and sequence if applied at the two- or four-leaf stage, which is the critical stage at which the suppression or promotion of either sex is possible. The male to female flower ratio of cucumber plants is also regulated by plant hormones, ethylene and auxin promote the formation of female flowers, whereas gibberellins promote the formation of male flowers. The first report in any plant species of alteration of sex expression via exogeneous chemicals was done by the application of auxin shifted sex expression in cucumber towards femaleness. Gynoecious lines are obtained with the use of chemicals to induce staminate flowers. GA□ acts as an ethylene biosynthesis blocker which blocks the ethylene precursor due to which the ethylene production is hindered. Correspondingly AgNO□ acts as a ethylene action blocker avoids the ethylene action and increases male flower production. CEPA 150 ppm and NAA 50 ppm increased the total number of female flowers by 40 and 29 %, respectively in bittergourd by fsirst female flower at 10 to 12 days earlier than control at lower nodes.

Keyword: Sex manipulation, plant growth regulator, gynoecious lines, NAA, GA and AgNO3

CSPT: 72.

PHYTOTOXIC HAZARDS OF ARSENIC ON WHEAT AND ITS MITIGATION BY THE APPLICATION OF VERMICOMPOST AND ZINC SULPHATE

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Arsenic, a toxic metalloid, is typically considered a non-essential element for plant and may be toxic even at low concentration (in the μg L^{-1} range) to plants and animals. The accumulation of arsenic in plants not only affects the plant growth but also come into the food chain, which in turn, causes potential health risks to human beings. In a wide range of plant systems, arsenic toxicity and its tolerance studies have been carried out. Our study elucidates the phytotoxicity of arsenic (As) on wheat (HUW-234) seedlings and pre-application of zinc sulphate and vermicompost for mitigating the toxic effects of As. Seedlings of HUW-234 genotype of wheat (*Triticum aestivum* L.) were raised in pot soil culture using eight treatment combinations viz., Control (without arsenic, vermicompost and zinc sulphate), Vermicompost @ 15 $t.ha^{-1}$, $ZnSO_4.7H_2O$ @ 20 ppm Zn, Vermicompost @ 15 $t.ha^{-1}$ + $ZnSO_4.7H_2O$ @ 20 ppm Zn, $Na_2HAsO_4.7H_2O$ @ 30 ppm As, $Na_2HAsO_4.7H_2O$ @ 30 ppm As + Vermicompost @ 15 $t.ha^{-1}$, $Na_2HAsO_4.7H_2O$ @ 30 ppm As + $ZnSO_4.7H_2O$ @ 20 ppm Zn and $Na_2HAsO_4.7H_2O$ @ 30 ppm As + Vermicompost @ 15 $t.ha^{-1}$ + $ZnSO_4.7H_2O$ @ 20 ppm Zn. Perusal of data indicated that arsenic @ 30 ppm treated pots showed significant decrease in plant height, leaf area, total chlorophyll content and grain yield per plant as compared to pots with no arsenic treatment. In our experiment, zinc @ 20 ppm and vermicompost @ 15 tha^{-1} in arsenic treated pots were better in most of the parameters

as compared to no zinc and no vermicompost. Zinc @ 20 ppm and Vermicompost @ 15 $t.ha^{-1}$ alone resulted in significant increase in plant height, leaf area, total chlorophyll content and grain yield per plant. The highest plant height, leaf area, total chlorophyll content and grain yield per plant in arsenic treated pots were found in treatment supplemented with Zinc @ 20 ppm and Vermicompost @ 15 $t.ha^{-1}$, whereas, least of above parameters were recorded in pots without zinc and vermicompost supplementation.

Keywords: Arsenic, metalloid, wheat, phytotoxicity, vermicompost, zinc

CSPT: 73.

TARGET SITE OF INSECTICIDES IN INSECTS: RECENT DEVELOPMENT

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Insecticides are substances used to kill insects. They include ovicides and larvicides used against insect eggs and larvae, respectively. Insecticides are used in agriculture, medicine, industry and by consumers. Insecticides plays a pivotal role in pest management, Mode of action of insecticides is very important toxicological aspects to be clearly understood to develop a strategic plan against pests. Insecticides are claimed to be a major factor behind the increase in the 20th-century's agricultural productivity. Nearly all insecticides have the potential to significantly alter ecosystems; many are toxic to humans and/or animals; some become concentrated as they spread along the food chain. Insecticides have chemical structures that allow them to be classified based on the commonality of the active ingredient's chemistry. Thus, all members of an insecticide class have similar characteristics. The chemical structure of an insecticide generally defines its target site and its mode of action at that target site. Target site is defined as the physical location within an organism where the insecticide acts. Mode of action, alternatively, is defined as the action of an insecticide at its target site. In other words, the mode of action of an insecticide is the way in which it causes physiological disruption at its target site. Therefore, insecticide class, target site and mode of action are highly inter-connected concepts. Most of the insecticides commonly used can be technically classified as neurotoxins — i.e., their target site within the target organism is some aspect of the nervous system. Only a few of the commonly used insecticides, such as insect growth regulators (juvenile hormone analogs and chitin synthesis inhibitors) and a few miscellaneous active ingredients (borates, energy inhibitors and dehydrating dusts), do not target the nervous system. Insecticides that target the insect nervous system can be subdivided based on their specific target site within the nervous system. Specific neurological target sites include sodium and chloride channels and various components of the acetylcholine system. DDT and pyrethroids act similarly on sodium channels to keep them open leading to hyperexcitation. Indoxacarb inhibits sodium channels and certain subtypes of nicotinic receptors. Dieldrin, lindane and fipronil block GABA receptors. Imidacloprid modulates nicotinic receptors in a complex manner. Spinosads major target site appears to be nicotinic receptor. Insecticides that do not target the nervous system also can be subdivided by target site and mode of action, and include muscular calcium channel disruptors, insect growth regulators, inhibitors of energy production and non-specific cellular disruptors, as well as insecticides that act via desiccation (exoskeleton).

Keywords: Insecticides, neurotoxins, target, action

CSPT: 74.

BIORATIONALS: AN ALTERNATIVE TO CHEMICAL PESTICIDES

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In most of the developing countries, plant protection is mainly based on chemical pesticides. Which is the most effective and quickest method and farmers get spectacular result from it within a short period of time. But over reliance and misuse of pesticides created many problems in the agricultural ecosystem mainly, the development of

resistance in insects, pest resurgence, secondary pest out-break, environmental contamination and residue hazards, destruction of natural enemies of insect-pests, high input cost etc. Consequently, there is an urgent need to explore and utilize naturally occurring products for combating pests. There is a need to explore and develop a new method which would tackle most of the problems associated with conventional insecticides .i.e. Biorational methods. These involve the utilization of chemicals that suppress insect populations by modifying behaviour, disrupting growth and impeding reproduction of the insect populations. In other words, biorational or 'reduced risk' pesticides are synthetic or natural compounds that effectively control insect pests. These include: botanicals (neem, pyrethrum etc.), insect growth regulators (Chitin synthesis inhibitors, Ecdysteroid agonist, JH analogues, anti- juvenile hormones etc.) insect pheromones (mating disrupting hormones). All the above categories of biorationals have a significant role in managing insect-pests. The use of semiochemicals and of insect signalling still needs to be improved and commercialized. For example, Sex pheromones are used as treatments to reduce pest populations through mating disruption, or sexual confusion, by inundating a crop area with pheromone so that males cannot locate females, thus preventing reproduction. This strategy has proven to be highly effective with insects such as the oriental fruit moth, the pink bollworm and the diamondback moth.

Keywords: Biorationals, Resurgence, Pheromones, Semiochemicals

CSPT: 75.

EFFECT OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) ON GROWTH PROMOTION IN RICE (*Oyza sativa* L.)

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Plant growth promoting rhizobacteria (PGPR) are a heterogeneous group of soil bacteria inhabiting in the rhizosphere involved directly or indirectly in promoting plant growth. PGPR plays a significant role in sustainable agriculture by increasing crop production with a significant reduction of synthetic chemical fertilizers. The present study was undertaken to characterize four promising bacterial isolates (RRE3, RRE6, BHU3, BHU8) biochemically and to study the effect of inoculation of these strains singly as well as in combination on different plant growth parameters in rice. Strain BHU8 (*Pseudomonas saponiphila*) showed maximum IAA production and maximum siderophore production was exhibited by BHU3 (*Pseudomonas aeruginosa*). Effect of these endophytic PGPR strains individually and in coinoculation on plant growth parameters like shoot length, root length, shoot and root fresh weight, dry weight in rice cv. HUR105 was testedunderpolyhouseconditionalso. All the four PGPR strains and their combinations when applied through seed inoculation along with soil application were capable of significantly increasing root and shoot length, fresh and dry biomass of rice plants. RRE3 (*Burkholderia cepacia*) + BHU8 (*Pseudomonas saponiphila*) combination was identified as the best for improvement of shoot and root length, shoot and root biomass. Better result of the plants inoculated with consortium of bacterial strains than plants inoculated with single strain supports the synergistic effects. Enhanced growth response in plants is attributed to the stimulatory effect of microbes that produce or induce plant growth regulators.

Keywords: Rice, PGPR, IAA, siderophore, *Pseudomonas*, *Burkholderia*

CSPT: 76.

CROP ESTABLISHMENT AND NITROGEN MANAGEMENT STRATEGIES TO REDUCE GREENHOUSE GAS EMISSION IN DIRECT SEEDED RICE

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A field experiment was conducted at research farm, Bihar Agricultural University, Sabour during 2017 and 2018 to assess the impact of crop establishment and nitrogen management practices on productivity, profitability and green house gas emission in direct seeded rice (DSR). The experiment was conducted in split plot design with two crop establishment methods viz. zero tilled DSR and conventional DSR as main plot and with four nitrogen management practices viz. 100% nitrogen through neem coated urea, SPAD based nitrogen management, 75% through neem coated urea +25% nitrogen through Vermicompost, and ¼ nitrogen as basal and rest in equal three splits at 20, 40, 60 DAS as sub plot replicated thrice. The highest yield (44.6 q ha^{-1}), net return (46440 Rs ha^{-1}) and B:C ratio (1.4) were recorded from zero tilled plots. Further, highest yield (44.17 q ha^{-1}), net return (44880 Rs ha^{-1}) and B:C ratio (1.3) was obtained under split application of nitrogenous fertilizers among other subplot treatments. The methane (1.33 mg m^{-2} hr^{-1}) and nitrous oxide (0.00252 mg m^{-2} hr^{-1}) emission was recorded lowest in zero tilled plots and split application of nitrogenous fertilizer also emitted lowest values of 1.53 mg m^{-2} hr^{-1} methane, 0.00255 mg m^{-2} hr^{-1} nitrous oxide irrespective of phenological stages of crop growth. Moreover, a gradual decrease of methane and nitrous oxide emission was found from maximum tillering stage to harvesting stage. Zero tilled DSR with split nitrogen fertilizer application ascribed lowest greenhouse gas intensity among the other crop establishment and nitrogen management options. Thus, zero tilled method of crop establishment with split application of nitrogenous fertilizer could be a remunerative and environmentally stable method for direct seeded rice cultivation.

Keywords: Direct seeded rice, Greenhouse gas intensity Nitrogen management, Zero tillage.

CSPT: 77.

THE EFFECTIVENESS OF BIO-PESTICIDES TO CONTROL BANANA PEST *Odoiporus longicollis* IN BIHAR

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In course of investigations on the bionomics of banana pests in Bihar during 2015-16, an attempt had been taken to control the infestations of banana pest *Odoiporus longicollis* , the serious pest of banana (*Musaparadisiaca*), with the help of some bio-pesticide of plant origin instead of chemical insecticides. An attempt had been taken to test the relative impact of these bio-pesticides, such as Neem leaf powder, Neem cake, Neem seed and cow dung to control the infestation of banana pest *Odoiporus longicollis*. The application of Neem (*Azadirachta indica*) products was done at rhizome pit of infested banana along with cow dung. Results showed, application of Neem seed & cow dung is relatively more effective than mixture of Neem leaf & cow dung and Neem cake & cow dung. But the yields were very neck to neck among these three types of application. Final data showed applications such bio-pesticides can control 62.35% of the pest infestation.

Keywords: Banana pest, Insecticides, Bio-pesticides, Neem, Cow dung

CSPT: 78.

WEED MANAGEMENT IN INDIAN MUSTARD [*Brassica juncea* (L.) Czern & Cosson]

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A field experiment was conducted at Agronomy Research Farm, N. D. University of Agriculture & Technology, Kumarganj, Ayodhya (U. P.), India. During the *Rabi* season of 2017-2018 to access the "Weed management in Indian mustard [*Brassica juncea* (L.) Czern & Cosson]".The experiment was conducted with Randomized Block Design and replicated three times.The experiment comprised of nine treatments *viz*.T_1- Weedy check, T_2- One hand weeding at 30 DAS, T_3- Two hand weeding at 20 &40 DAS, T_4-Pendimethalin (PE) 1.00 ai kg ha^{-1} T_5- Oxyflorafen (PE) 1.00 ai kg ha^{-1}, T_6-Isoproturan (PE) 1.00 ai kg ha^{-1} ,T_7-Pendimethalin (PE) 1.00 ai kg ha^{-1} + One hand weeding at 30 DAS, T_8-Oxyflorafen (PE) 1.00 ai kg ha^{-1}+ One hand weeding at 30 DAS and T_9-Isoproturan (PE) 1.00 ai kg ha^{-1}+ One hand weeding at 30 DAS. Comparable to hand weeding at 20&40 DAS pre-emergence application of pendimethalin @ 1.00 kg ai ha^{-1}supplimented with one hand weeding at 30DAS registered the lowest weed density and their dry weight and uptake of nitrogen by weeds in Indian mustard crop. Weed infestation during entire crop period of mustard reduce the yield by 33.33 per cent. The growth characters like plant height, leaf area index, number of branches and dry matter accumulation $plant^{-1}$ days taken to maturity, yield and yield attributes like number of siliquae, number of seed, length of siliquae, seed and stover yields, and nitrogen uptake by mustard crop were observed significantly higher with hand weeding at 20& 40 DASand closely followed by pre-emergence application of pendimethalin @ one kg a i ha^{-1}+ one hand weeding at 30 DAS during course of investigation. On the basis of economics, it may be concluded that pre- emergence application of pendimethalin@ 1.00 ai kg ha^{-1} alone in Indian mustard was found more remunerative which recorded the net return per rupee investment of Rs. 2.76.

Keyword: Weeds, Indian mustard (*Brassica juncea* (L.), and chemicals.

CSPT: 79.

WEED FLORA AND YIELD OF DIRECT SEEDED RICE INFLUENCED BY CROP ESTABLISHMENT METHODS AND WEED MANAGEMENT PRACTICES

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An experiment was conducted in sandy clay loam soil using rice variety 'Rajendra Kasturi' at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, during *kharif* season of 2016 and 2017. The experiment was carried-out in split-plot design involving three crop establishment methods (S_1 - ZT-DSR + *Sesbania* co-culture, S_2 - ZT-DSR + residue + *Sesbania* co-culture and S_3 - Conventional till DSR + *Sesbania* co-culture) in main plots and five weed management practices (W_1- Pendimethalin (1000 g ha^{-1}) *fb* bispyribac sodium (25 g ha^{-1}) at 20 DAS, W_2 - Pendimethalin (1000 g ha^{-1}) *fb* pyrazosulfuron (30 g ha^{-1}) at 20 DAS + one hand weeding at 45 DAS, W_3- Pendimethalin (1000 g ha^{-1}) *fb* chlorimuron + metsulfuron (4 + 4 g ha^{-1}) at 20 DAS + one hand weeding at 45 DAS, W_4 - Weed free and W_5 - Weedy check) in sub-plots with three replications. Results showed that among the crop establishment methods ZT-DSR + residue + *Sesbania* co-culture was found effective in reducing crop-weed competition, recorded lower weed density, higher grain yield and benefit: cost ratio during both the years. However, among weed management practices, Pendimethalin (1000 g ha^{-1}) *fb* chlorimuron + metsulfuron (4 + 4 g ha^{-1}) at 20 DAS

+ one hand weeding at 45 DAS was recorded lowest weed density and higher grain yield and benefit: cost ratio than other treatments during both the years of experimentation.

Keywords: Crop establishment method, DSR, Pendimethalin, Rice, *Sesbania*, Zero-tillage

CSPT: 80.

STUDIES ON FARMERS' FIELD OF YELLOW GYPSUM FROM LD SLAG AS A SOURCE OF PLANT NUTRIENTS IN DIFFERENT CROPS

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This field trial in farmer`s field at Patamdah revealed detailed socio-demographic aspects on application of Yellow Gypsum on Rice cultivation at Bansgarh village and surroundings, near Jamshedpur, Jharkhand. 27 farmers were selected for the trial and were supplied with ample amount of Yellow Gypsum to be applied according to the dose determined and co-ordinated scientists of R&D wing of M/S Tata Steel Ltd and Soil Science Research Scholars of BCKV, Nadia, West Bengal. This trial is one of its kind due to the applicability of Yellow Gypsum, which is an industrial byproduct of a waste material from iron ore processing, called LD slag. The observation of its potential upon different kinds of farmer`s cultivation practice and a varied kind of fields, makes it unique too. Fields at Bansgarh can roughly be divided under upland, medium and lowland topographic positions. Upland soils are solely dedicated for vegetable cultivation, whereas medium and lowland soils are mainly used for rice cultivation in kharif and vegetables in winter. Application of Yellow Gypsum in the field resulted in significant increase of different soil parameters viz. pH and the amounts of available Ca, Mg, S, Fe, Mn, Zn and decrease in soil EC, Oxidisable organic Carbon content, available N, P, K and exchangeable Cu during tillering as well as at Harvest stage of rice in the soils collected from Patamda area of Jharkhand. Significant increase in the nutrient concentration in plants during vegetative as well as at harvest stage due to application of Yellow Gypsum was observed. While application of Yellow Gypsum effectuated increase in total N, P, Fe, S, Mg, Mn and Cu content, a decrease in the total K content and the differences in the concentration of different heavy metals viz. Cd, Cr, Ni and Pb were also observed. The results are elucidated in detailed report.

Keywords: Yellow Gypsum, Waste material, LD Slag, Rice, Nutrient Concentration

CSPT: 81.

EVALUATION OF BOTANICALS AS GRAIN PROTECTANTS AGAINST *Callosobruchus chinensis* (Linnaeus) ON CHICKPEA *(Cicer arietinum* L.*)*

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The present study on "Evaluation of botanicals as grain protectants against *Callosobruchus chinensis* (Linnaeus) on chickpea *(Cicer arietinum* L.*)"* was carried out at departmental laboratory of Chandra Shekhar Azad University Of Agriculture & Technology Kanpur. The chickpea variety *Radhey* was selected to conduct the investigation on *C. chinensis.*The experiments were based on "complete randomized design" (CRD) with 7 treatments and 3 replications. To evaluate the efficacy of different indigenous botanicals as seed protectants viz.t_1-leaves of *neem*, t_2 leaves of *dhatura*, t_3*castor*, t_4 leaves of oak and vegetable oils viz.., t_5 mustard oil, t_6 linseed oil and t_7 coconut oil on larval period of *C. chinensis.*It is clear from that the treatment of ***neem*** leaf powder @ 15g/kg of seed

showed their superiority over all other treatments to maximize the larval period of the pest (23.97 days). Significantly more larval period (22.95 days) was also recorded in the grains treated with mustard oil @ 3 ml/kg of seed followed by *dhatura* leaf powder @ 15g/kg of grains, linseed oil and coconut oil @ 3ml/kg of grains which were 22.92, 21.54 and 18.98 days, respectively. Treatment with castor leaf powder and oak leaf powder @ 15g/kg of seed were found to be at par with each other in increasing the larval period viz., 21.22 and 19.71 days, respectively, whereas coconut oil @ 3ml/kg (18.98 days) of seed was observed least effective, but superior to the untreated check (17.31 days).

CSPT: 82.

ASSESSMENT OF FLUORESCENT PSEUDOMONADS FOR PLANT GROWTH PROMOTING TRAITS AND SALT TOLERANCE

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Rhizosohere is well known to be a habitat for plant growth promoting bacterial communities that extensively colonize in rhizosphere and intensify the crop productivity. It entitle the plants to resist the several abiotic stresses like salinity, drought, heat and cold etc. Fluorescent pseudomonads are such kind of bacteria which represents itself as a most acceptable rhizobacteria having several of the plant growth promoting characters such as indole-3-acetic (IAA) production, phosphate solubilisation etc. Fluorescent pseudomonads are also reported to cope up with salinity in many plants. The present study was taken with an aim to isolate and assess the fluorescent pseudomonads from rizospheric soils of various locations of Hamirpur district of Uttar Pradesh and screen them for salinity tolerance. A total of 8 fluorescent pseudomonad isolates were obtained after screening of 58 isolates on King's B agar media from rhizospheric soils of 10 locations of Hamirpur having various crop grown. When these 8 isolates were tested for IAA production all were found positive with maximum amount of 141.18 mg/L by isolate HST4-7. When these isolates were tested for P-solubilization using tri calcium phosphate as the key ingredient for phosphorus, the maximum amount of phosphate was solubilized from insoluble form by isolate HST5-6 (7.756 mg/L). These isolates were further tested for salinity tolerance qualitatively at four concentrations of sodium chloride (NaCl) 250, 500, 750 and 1000 mM respectively on Pikovskaya agar media supplemented with bromocresol purple. The result was promising and all the 8 isolates observed to show appreciable growth all salinity levels with simultaneous production of organic acid. The results indicated that these isolates of fluorescent pseudomonad could be able to solubilize the insoluble phosphorous while providing the tolerance against salinity. Overall these observations suggest that these fluorescent pseudomonad isolates may serve as promising salinity tolerant inoculants for growth promotion of crop plants.
Keywords: Rhizosphere, fluorescent pseudomonads, salinity

CSPT: 83.

ISOLATION OF CHLORPYRIFOS TOLERANCE AND PLANT GROWTH PROMOTING MICROBES FROM THE FIELDS OF VEGETABLE CROPS OF VARANASI DISTRICT

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In India, green revolution was introduced to enhance the total food production for rapid growing population, the use of pesticides and chemical fertilizers were also increased. Chlorpyrifos is an organophosphate pesticide

widely used in agriculture and farms for killing insects, worms, termites and variety of other pests. Due to its wide range of pest toxicity and low cost, it is widely used in developing countries including India for effective crop protection. Farmers are using these pesticides in an unmannered way and excess application in the fields without realising its toxic effects to the non-targeted organisms. Chlorpyrifos and other pesticides can persist in environment for a very long period of time which leads to the contamination of environment, soil, ground water as well as in human beings. In humans, people with short term oral exposure with low level of dose of chlorpyrifos can cause dizziness, fatigue, runny nose and eyes, salivation, nausea, sweating, intestinal discomfort and change in heart rate. Thus, the rampant use of pesticide become havoc for whole environment. The use of microbes for degrading these toxic compounds is a promising approach. Many microbial (including bacteria, fungi, actinomycetes) strains showed the degradation of these pesticide due to the fact that these efficient microbes use these pesticides as a sole of energy for their several metabolic activities. These efficient microbes also showed plant growth promoting properties (Phosphate solubilization, siderophore production, amylase production, HCN production and biocontrol properties). Thus, the present study is focused on the isolation of such efficient microbes which shows PGPR properties as well as have the potential of degrading the Chlorpyrifos pesticide for establishment of sustainable agriculture. We have isolated 41 microbial strains in which ESD2, ESD 10, ESD15, ESD17, ESD24 showed higher PSB production, ammonia production, HCN production, antifungal activity respectively. ESD 10 and ESD15 showed all PGPR results as well as more tolerance against the chlorpyrifos.

CSPT: 84.

ESTIMATION OF STEM STRENGTH OF EMS INDUCED MUTANTS OF HEXAPLOID WHEAT (*Triticum aestivum* L.) FOR DETERMINING LODGING TOLERANCE

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Wheat *(Triticum aestivum* L.) is one of the most important cereal crops being cultivated all over the world. It is the staple food for approximately 1.2 billion people of the world. With the rapid hike in population, improvement of both quantity as well as quality of crop is of great importance. Strong winds during wheat harvesting in the months of March-April have proved to be highly detrimental for the crop. Therefore, in our present study, we have characterized previously developed mutant (M1) for lodging tolerance by estimation of stem strength under different plant densities, nitrogen and NPK gradients in comparison to control plants *i.e.* DPW 621-50 and HD-2967.The stem strength was measured using a device referred to as prostrate tester. The mutant line (M-1) was found to show superior performance in terms of stem strength in comparison to both the controls (DPW 621-50 and HD 2967) under all the experimental conditions used in the present investigation. Therefore, mutant M1 may be directly utilized as a cultivar followed by its AICRP/State Varietal Trials evaluation or may also be utilized as a donor parent for the development of improved lodging tolerant genotype.

Keywords: mutants, lodging tolerant, prostrate tester, stem strength

CSPT: 85.

INVESTIGATING THE ROLE OF NITROGENEOUS FERTILIZERS AND METHANE OXIDIZING BACTERIA (MOB) ON METHANE DYNAMICS OF PADDY CROP

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Methane is the second most important greenhouse gas after CO_2. Indian flooded paddy fields produce about 3.37 MT of methane annually. Nitrogenous fertilizers like urea, DAP and ammonium sulfate affect the population of both methanogens as well as methanotrophs in field crops and affect their methane dynamics. Methane oxidizing bacteria, MNL-7 and MaAL-70, obtained from previous studies were used in a field study to determine the effect of their inoculation in paddy var IR 64 on methane oxidation as well as crop growth. Urea, DAP + Urea and FYM were used as nitrogenous fertilizer and the field experiment was carried out in randomized complete block design with three replications. Cumulative methane emission was highest in plots having FYM as N- source. Higher organic matter content possibly resulted in higher methane emission. Significant decrease in cumulative methane emission was observed upon inoculation with MOB viz. *M. oryzae* MNL-7 and *P. polymyxa* MaAL-70. Cumulative methane emission in urea plots treated with MOB was estimated to be 26.76 kg $CH_4 ha^{-1}$ which was 20.90% lower than that of control (33.83 kg CH_4 ha^{-1}). In all the treatments, inoculation with MOB (*M. oryzae* and *P. polymyxa*) resulted in substantial reduction in methane emission. Positive effect of inoculation with MOB could clearly be seen on tillers and shoot length of the treated plants. Due to plant growth promoting properties of the selected isolates, pronounced positive effect on N, P and K content of rice straw could be observed. Increase in seed protein content by 58.9% was observed in urea plots treated with MOB. Inoculation with MNL-7 and MaAL-70 could increase yield by 38% in FYM treated plots. Methane dynamics as well as crop yield was largely affected by the type of nitrogen fertilizer and microbial culture used.

CSPT: 86.

FATE AND INSECTICIDAL ACTIVITY OF DIMETHOATE IN MANAGEMENT OF INSECT PEST IN FOXTAIL AMARANTHUS AND SPINACH

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Leafy vegetables are the cheaply available but richest source of vitamin; mineral and dietary fiber, grown and consumed worldwide. Pesticides have become essential to modern agriculture and they are also hazardous to the health of domestic animals and human beings if not handled properly. Disintegration of pesticide usually occurs in plant system through plant metabolism and it is essential to find out the safe waiting period and half-life of a particular compound for safe consumption. In foxtail amaranthus, occurrence of amaranthus stem weevil, *Hypolixus truncatulus* Boheman), leaf webber, *Hymenia recurvalis* (Fabricius), leaf caterpillar, *Erectmocera impactella* (Walker) and ear-head bug, *Cletus pugnator* (Fabricius) was prevalent in the field. In Spinach severe damage by leaf eating caterpillar, *Spodoptera litura* (Fabricius), cut worm, *Agrotis ipsilon* (Hufnagel) was observed. These insect pests are managed by extensively used insecticides like dimethoate to increase the production and marketability. Being short duration crop of 40 – 50 days, quick and effective pest management is required. Dimethoate being the most predominant insecticide used for pest management in spinach and foxtail amaranthus under study. Dimethoate was found being metabolized into omethoate in plant system, which in turn is more toxic and persist for longer than dimethoate residue in plant. This poses a high risk of omethoate residues in leafy vegetables like spinach and foxtail amaranthus. Most of the farmers growing green leafy vegetables resort to spraying of insecticides to minimize insect

pests though none is recommended by CIBRC. Apart from the beneficial effect of insecticides in managing the pests they may also pose risk to the environment and health of humans by leaving residues on crop. Presence of insecticide residues in any of the produce particularly vegetables, is of great concern from consumer point of view and intense monitoring programmes are required to know the residue levels in vegetables.

CSPT: 87.

INHIBITORY EFFECTS OF LEAF EXTRACT OF *Lawsonia inermis* ON *Curvularia lunata* AND CHARACTERIZATION OF NOVEL INHIBITORY COMPOUNDS BY GC-MS ANALYSIS

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Plants produce a high diversity of natural products with a prominent function in the protection against microbial pathogens on the basis of their toxic effect on growth and reproduction. In the present study, effect of partially purified acetone fraction of *L. inermis* leaves on various cytomorphological parameters i.e. mycelium width, conidial size, etc. of test fungi and fraction was subjected to confirming the presence of primary and secondary metabolites by rapid qualitative phytochemical tests, chromatographic methods such as TLC, column chromatography and GC-MS etc. which were responsible for the inhibition of growth of test pathogen conidial size of *Curvularia lunata* decreased up to 64.76% at 0.039 µg/ml concentration of the extract. Mycelial width of *C. lunata* increased up to 55.91% at 0.312 µg/ml concentration of the extract.Carbohydrate, steroids, volatile oils, flavonoids, and tannins were found to be present in acetone extract of *L. inermis* leaf. Total of 7 bands were observed in TLC fingerprinting of *L. inermis* acetone fraction. Total of 10 fractions were collected fromthe column chromatography. Fractions which show the most significant antifungal activity against the test fungus was subjected to further GC-MS analysis for the separation and identification of active principle. GC-MS analyses show the presence of total 6 constituents i.e. hexacosane, octadecane, docosane, heptacosane methyl, octacosane, and tetracosane.

Keywords: *Lawsonia inermis*; Bioformulations; *Curvularia lunata*; Secondary metabolites; Chromatograph

CSPT: 88.

SCREENING AND EVALUATION OF RHIZOBACTERIA FOR THEIR PLANT GROWTH PROMOTING PROPERTIES AND SALINITY TOLERANCE

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Soil salinity is a major deleterious abiotic stress factor severely affecting the crop productivity worldwide. Salinity tolerant rhizobacteria can play an important role in alleviating soil salinity stress and help plants to withstand during stress condition. The present study was carried out with an objective to screen and identify salinity tolerant rhizobacteria with plant growth promoting traits. A total of 205 rhizobacterial isolates were isolated from rhizospheric soil samples of *Brassica juncea* (mustard) plant. Out of 205 total isolates 9 best salt tolerant isolates were screened which were able to grow up to 2 M NaCl salt amended nutrient agar media. These 9 isolates were S2, S4, S5, S6, S7, S17, S18, S19 and S23. Further these isolates were checked for their plant growth promoting attributes such as indole production, solubilisation of phosphorus and siderophore production under control and salt stress condition. All these 9 bacterial isolates were found positive for indole production and solubilisation of phosphorus. Although in case of siderophore production only two bacterial isolates S4 and S19 were found positive. Quantitatively the amount of IAA

produced by the bacterial isolates ranged from 0.57 mg/l to 2.56 mg/l, while in case of soluble phosphate it ranged from 7.17 mg/l to 25.66 mg/l. The amount of siderophore produced by both bacteria was ranged from 87.16% to 98.40% under control and stress condition. Amongst the isolates obtained, isolate S4 exhibited highest amount of IAA (2.56 mg/l) production, highest soluble phosphate (25.66 mg/l) and highest amount of siderophore (98.40%), which was followed by isolates S17 and S19. The morphological and biochemical characterization revealed that all 9 bacterial isolates were different from each other. The results obtained suggest that the bacterial isolates obtained might be useful as potential candidates for use in plant growth promotion under salinity stress.

Keywords: Soil salinity, abiotic stress,crop productivity, rhizobacteria.

CSPT: 89.

MORPHOLOGICAL AND PHYSIOLOGICAL VARIABILITY IN *Bipolaris sorokiniana*

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Variation among 6 isolates of *Bipolaris sorokiniana* (Sacc. in Sorokin) Shoem. was studied in respect of morphological and physiological variability. The isolates BS-F-5 and BS-P-3 were found to be fast growing and high sporulating. The isolates BS-DWR-K-1, BS-K-4, and BS-V-6 were found to be medium in growth and sporulation, whereas BS-D-2 was slow growing and least sporulating. The 6.5 pH was found to be most suitable for growth of five isolates and sporulation of all six isolates. BS-D-2 exhibited its maximum growth at 6.0 pH. Maltose was found to be most suitable carbon sources, whereas lactose as a poor source for the growth of all isolates. In case of sporulation, maltose was best for BS-K-4 and BS-F-5, glucose was the best for BS-P-3 and BS-V-6, whereas sucrose was best for BS-DWR-K-1 and BS-D-2. Among the nitrogen sources, sodium nitrate was best for the growth of BS-F-5 and BS-V-6 and sporulation of all isolates. Ammonium sulphate was best for the growth of BS-DWR-K-1, BS-D-2, BS-P-3 and BS-K-4. Among the phosphorus sources, dipotassium hydrogen orthophosphate was best for growth and sporulation, whereas sodium phosphate was inhibitory for growth and sporulation of all isolates. Among the potassium sources, potassium nitrate was best and potassium sulphate was inhibitory for growth and sporulation of all isolates. Among the vitamins, thiamine supported maximum growth of all isolates, whereas yeast extract supported maximum sporulation. Inositol and calcium pentothenate were found to be inhibitory for growth of all isolates.

CSPT: 90.

BIOEFFICACY OF COW URINE IN COMBINATION WITH PLANT LEAVES AGAINST STORED PRODUCT PEST, *Sitophilus oryzae* (Coleoptera: Curculionidae)

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Cow is equated to mother in the Indian tradition and her urine panacea of all diseases. Cow urine is a divine medicine and used for treatment of diabetes, blood pressure, asthma, psoriasis, eczema, heart attack, fits, cancer, AIDS, piles, gynaecological problems etc., It is natural, eco-friendly with no residual effects, economical and easily available.

Stored grain insect pests can cause reduction in weight, quantity, commercial value and seed viability. Seventy five percent of stored grain insect pests are coleopterans and the most damaging species of storage insects are in the genera Sitophilus and Tribolium. *Sitophilus oryzae* L., an ubiquitous pest of economic importance, is an internal feeding insect that bores into stored grains. Based on these points the present investigation was undertaken to study the impactt of different extracts of cow urine with two different plants namely *Azadirachta indica* and *Vitex negundo* against *Sitophilus oryzae.* Of the two plants tested cow urine extract of *A. indica* leaves produced higher percentage of mortality. The earlier experiments revealed that the cow urine extract of *A. indica* and *V. negundo* caused malformations and reduction in food consumption and growth. In order to understand changes induced in the level of protein, carbohydrate and lipid in plant extract treated insects, the quantification of these organic constituents were made and the results are discussed. The impact of these extracts on the digestive enzymatic activities were also analysed. Histopathological changes in treated insects were also observed. Histopathological studies showed deteriorations in reproductive cells which ultimately reduce the fecundity of the insects.

CSPT: 91.

VARIABILITY IN RESPONSES OF PALAK (*Beta vulgaris* L. var. All Green) AT MORPHOLOGICAL, BIOCHEMICAL AND PHYSIOLOGICAL LEVELS BY SUPPLEMENTING VARIOUS NITROGEN AMENDMENTS UNDER AMBIENT OZONE CONCENTRATION

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Tropospheric Ozone (O_3) is a secondary air pollutant formed in the atmosphere, in the presence of high light intensity and high temperature. Ozone induced loses in plant productivity are well documented, making tropospheric O_3 a major culprit behind global crop yield curtailments. The present experiment was conducted to assess the interactive effects of O_3 and different doses of Nitrogen amendments on Palak (*Beta vulgaris* L. var. Allgreen). Two doses of nitrogen amendments, N1 (25kg/hac) and N2 (50kg/hac) were given and plant responses at morphological, biochemical and physiological levels were analyzed. The sampling was done twice, one at 25 DAG (Days after Germination) and the other at 40 DAG. At 25 DAG, the total length of the plant increased by 43.08% and 58.11% for N1 and N2 treatments respectively as compared to control. At 40 DAG, the total length similarly increased by 3.7% and 30.8% for N1 and N2 treatments respectively as compared to control. The total dry weight showed increments of 211.5% and 327.5% for N1 and N2 treatments respectively at 25 DAG and similarly showed hike by 43.4% and 85.2% for N1 and N2 treatments respectively at 40 DAG as compared to control. The total chlorophyll content increased by 75.1% and 43.02% and 78.5% and 51.5%for N1 and N2 treatments at 25 DAG and 40 DAG respectively, as compared to control. The ascorbic acid content increased by 48.9% and 20.4% for N1 and N2 treatments respectively at 25 DAG, but at 40 DAG it decreased by 19.2% for N1 whereas increased by 38.7% for N2 treatment as compared to control. The MDA content increased by 7.03% and 64.6% for N1 and N2 treatments respectively at 25 DAG, but at 40 DAG it decreased by 8.3% for N1 whereas increased by 21.3% for N2 treatment as compared to control. The SOD content increased by 43.7% and 79.16% for N1 and N2 treatments respectively at 25 DAG and it increased by 15.7% and 29.21% for N1 and N2 treatments respectively at 40 DAG as compared to control. The Phenol content increased by 13.4% for N1 but decreased by 7.8% for N2 treatment at 25 DAG, but decreased by 6.4% and 30.86% for N1 and N2 treatments respectively at 40 DAG as compared to control. The photosynthetic rate increased by 29.77% and 54.71% for N1 and N2 treatments respectively at 40 DAG as compared to control. The stomatal conductance decreased by 9.1% for N1 but increased by 92.5% for N2 treatment at 40 DAG as compared to control. The results clearly indicate the positive role of nitrogen amendments in mitigating O_3 stress in plants to some extent, the effect being more evident during later growth stage.

Keywords: Tropospheric ozone, plant productivity, amendments, DAG

CSPT: 92.

GENETIC VARIABILITY AND CHARACTER ASSOCIATION IN OKRA GENOTYPES FOR YIELD AND CONTRIBUTING CHARACTERS

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A study of genetic diversity in 31 okra germplasm, including indigenous and exotic collections along with two checks for 16 important quantitative morphological and biochemical traits was laid out in randomized block design with three replications during 2017-18. The phenotypic and genotypic variances, phenotypic coefficient of variance (PCV) and genotypic coefficient of variation (GCV), heritability, genetic advance of the characters were studied. The genotypes demonstrated wide range of variability for all characters. In this study PCV was higher than its corresponding GCV thus revealing the role of environmental factors. The experiment revealed that the treatments were highly significant for all the characters except fruit diameter. High PCV and GCV were observed for all the characters except moderate for number of fruits per plant (17.60 and 14.76 %), fruit yield per plant (18.45 and 15.70%) while low for days to first flowering (8.04 and 7.44%). Genetic advance in per cent of mean was high for all the characters except moderate for days to first flowering (14.09 %), fruit length (12.93), fruit diameter (12.30). The higher value of genetic advance indicates that selection of genotypes on the basis of these characters is desirable.The genotypes, viz. Kashi Kranti, IIVR-11, VRO-3, Kashi Satdhari and IC-282232 were found promising for most of the yield contributing traits. These genotypes could be used further in hybrid breeding programme.

Keywords: Character association, Genotypes, Heritability, Okra, Variability, Yield

CSPT: 93.

BIO-EFFICACY OF COMBINATION OF INSECTICIDE AND FUNGICIDE FOR MANAGEMENT OF APHID ON BLACK GRAM

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Black gram or Urdbean (*Vigna mungo* L.) Hepper is one of the important pulse crop which infested by number of insect pests in field condition out of which aphid is one of them. It takes role in yield losses due to sucking the plant sap and also contributes in spread of viral diseases. To validate the objective of the experiment ten treatments with three replications was taken in randomized block design at research farm of Birsa Agricultural University, Ranchi for the period of two years *kharif* 2016 and 2017.The treatments were T_1(thiamethoxam 25 WG + propiconazole 25 EC @ 0.2g+1.0ml/L), T_2 (thiamethoxam 25 WG + propiconazole 25 EC @ 0.3g+1.0ml/L), T_3 (spinosad 45 SC + propiconazole 25 EC @ 0.5ml+1.0ml/L), T_4(spinosad 45 SC + propiconazole 25 EC @ 0.6ml+1.0ml/L), T_5(NSKE + propiconazole 25 EC @ 5%+1ml/L), T_6(thiamethoxam 25 WG @ 0.3g/L), T_7(spinosad 45 SC @ 0.6ml/L), T_8(NSKE 5% @ 5%), T_9(propiconazole 25 EC @ 1.0 ml/L) and T_{10}(control). The application was done 30 and 40 days after sowing and observation recorded one day before spray and 3, 7 and 10 days after each spray. Among these ten treatments, T_2combination of thiamethoxam and propiconazole @ 0.3g+1.0ml/L and T_6thiamethoxam @ 0.3g/L were identified as highly efficient to manage aphid by reducing 0.85 and 1.04 number of aphid/ top 5 cm shoot against control with 7.68/ top 5 cm shoot. The next best effective treatment was T_1 with minimizing 1.41number of aphid / top 5 cm shoot. The maximum yield 1080 kg/ha recorded in T_4 withcombination spinosad 45 SC + propiconazole 25 EC @ 0.6ml+1.0ml/L followed by 1052 kg/ha. in T3(@ 0.5ml+1 ml/L dose of same combination.

Keywords: black gram, aphid, insecticide and fungicide

CSPT: 94.

INFESTATION PATTERN OF GUNDHI BUG IN BORO RICE IN TERAI REGION OF WEST BENGAL

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Pattern recognitions of pest infestations substantially aid in understanding the changes in the population dynamics due to several biological, environmental and climatological factors. As insect data are usually count in nature, appropriate choice of distributions as well as linear and non-linear growth models are obvious with a view to unearth the variability present in the insect- pest populations. Hence, an experiment was conducted to study the infestation pattern of gundhi bug in rice at the farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal, India (26.52° N, 89.11° E) during boro season of 2016-17. Size of the field was 15 m × 10 m. The crop was sown in the first week of February and transplanted in the first week of March. No pesticides were used in order to observe natural pest population build up. 15 sample area of size 270 cm × 120 cm were selected using random number table, which covered 32.4 per cent of the total experimental area. 13 plants from each sample area were sampled by using 'W' pattern. Data on insect counts were recorded from the sampled plants from 21 DAT to 90 DAT (up to harvesting) at 3 days' interval. Appropriate discrete distributions along with the various linear and non-linear growth models were fitted to investigate the infestation pattern of gundhi bug. Among all the fitted discrete distributions, Poisson distribution fitted best, having the minimum Kolmogorov-Smirnov test statistic value (0.1712), whereas, among various fitted linear and non-linear models, quadratic model was found to be the best fit with least AIC (-28.85) and BIC (-25.32) values, followed by cubic model. Co-efficients of both linear and quadratic term of quadratic model were found to be significant at 1 per cent level. Validation of the necessary assumptions were also found justified from the outcomes of residual analysis.

Keywords: Gundhi bug, Growth models, Modelling of rice pest, Rice pest infestation.

CSPT: 95.

EFFECT OF POST-EMERGENCE HERBICIDES ON WEED AND YIELD OF WHEAT (*Triticum aestivum* L.)

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Field investigation were carried out during winter season of 2017-18 at agriculture research farm of Innocent Hearts Group of Institutions, Jalandhar,Punjab.The experimental field was mainly infested *with Parthenium hysterophorus, Cynodon dactylon, Chenopodium album, Anagallis arvensis, Cyperus rotundus, Euphorbia hirta, Fumaria palviflora and Coronopus didymus* during the study period.The experimental result indicated that the post-emergence application of clodinafop *fb* 2,4-D was most effective herbicides and recorded minimum density and dry weight of total weeds, without any phytotoxicity symptoms on the crop. The application of clodinafop *fb* 2,4-D were registered higher weed control efficiency over isoproturon and clodinafop alone. Significantly higher values of wheat yield, Yield attributes *viz*. number effective tillers, length of ear head, weight of ear head, weight of grain per ear head,

number of grain per ear head, test weight and grain and straw yield were recorded in clodinafop *fb* 2,4-D treated plat at 30 DAS when compared with weedy check. Weed growth suppression effect of clodinafop *fb* 2,4-D resulted 86.71 per cent higher grain yield of wheat over weedy check and remain statistically similar with weed-free condition in respect to grain yield of wheat crop.

Keywords: Herbicide, wheat, weed management

CSPT: 96.

ORGANIC FARMING IN INDIA AND PROBLEMS FACED BY INDIAN ORGANIC FARMERS

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Organic farming is a system which largely excludes the use of synthetic inputs (fertilizers, pesticides, hormones, feed additives etc) to the maximum extent feasible, relying upon crop rotations, crop residues, animal manures, off-farm organic waste, biological system of nutrient mobilization and plant protection. According to the World of Organic Agriculture 2018 report, India is home to 30 per cent of the total organic producers in world, but accounts for just 2.59 per cent (1.5 million hectares) of the total organic cultivation area 57.8 million hectares. India has the highest number of organic farmers globally, but most of them are struggling. The organic farmers complained of low productivity during the transition from chemical to organic farming. They suggested that government needs to develop a plan in order to support the farmers during the transition stage. They also cited pest attack as another reason for low productivity and demanded education and training to deal with it. Availability of certified organic seeds is a major issue in organic farming. While the government provides subsidy for chemical fertilizers and pesticides, there is no such provision for organic inputs. 98 percent farmers in Rajasthan are aware of the hazards caused due to chemical conventional farming, but they don't switch to organic farming due to fear of low productivity and unavailability of organic inputs. Marketing of organic produce requires connecting farmers with domestic and global supply chain. But the supply chain is underdeveloped. As a result, the small, mid-sized farmers located in hilly regions and tribal belts find it extremely difficult to access the market. The certification systems are not only cumbersome and time-consuming, but also expensive. It is important to eliminate confusion over multiple certification systems and multiple ministries regulating organic production and sales.

Keywords: Organic farming, conventional chemical farming, organic farmer, certified organic seed

CSPT: 97.

EVALUATION OF DIVERSE LENTIL (*Lens culinaris*) GERMPLASM FOR DROUGHT TOLERANCE AT SEEDLING STAGE

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Lentil (*Lens culinaris*) is an important food legume grown on residual moisture as post-rainy season crop. Crop invariably faces water scarcity, which leads to forced maturity and lower yield. Systematic mining of conserved germplasm is required for improvement of drought tolerance in lentil. Keeping it in view, present study was undertaken to screen lentil germplasm for drought tolerance at seedling stage. A set of 200 diverse lentil accessions was selected for the study. Cigar roll method was used and stress was imposed on seedling stage using15 %

Polyethylene glycol 6000. All the seedlings were harvested and weighed after two weeks of sowing. Root scanner was used to observe the variation in root traits among different lines in response to stress. Seedling survival, biomass, root length, shoot length, root surface area, root volume and root diameter were recorded and there was significant variation among the studied lines for all the recorded traits. 28 lines did not germinate under stress compared to control, while, 23 showed 100 % germination. Under stress, total biomass (g) varied from 0.004 -0.006 g, while root length and shoot length varied 7.05-9.48 cm and 3.88 – 6.18 cm respectively. Based on different parameters, accessions EC78414, IC268239, IC268243, IC321219, IC560051, IC560337, EC78424, IC346092, IC361296, IC385822, IC559757 showed drought tolerance. Identified lines will be validated further for drought tolerance under field conditions for future use as donor in breeding program.

CSPT: 98.

ASSESSING THE SUSCEPTILIBILITY OF EPIGEIC EARTHWORM *Eisenia fetida* TO AGRICULTURAL APPLICATION OF CHLORPYRIFOS AND DIMETHOATE

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World is facing a rapid pace of increase in population; it is projected that by 2050 global population is increased by 50% than present level and global grain demand is projected to double. Doubling food production and sustaining food production to this level, are major challenges. Thus, in order to achieve this pesticide and insecticides are the major inputs in addition to seed, water and fertilizer in the agro-ecosystems throughout the world. In India use of organophosphate is 4 to 5 times higher than organochlorine pesticides. Extensive and unmannered application rates of pesticide affect the ecosystem and environment by entering the residues in food chain and polluting air, soil, surface and underground water. Unfortunately, the non-target organisms in soil and water have been largely affected by indiscriminate use of pesticides in recent years and there occurred serious damages to ecosystem. In present study effect of lethal and sub-lethal doses of chlorpyrifos and dimethoate insecticides on avoidance response, acute toxicity, growth and reproduction of the earthworm, *Eisenia fetida* were investigated under laboratory conditions. Dimethoate is found to be highly toxic to E. *fetida* (LC_{50}=17.45 mg/kg dry soil), significantly reducing earthworms biomass and showing an avoidance response at 10 mg/kg that was so close to the dose which applied in agricultural field. The insecticide chlorpyrifos showed a low acute toxicity (LC_{50}=257.03 mg/kg dry soil) but appeared to produce adverse effect on growth and reproduction at higher sub-lethal concentrations. Based on recommended agricultural dose of each insecticide, it was concluded that application of dimethoate was potentially dangerous to earthworms. In comparison the chlorpyrifos was safer than dimethoate at sub-lethal concentrations for the development and reproduction of earthworm *E. fetida*.

Keywords: *Eisenia fetida*; chlorpyrifos; dimethoate; $LC_{50.}$

CSPT: 99.

SOLID WASTE MANAGEMENT AND THE FERTILIZING POTENTIAL OF POST-DIGESTION MATTER

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The challenge of agriculture in the 21st century requires a systemic integration of the environmental, social and economic pillars of development to meet the needs of present generations without sacrificing the livelihoods of

future generations. Over the next 50 years, the world population is projected to increase by some 3 billion, primarily in the developing countries. Yet, even today, some 800 million people go hungry daily, and more than a billion live on less than a dollar a day. This food insecurity and poverty affecting one-quarter of the world's population is a sad indictment of the failure to respond adequately in a time of unprecedented scientific progress and economic development. There is no way we can meet food security and poverty concerns without first addressing the issues of sustainable agricultural and rural development. Solid waste management (SWM) is one such service where India has an enormous gap to fill. The current SWM services are inefficient, incur heavy expenditure and are so low that causes potential threat to the public health and environmental quality. Improper solid waste management deteriorates public health, causes environmental pollution, accelerates natural resources degradation, causes climate change and greatly impacts the quality of life of citizens. Pollution of air, water or land results in long-term reduction of productivity leading to a deterioration of economic condition of a country. To address this problem, citizens should make their goal to use waste as resource. Hence initial focus is to reduce waste by designing such practises that can make use of waste at its source. Anaerobic digestion (AD) is another promising organic waste management technique in which stabilization of organic waste and energy recovery are attained. During the process fermentation of organic waste is done and organic waste gets converted into various organic acids further they are converted into acetate, hydrogen, carbon dioxide and other gases in fewer amounts that finally gets converted to methane by the help of methanogens. At the end of the process large amount of post-digestion matter gets generated that is known as anaerobic digestate. After studying the physico-chemical properties of digestate, it can be used as supplement to synthetic fertilizer. The present study was planned for - Assessing the fertilizer potential of anaerobic digestate: effect on soil properties, crop grown and the possibility of agricultural utilization of digestate.

Keywords: Solid waste management, fertilizer potential, anaerobic digestate, agricultural utilization

CSPT: 100.

EPIGENETIC MODULATION AND BIO-POTENTIAL CHARACTERIZATION OF ENDOPHYTIC FUNGI Diaporthe *melonis* ISOLATED FROM *Saraca asoca*

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The endophytic fungi are comparatively less studied group of microbes producing surfeit of compounds having the biomedical and agricultural importance, residing inside their host. They are known to increase the defense of host plant by producing secondary metabolites active against all kinds of microbial pathogens. Isolation and identification of endophytic fungus *Diaporthe melonis* were done through available microscopic techniques and DNA sequencing. There metabolite were extracted using Potato Dextrose Broth medium and analyzed for antibacterial antifungal and anti-oxidant activities. Extracted metabolite show strong activity against some bacterial pathogens of Human with inhibition zones 16mm, 15mm, 11mm, 9mm and 7mm against *E.coli, S.boydii, E.feacalis, C.koseri, K.pneumoneae S.aureus* respectively, while antifungal activity was found against *candida albicans* only with inhibition zone 11mm. Compound identification *of Diaporthe melonis*crude metabolite were performed through GC-MS. Treatment of *Diaporthe melonis* in Potato Dextrose Broth medium with epigenetic modulator BRD4770 (lead to competitive inhibition of S-adinosyl methionine) were performed in the range of 1nM,10nM,25nM,50nM,100nM,200nM and 1μM concentration. Metabolite was extracted and comparative studies were performed between treated and untreated fungus in respect to changes in the metabolite composition through GC-MS and LC-MS analysis. Significant changes were observed in 100nM treated fungus crude metabolite composition as compared with the control. The preliminary results of this experiment trigger the interest in improving the bio-potential of the endophytic fungus.

CSPT: 101.

EFFECT OF POST-EMERGENCE HERBICIDES ON WEED AND YIELD OF WHEAT (*Triticum aestivum* L.)

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Field investigation were carried out during winter season of 2017-18 at agriculture research farm of Innocent Hearts Group of Institutions, Jalandhar,Punjab.The experimental field was mainly infested *with Parthenium hysterophorus, Cynodon dactylon, Chenopodium album, Anagallis arvensis, Cyperus rotundus, Euphorbia hirta, Fumaria palviflora and Coronopus didymus* during the study period.The experimental result indicated that the post-emergence application of clodinafop *fb* 2,4-D was most effective herbicides and recorded minimum density and dry weight of total weeds, without any phytotoxicity symptoms on the crop. The application of clodinafop *fb* 2,4-D were registered higher weed control efficiency over isoproturon and clodinafop alone. Significantly higher values of wheat yield, Yield attributes *viz*. number effective tillers, length of ear head, weight of ear head, weight of grain per ear head, number of grain per ear head, test weight and grain and straw yield were recorded in clodinafop *fb* 2,4-D treated plat at 30 DAS when compared with weedy check. Weed growth suppression effect of clodinafop *fb* 2,4-D resulted 86.71 per cent higher grain yield of wheat over weedy check and remain statistically similar with weed-free condition in respect to grain yield of wheat crop.

Keywords: Herbicide, wheat, weed management

CSPT: 102.

EFFECT OF PHOSPHORUS IN PEA (*Pisum sativum* L. var. Hortens) UNDER ARSENIC TOXICITY

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Arsenic toxicity is a threat to biosphere affecting the environment and people's health. Arsenic is the most toxic metalloid and widely distributed in the earth's crust, and in groundwater in many countries. In India, no of states are affected by arsenic contamination of groundwater above the permissible level Irrigation water containing arsenic affects the crop quality and quantity. Legumes are sensitive heavy metals like cadmium, arsenic, nickel, mercury, etc. In the present study, investigated the effect of arsenic on early seedling growth of pea (*Pisum sativum* L. var. Hortens) with different levels of phosphorus application. Arsenic-treated seedlings showed reduction in germination percentage, root and shoot length, root and shoot dry weight, leaves number, chlorophyll content and protein content. Arsenic significantly enhances electrolyte leakage and proline level showing oxidative stress. Application of phosphorus with arsenic resulted in significant positive alterations in morphological and biochemical parameters tested under the arsenic treatments alone which promote better growth in pea.

CSPT: 103.

SUSTAINABLE CROP PRODUCTION IN CHANGING RAINFALL PATTERNS

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As a result of global warming, the world's climate is changing and its effect is being felt the world over. One of the most important parameters of climate is rainfall. So, there is direct relationship between rainfall and agriculture. When rainfall patterns change, its effect is directly felt on cropping pattern of a region. An important aspect to be understood regarding the relationship between rainfall and agriculture is that rainfall is the major factor in the growth and production of food crops both at the germination and fruit development stage. Shifting planting season along with changing rainfall patterns. Currently, about 60 percent of the world and 90 percent sub-Saharan African staple food production are under direct rainfed agriculture. As we have seen, the two main changes in patterns of rainfall include high and low rainfall. Managing the problem of low rainfall, however, is nearly possible through irrigation, but only if dealt with efficiently and without degradation to the water table, by ensuring ground water recharge practices. Ground water withdrawal turned out to be a serious problem in most parts of India. In this new scenario, the management of water resources should fall in the core of all adoption strategies. Many communities are also reviving traditional water harvesting, a method of storing rain water. In some cases, farmers change their crops to suit the prevailing conditions. Although there is no one-stop solution, sustainability can be achieved through the use of good quality seeds, a diverse range of crop species and varieties grown in associations, intercrops or rotation and sustainable water management practices.

Keywords: Agriculture, Rainfall patterns, crop production.

CSPT: 104.

ASSESSMENT AND QUALTY OF WATER: ESSENTIAL FOR PRIMARY PRODUCTIVITY IN FISH CULTURE

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The availability of water of appropriate quality is important for fish production, but the quantity is particularly important for land based systems. It is therefore, necessary to investigate, as thoroughly as possible, the extent and seasonality of water sources as well as liability to pollution. For fish production, when rain-fed or ground-water ponds are used, as in eastern region of our country, water levels in the ponds become dangerously low due to seepage and evaporation in summer months, when the ponds have generally the maximum biomass of fish. Access to other reliable sources of water like rivers, reservoirs or even tube wells can be beneficial. In terms of quality of water, high turbidity caused by suspended solids can effect productivity and fish life. It will decrease light penetration into the water and thus reduce primary production. This would naturally also effect secondary production. In certain cases, oxygen deficiency has also been reported as a result of a sudden increase in turbidity. The suspended solids may clog the filter-feeding apparatus and digestive organs of planktonic organisms. The gills of fish may be injured by turbid water. The use of turbid water in hatcheries should be avoided as it can greatly affect the hatching and rearing of larvae. Among other water qualities, unsuitable pH and greater degree of water pollution must be taken care. For this, it is essential to investigate any existing or potential sources of pollution and the nature of pollutants that may affect the quality of water. In certain circumstances, it may also be considered necessary to reduce risks of infection by pathogens and parasites through continued use of water from external sources. Where the availability of good quality water is

limited, hatcheries must be prioritized for reconditioning and recirculation of water. The existence of tested technologies, or the ability to develop or adapt existing technologies to suit local conditions would be an important aspect to be taken into account in a planning to improve the water conditions.

Keywords: Seepage, Primary Productivity, Filter feeding, Turbid, Tested technologies

CSPT: 105.

MODERN TECHNOLOGIES FOR CLIMATE-SMART LIVESTOCK PRODUCTION

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Global demand for Livestock production is expected to double by 2050 mainly due to improvement in the worldwide standard of living. Meanwhile Climate change is a threat in livestock production because of impact on quality of feed crop and forage, water availability, animal reproduction and Bio-Diversity. Livestock production will be limited by climate variability as animal water consumption is expected to increase by a factor of three, demand for agricultural lands increase due to need for 70% growth in production, one-third of global cereal harvest is used for livestock feed, livestock sector contributes 14.5% of global green house gases emissions. So there is need to climate smart crop and livestock production technologies to' sustainably increase productivity, enhances resiilence (adaptation), reduces GHG's emission (mitigation) and enhances achievement of National food security and development goals'. Several climate smart agriculture practices are available which includes Grass land restoration and management and manure management. The main climate smart crop strategies for dominant livestock production systems are 1.Land based systems(Animal breeding, pasture and grazing management, vaccines against diseases, Agroforestry practices) 2.Mixed farming systems(lmproved crop varieties i.e genetically modified stress tolerant crops, croprotation, intercropping with legumes, water use efficiency, Nutrient management) 3.Land less systems (anaerobic digestion for biogas and fertilizer, composting, improved manure handling and storage, precision feeding). Barriers to adoption are most often related to a lack of information, limited access to technology and insufficient capital, overcoming these barriers require specific policy intervensions, including extension work, financing mechanisms, for improving access to credit and payment for environmental services.

Keywords: Climate smart crop, Livestock, Land based systems, Mixed farming, Land less systems.

CSPT: 106.

GENETIC DIVERGENCE AND CHARACTER ASSOCIATION IN RICE (*Oryza sativa* L.) UNDER SALT AFFECTED SOIL

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The present investigation entitled "Genetic divergence and character association in rice (*Oryza sativa* L.*)* under salt affected soil." wasconducted at Main Experiment Station (MES) of A. N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during *Kharif 2018*. 80 varieties per lines of rice along with three checks. The experiment was laid out in Augmented Block Design. The entire experimental field was divided into8 blocks of equal size and each block had 13 plots of test entries along with 3 checks in each block. The characters studiedwere days to 50% flowering, plant height, spikelet fertility, spikelets per panicle, panicle bearing tillers per plant, flag leaf area, panicle length, L/B ratio,1000-grain weight, biological yield per plant, harvest index and grain yield per plant.

The assessment of existing variability in the germplasm collections was done by computing means, range, correlations, path-coefficients andgenetic divergence. The wide range of variation for different characters and comparison of means of germplasm line indicating existence of very high degree of variability for all the characters in the indigenous and exotic lines of rice. The variety CSR-2016-IR18-6 produced highest grain yield per plant followed by CSAR17135, CR3890-35-1-3-4, CR3881M-3-1-5-1 and CR38833-1-5-2-1 while these lines also possessed average to high mean performance for most of the yield components. Therefore, these entries are identified as most promising varieties/lines for use in hybridization programme as a donor parents. The other promising genotypes for other character than grain yield per plant is Kalanamak for 1000-grain weight, CR3884-244-8-56 for biological yield per plant, , CSR-2016-IR18-6 for highest panicle length ,CSRRIL-01-IR75 for panicle bearing tillers per plant, IR83421-6-B-3-1for plant height, RP5683-101-30-2 for spikelet per panilcle, Kalanamak for flag leaf area, CARI Dhan 7 for days to 50% flowering and KRI5100 for harvest index.A very strong positive association of grain yield per plant was observed with biological yield/ plant.The characters showing highly significant positive correlation among yield and its components suggested that during selection these characters may be given due to importance for developing high yielding varieties.

The path analysis revealed that biological yield per plant followed by 1000-grain weight as the major direct positive contributor towards expression of grain yield/plant while biological yield per plant emerged as most important indirect yield component. The 80 lines and 3 check varieties of rice were grouped into 10 distinct clusters by using non- hierarchical Euclidean cluster analysis. It indicated the existence of high degree of genetic diversity present in the varieties/lines. Therefore, these varieties/lines may serve as valuable source for selection of diverse parents. Maximum intra-cluster distance was found for cluster-VII followed by cluster-V. The minimum intra-cluster distance was recorded for cluster-VIII followed by cluster-VI. The highest inter-cluster distance was observed between cluster-III and cluster-X. The lowest inter-cluster distance was observed between cluster-I and cluster-II. Hence, crosses should be made between these widely related genotypes located in intra and inter cluster distances, to get desirable extinct of heterotic potential.

Keywords: Path analysis, genetic divergence, cluster analysis

CSPT: 107.

ULTRA VIOLET RADIATION AND THEIR EFFECT ON CROP PLANTS

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Plants use sunlight to prepare their food via process called photosynthesis and, as a consequence, are exposed to the ultraviolet (UV) radiation that is present in solar light. Recent measurements of ozone levels have led to concern that the stratospheric ozone layer is being depleted as a result of contamination with man-made chlorofluorocarbons and other harmful ozone depleting natural gases like water vapour, carbondioxide, methane, nitrous oxide. All types of UV radiation are known to damage various plant processes. Such damage can be classified into two categories: damage to DNA (which can cause heritable mutations) and damage to physiological processes. The 7% of electromagnetic radiation has been emitted from the sun rays is in UV spectrum ranging 200-400nm, as it passes through the atmosphere the total energy UV energy transmitted is greatly reduced as short wave UV-C (200-280nm) which is completely absorbed by the atmospheric gases. The amount of UV-B radiation reaching the earth surface is 280-320 absorbed partially by atmospheric ozone. While, UV-A (320-400nm) is hardly absorbed by ozone and reaches to earth surface. UV-B radiation has been found to be harmful to living organisms, damaging DNA, proteins, lipids and membranes. Concomitantly, the amounts of solar UV-B radiation reaching the Earth's surface is increasing. Plants, which use sunlight for photosynthesis and are unable to avoid exposure to enhanced levels of UV-B radiation, are at risk. Thus, mechanisms by which plants may protect themselves from UV radiation are of particular interest. Exposure to UV-B decreased plant height, leaf area and plant dry weight increased auxiliary branching and leaf curling. To prevent mutation and/or cell death, UV radiation-induced DNA damage must be repaired before DNA

replication to allow transcription. Repair of UV radiation-induced lesions may be of particular importance in plant pollen, especially in wind- pollinated species.

Keywords: Ultra Violet, Photosynthesis, Gases, Radiation

CSPT: 108.

CHROMATIN DYNAMICS IN PLANTS IN RESPONSE TO DIFFERENT BIOTIC AND ABIOTIC STRESSES

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In the nucleus of eukaryotes, chromatin is found in the form of DNA–protein complex, in which DNA is wrapped around histone oligomers. It is subjected to numerous types of post-translational modifications (PTMs) such as; histone acetylation, methylation, phosphorylation, ubiquitination, sumoylation, carbonylation, and glycosylation, among others (Tan *et al*., 2011). Among these, histone acetylation is a major PTM leading to functional change in gene expression or chromatin structure. Acetylation occurs on lysine residues present on N-terminal histone tails at different positions: 9, 14, 18, and 23 of histone 3 and 5, 8, 12, 16, and 20 of histone 4 (Hartl *etal*., 2017). It is regulated by two key enzymes i.e., Histone acetyl-transferases (HAT), which add an acetyl group whereas, histone deacetylase (HDA) which removes an acetyl groups from the lysine residues from both histone and non-histone proteins to maintain homeostasis (Seto and Yoshida, 2014). Several kinds of these enzymes have been produced by eukaryotic genome to regulate the expression dynamics in response to different biotic and abiotic stresses. In rice plants, on exposure to drought stress significant increase in the expression of four HATs (OsHAC703, OsHAG703, OsHAF701 and OsHAM701) was also reported (Fang *etal*., 2013).

Keywords: Eukaryotes, Chromatin DNA–protein complex, Post-translational modifications Histone acetyl-transferases Biotic & abiotic stresses.

CSPT: 109.

CLIMATE AMENDMENT- A RED WARNING FOR INSECTS

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Change is the law of nature, so as the climate, so as the insects, so as the ecology or ecosystem. Increase temperature, elevated carbon dioxide, erratic rainfalls have greatly effect on insect pest population. It also play significant role in long term dynamic of forest ecosystem as well as man-made ecosystem. Insects are poikilothermic animal, temperature of their body is approximately same as the environment, and so insect population is greatly affected by a little change in temperature. Increase in temperature time of pupation of the insect is decreased, so lifecycle of insect per season is additionally increased it affect the crop production and also increase the population of insect pest. Temperature increased change the gender of the insect like thrips, aphids etc. Climatic uncertainties consequences are outbreak of secondary population, harmful effect on beneficial insect, development of insect biotype, crop cultivation practices may change. Due to climate change elevated carbon dioxide is increased, than less nutritious leaf is formed to mitigate this problem insect feed more leaf than earlier ultimately crop damaged is increased. Elevated carbon

dioxide decrease the nitrogen and water content in leaf which is necessary for the foliage feeder, population of insect is decreased. From above reason climatic uncertainties greatly affect insects.

Keywords: Climate-change, Elevated carbon dioxide, pest resurgence, secondary pest outbreak and biotype.

CSPT: 110.

EFFECT OF SALINE CONDITIONS ON GERMINATION AND ENZYMATIC ACTIVITY IN SIX VARIETIES OF RICE (*Oryza sativa* L.) SEEDS

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Rice (*Oryza sativa* L., 2n= 24), belongs to the family Poaceae (Graminae). Rice is the most important food crop of the developing world and is the staple food of more than half of the world's population. Salinity is a common environmental stress seriously affecting crop growth, food production and crop yield in many regions, particularly in arid and semi-arid regions. Salt contaminated soils (ECe> 4 dS m^{-1} or 40 mM NaCl or osmotic potential < 0.117 MPa) are defined as saline land, which directly affects plant growth and development in vegetative growth prior to reproductive stage, especially crop species.To evaluate the performance of six cultivar of rice, three tolerant (CSR 36, CSR 43, UsarDhan 3) and three susceptible- (Swarna Sub 1, IR 28, Pusa 44) expose to three (0, 50, 100 mM) salinity level at germination stage. Germination percentage was delayed and decreased with increasing level of salinity. The adverse effect of salt is more pronounced in susceptible variety (Pusa-36) than the tolerant (Usar dhan-3). Increasing levels of salinity, induced by NaCl resulted in reduced plumule, radicle length and seed vigour index in all the six genotypes. Among the varieties, Pusa-36 was found to be more sensitive to salinity whereas Usar dhan-3 was relatively tolerant in relation to above parameters.Salinity resulted in the accumulation of proline content which improves progressively with increase in salinity level from 0 mM to 100 mM. Although genotype Usar dhan-3 possesed higher proline content under all the salinity level. Total carbohydrate content in embryo decreased progressively with increase in salinity level as compared to control or 0 mM NaCl. Tolerant genotype Usar dhan-3 possesed higher sugar content than the susceptible genotype Pusa-36. Stress developed by NaCl showed more harmful effect on α-amylase activity. The activity of α-amylase in the embryo of both the genotypes decreased significantly with increasing level of salinity. Whereas, the activity of catalase enzyme increased with increase in salinity level in all the rice varieties either tolerant or susceptible one.

CSPT: 111.

EXOGENOUS GLYCINEBETAINE AFFECTS GROWTH OF RICE SEEDLINGS AND PROLINE ACCUMULATION IN TWO RICE CULTIVARS UNDER NACL STRESS

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Rice is one of the most widely grown food crop worldwide, serving as the staple food for over one-third of the world's population. At the present, salinity is considered as a serious constraint in increasing the rice production. Present investigation was carried to study the effect of seed priming with 50 ppm, 100 ppm and 150 ppm concentration

of glycine betaine on germination and biochemical traits of rice (Oryza sativa L.) exposed to three level of salinity i.e. 50, 100 and 150 mM NaCl and water, in complete randomized design (CRD) with three replication on two genotypes of rice crop *i.e.* Usar dhan-3 and Pusa-44. Germination and seed vigour both were delayed and decreased with increasing level of salinity. The adverse effect of salt is more pronounced in susceptible variety (Pusa-44) than the tolerant (Usar dhan-3).Seed priming with glycine betaine improved germination percent and seed vigour significantly over control in both saline as well as non-saline conditions. Salinity resulted in the accumulation of proline content which improves progressively with increase in salinity level from 50 mM to 100 mM and then decreased at 150 mM in both the varieties. Although genotype Usar dhan-3 possessed higher proline content under all the treatments but Pusa-44 responded more to GB application showing greater increase in proline content under saline as well as non-saline. Seed priming effectively modulated the adverse effect of salinity showing better growth and biochemical characters like carbohydrate content, enzymetic activity and proline accumulation.

CSPT: 112.

POPULATION DYNAMICS AND SEASONAL VARIABILITY OF TOMATO FRUIT BORER *Helicoverpa armigera* Hubner IN VARANASI

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Tomato *(Solanum lycopersicon L.)* is one of the major and remunerative vegetable crops which have achieved tremendous popularity over the last century. It is one of the most important protective crops. Tomato is the world's largest producing vegetable crop after potato and sweet potato. A field study was conducted at the Vegetable Research Farm, Institute of Agricultural Sciences, BHU, Varanasi, under normal weather conditions in year 2018-19. At field condition investigation was done for calculation of larvae population on entire crop season. On the basis of "Direct visual counting method" population of *Helicoverpa armigera* larvae was estimated. The relationship between the *Helicoverpa armigera* incidence and weather parameters was worked out through correlation a multiple linear regression. The present experiment revealed that the incidence of *H. armigera* on tomato initiated in the second week of December (49th SMW) and reached highest at second week of January. Later on the 4th week of March the population of fruit borer decline gradually with increasing of temperature.

Keywords: Population dynamics, Seasonal abundance, correlation, *Helicoverpa armigera*

CSPT: 113.

GREEN HOUSE-POLY HOUSE HELPING CROPS AND FARMERS DURING CLIMATE CHANGE

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As we all know day by day climate is getting change,we are witnessing in change of weather as somewhere we are observing high heat somewhere heavy rainfall. This all are affecting the crops and farmers as the crops are not getting the favourable conditions to grow and in result the heavy crop loss can be seen. In all this climate change problem Green House and Poly House effectively helping the farmers. Green house and Poly House provide the favourable conditions to crops like the Temperature, Moisture and Humidity. With this technologies farmers are getting good result in crop yields even if there is high temperature outside the Green house or Poly House the new technology of Green House are able to maintain the inside temperature low as well as high in need for the crop growth. The sensors fitted inside the structures are able to identify that there is requirement of moisture or not which helps in water saving..Green House also helps in saving the soil from getting pollute and helps the crops from Biotic and

Abiotic stresses. Today many farmers are moving towards the uses of Green House and getting high productivity of crops.

CSPT: 114.

SIDEROPHORE ASSISTED HEAVY METAL TOLERANCE FOR AGRICULTURAL SUSTAINABILITY

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Siderophores are low molecular weight (600-1500 Da) ferric ion chelators which are non-ribosomal peptides. Under enhanced heavy metal concentration, these secondary metabolites also tend to chelate them, thus minimizing their toxic effects. In the present study, we hypothesize that siderophore of *Aspergillus* origin chelate heavy metal and thus reduce the bioavailability of cadmium ions in wheat plant. The toxicity of heavy metal, cadmium, was assessed on physiological and biochemical traits of wheat seedlings. Plant exposed to cadmium showed significantly reduced root and shoot length, chlorophyll and carotenoid contents and activities of various antioxidative enzymes. Exogenous supply of hydroxamate isolated from *Aspergillus nidulans* to plants growing under such stress showed substantial improvement in growth and antioxidative performance of the plants while reduction in lipid peroxidation and oxidative stress was observed. Reduction in total soluble sugar and free amino acid was also recorded. *In silico* studies support experimental investigation and suggest higher affinity of siderophore for cadmium ions as compared to ferric ions leading to thermodynamically stable complex. Thus, utilization of hydroxamate siderophore might serve as a possible bioremediation strategy with respect to wheat cultivation in cadmium laden areas leading to agricultural sustainability.

CSPT: 115.

EVALUATION OF PLANT GROWTH PROMOTING FLUORESCENT PSEUDOMONADS FOR ABIOTIC STRESS TOLERANCE

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Plant growth promoting rhizobacteria are a vital component of soil ecosystem owing to their beneficial activities towards plants. Presence and abundance of these PGPR's within the vicinity of plants root helps in better growth, development and production of plant. Fluorescent pseudomonads are one such group of PGPR that play a major role in plant growth promotion, induced systemic resistance, biological control of pathogens and resistance against several types of abiotic stresses. Pseudomonas fluorescens are known to enhance and promote plant growth and reduce severity of various abiotic stresses. The present work was carried out with an objective to evaluate the plant growth promoting traits and abiotic stress tolerance potentials of fluorescent pseudomonads isolated from different locations. A total of 16 fluorescent pseudomonad isolates showing production of green fluorescent pigments on King's B agar media were tested in this work. All the 16 isolates tested were found positive for the production of the phytohormone indole-acetic acid. The amount of IAA produced ranged from 25 mg/L to 153 mg/L. All the 16 isolates were also found to exhibit phosphate solubilization potential under in-vitro conditions. Using insoluble tricalcium phosphate as sole source of phosphate the amount of phosphate solubilized ranged from 3.18 mg/L to 9.37 mg/L. These isolates were further evaluated for their tolerance capabilities against 3 different abiotic stressors viz. salinity, heavy metal and water limiting/desiccation stress. All the isolates were tested for growth against salinity on 4 levels of salinity amended media (250 mM, 500 mM, 750 mM and 1000 mM). All the isolates showed survival and growth upto the highest level of salinity tested. These isolates when tested for heavy metal tolerance (Cd and Pb) showed selective

tolerance and only 8 out of 16 isolates exhibited tolerance against heavy metal stress. Both the heavy metals were tested at different concentrations by amending the growth media with their respective salts. Incase of Cd applied as $CdSO_4$ 8 isolates exhibited growth at 150 µM; amongst these 8 only 4 isolates showed growth at 200 µM; while further from these 4 only 2 isolates survived at 250 µM $CdSO_4$. In case of Pb the 8 isolates which expressed tolerance showed survival and growth upto 1000 µM of $PbCl_2$ tested. Tolerance of the fluorescent pseudomonad isolates against desiccation was tested by culturing and growth evaluation in media amended with different concentrations of PEG 6000. All the 16 isolates exhibited growth at 10% of PEG. With increase in PEG concentration to 15% only 8 isolates showed growth and survival. With further increase in PEG concentration to 20% and 25% respectively these 8 isolates exhibited significant survival but with delayed growth. The results obtained in this study put forward that these fluorescent pseudomonad isolates tested hold promising potentials for their field application owing to their dual nature of plant growth promotion capabilities and a wide range of abiotic stress tolerance.

CSPT: 116.

MUTATION AND ITS ROLE IN GENETIC DIVERSITY

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Genetic diversity is the variation occurred in genetic information, which depends on frequency and diversity of alleles among individuals within populations or a species. This is also a part of the evaluation process, allows the organism to adapt to changing environmental conditions and to survive. The two sources of genetic diversity are mutation (main cause) and recombination. Mutations, naturally occurred in the evolutionary process, are changes in the genetic sequence leads to changes in functions which is narrowed as a result of natural selection and classical breeding studies. The rate of spontaneous mutations in higher plant is quite low (10^{-5} to 10^{-8}). Obtaining useful genetic variation through natural mutation is a very slow process because it also supports random genetic drift. Mutation induction studies, provides new alleles to the genome by different methods, contribute to the increase of genetic diversity. The deleterious or neutral mutations occur in the natural process may disappear in the evolutionary process. The protected mutants may have desirable agricultural characteristics or easily adapt to the changing environmental conditions. Alleles that are previously neutral or have little effect on the reproduction success of individual may suddenly become important. According to the neutral hypothesis, mutations that occur with smaller changes are harmless mutations. They are protected in the evolutionary process by contributing to the formation of genetic diversity. Most of the polymorphism is kept in a population by mutation and random genetics drift.The increase in genetic variation will increase the chance of survival of species in changing biotic and abiotic conditions. Genetic diversity is not only important for the continuity of species, but also improves the quality criteria of plants for various humankind uses.

Keyword: Genetic diversity, Mutation, Alleles, Evolution, Adaptation, Population

CSPT: 117.

METHANE EMISSION AND MITIGATION STRATEGIES IN RICE FIELD

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Methane (CH_4) is the second major greenhouse gas (GHG) after carbon dioxide but it is 21 times more potent per unit as a GHG and agriculture accounts for 40% of these emissions. Although farm animals are a major source, flooded rice paddies emit as much as 500 million tons, which is around 20% of total manmade emissions of this gas. Anaerobic decomposition of organic material in flooded rice fields produces methane, which escapes to the

atmosphere primarily by diffusive transport through the rice plants during the growing season. The rice paddies characterized by anaerobic conditions, high moisture, warm temperature and relatively high organic substrate levels, provide an ideal environment for the activity of methanogenic and methanotrophic bacteria, and are one of the most important sources of anthropogenic methane emissions. There are three processes of methane release into the atmosphere from rice fields which are the Diffusion loss of CH_4 across the water surface, Methane loss as bubbles (ebullition) from paddy soils is a common and significant mechanism, especially if the soil texture is not clayey and the Third process is CH_4 transport through rice plants, which has been reported as the most important phenomenon. More than 90 per cent of total CH_4 emitted during the cropping season is released by diffusive transport through the aerenchyma system of the rice plants. Selection of rice cultivar, Direct seeding, Periodic drainage of irrigated rice paddies like intermittent irrigation, infiltration irrigation which inhibit the activity of methane producing bacteria under oxidizing condition, Reduction of organic material amendment such as rice straw, decrease anaerobic fermentation of soil organic matter and diversifying crops in rice-based cropping systems always reduces methane emissions from the crop and can be up to 90%, but that depends on methods used and the water management system.

Keywords: Methane, rice, anaerobic, diffusion, drainage, emission

CSPT: 118.

IMPACT OF PESTICIDE USE ON AGROECOSYSTEM

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Pesticides are toxic chemical substances or a mixture of substances or biological agents that are intentionally released into the environment in order to avert, deter, control and/or kill and destroy populations of insects, weeds, rodents, fungi or other harmful pests.As per the recent estimates, about 5.2 billion pounds of pesticides are used worldwide per year.Pesticides are used to kill the pests and insects which attack on crops and harm them. Different kinds of pesticides have been used for crop protection for years. Pesticides benefit the crops; however, they also impose a serious negative impact on the environment. Excessive use of pesticides may lead to the destruction of biodiversity. Many birds, aquatic organisms and animals are under the threat ofharmful pesticides for their survival. Pesticides are a concern for sustainability of environment and global stability. Pollution as a result to overuse of pesticides and the long term impact of pesticides on the environment. There is a need to develop methods to eradicate the use of pesticides and finally it the future impacts of the pesticide use of the world should be considered for pesticide use.

CSPT: 119.

DIRECT SELECTION PARAMETER FOR CERTAIN QUANTITATIVE TRAIT IN FIELD PEA (*Pisum sativum* L. *var. arvense*)

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The present investigation was carried out to estimate the direct selection parametersuch as genetic variability, heritability and genetic advance for certain quantitative traits among ninety genotypes along with four check varieties. Analysis of variance revealed highly significant differences among all the genotypes for majority of the traits except pod length. Moderate to high level of genotypic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV) were exhibited by the genotypes under study. In general, phenotypic coefficient of variance was found to be higher than their genotypic coefficient of variance but difference was quite meager, indicating negligible environmental influence on the expression of the characters. High PCV coupled with high GCV was found for pod

length (25.30 %) followed by number of pods per plant (21.02 %). Moderate to high level of heritability and genetic advance were reported for various quantitative traits under study. Maximum heritability in broad sense, were reported for number of primary branches per plant (99.46), number of pod per plant (99.36) and seed yield per plant (98.54). Maximum genetic advance in percent of mean was reported for number of pod per plant (43.04), number of primary branches per plant (42.69) and pod length (42.49). The characters such as number of primary branches per plant, number of pod per plant and number of seed per pod showed high GCV, heritability and genetic advance would be more helpful in formulation of selection strategy for prediction of the gain under selection.

Keywords: Genetic variability, GCV and PCV, Heritability, Genetic advance and Fieldpea.

CSPT: 120.

INTEGRATED PEST AND DISEASE MANAGEMENT IN TOMATO (*Solanum Lycopersicum* L.)

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Tomato (*Solanum Lycopersicum* L.), an important vegetable crop in India, is grown on an area of 4.58 million hectares with a production of 74.62 million tonnes. The most important insect pests of tomato is fruit borer (*Helicoverpa armigera* L.), leaf miner, *Liriomyza trifolii* (Burgess), red spider mite, *Tetranychus urticae* (Koch) *etc.* Early blight (*Alternaria solani*), late blight (*Phytropthora parasistica*), powdery mildew (*Leveillula taurica*) and Leaf curl (insect vector, white fly) *etc.* are the major diseases of tomato. There are many alternative control methods used in tomato cultivation that help to control different pests and diseases but sometimes using only one method may not provide an efficient control over this issue. Integrated pest management (IPM) strategies are crop and variety specific, country specific, region and location specific, depending on local agricultural practices, available knowledge and crop protection means available for farmers which means that IPM has to be developed and adapted to fit local requirements. Sometimes only one method of management cause soil health issue and resistance problem. Integration of various potential way of pest and disease management according to the condition and feasibility is the need of present time. Crop rotation is a very important part of tomato IPM because almost all of these diseases overwinter in the residue of the previous year's crop. It is recommended to rotate to non-solanaceous crops, and if possible non-cucurbit crops. Try to avoid the repeated cultivation of tomato in the disease infested field at least for two years to reduce the risk of crop by disease infestation. Chemical method of pest control for tomato is a viable and efficient method which is time saving and quick responding. It is recommended to integrate cultural, chemical and biological method of pest and disease management for sustainable tomato production.

Keywords: Tomato, IPM, tomato crop protection, disease management

CSPT: 121.

INFLUENCE OF PREVAILING WEATHER PARAMETERS ON PREDATORY ROLE OF SPIDER AND INCIDENCE OF YELLOW STEM BORER AND LEAF FOLDER OF RICE

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This survey was conducted in rice field during *kharif* season of year 2017 at Pusa farm of Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur) Bihar. Spiders are the second most important predators after

coccinellid beetles in rice field. Spiders are numerous early season predators and are thought to play an important role in the suppression of insect pests such as yellow stem borer, leaf folder and plant hoppers. Pest resurgence after insecticide spraying has been clearly linked to the negative impact of insecticides on spiders and other natural enemies. The relatively low prey quality of pest species suggests that alternative prey serve as important food supplements. Future changes in the irrigated rice cropping system, such as direct seeding, chemical rather than manual weed control, mechanization and larger field sizes, will have significant impacts on spiders and other beneficial, thus disrupting natural biological control in rice. Natural biological control in *kharif* rice at the early crop stages can mainly be attributed to spiders.

Keywords: Yellow stem borer, Leaf folder, Spider

CSPT: 122.

FIELD EFFICACY OF NEWER INSECTICIDES AGAINST APHID AND POD BORER ON LENTIL

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This experiment was conducted at Research Farm of Tirhut College of Agriculture, Dholi, Muzaffarpur, a campus of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India during *rabi* season, 2017-18. All the insecticidal treatments were significantly superior to control in reducing the aphid population. It varied from a minimum of 6.3 aphid/plant to the maximum of 33.9 aphid/plant in control. The per cent reduction in aphid population over control ranged from 65.8 to 81.5 per cent. Among treatments, foliar application of profenophos (50 EC) was found to be most effective in reducing aphid population (6.3 aphid/plant). All the treatments were found significantly superior over control in minimizing mean per cent pod damage. The lowest mean per cent pod damage (2.0 %) was recorded by the application of profenophos (50 EC) @ 1 lit. /ha as against 14.0 per cent in untreated control. The per cent reduction in pod damage over control was maximum (85.8 %) by the application of profenophos 50 EC whereas minimum by the application of novaluron 10 EC (28.6 %).Maximum grain yield (15.6 q/ha) was recorded with foliar application of profenophos (50 EC).

Keywords: Aphid, pod borer, lentil

CSPT: 123.

OPTIMIZATION OF PLANT GROWTH REGULATORS REQUIREMENT FOR *IN-VITRO* CULTURE OF POTATO

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Potato is the one of the most important cash crop grown for its high biological value. It is the fourth most important crop by production with high nutritive value and high returns. This crop is mainly damaged by diseases thus, production of disease free plant and genetic manipulation to improve the existing cultivars. Moreover, the production of this crop is affected by the non-availability of quality seed of high yielding varieties which have resistant to diseases and pets. Now days, micropropagation techniques are established as viable tool for production of quality and disease free seedling. The success of micropropagation is mainly dependent on genotype, hormonal concentration, and appropriate media combination. Therefore, present study was designed to optimize hormonal requirements for *in-vitro* culture of potato. The leaf and stem was collected as explant from three months old plants. The explants were excised into 2.5 and 5.0 mm diameter in size and placed on MS medium supplementing with various concentrations of PGRs (2,4-D and BA) for callus initiation. The inoculated cultures were placed in growth at 25± 2°C under light intensity of 30.0 μm $dm^{-1}s^{-1}$. The plants were regenerated by transferring callus on MS media

containing different concentrations of BAP, Kn, TDZ, NAA, IBA and GA_3. The best callus was observed in media containing 2.0 mg/L 2,4-D and 1. Mg/L BAP. The multiple shoots were produced on media supplemented with 1.5 mg/L BAP + 25.0 mg/L $AdSO_4$. Supplementation of GA_3 and NAA along with optimum hormonal combination was resulted in enhanced shoot growth and shoot multiplication.

CSPT: 124.

ECOLOGICAL EFFECT OF RICE CULTIVATION AND ITS MANAGEMENT PRACTICES

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Paddy rice is physiologically adapted for growing in standing water creating ideal conditions for methane emissions. Methane (CH_4) is a very important greenhouse gas. Rice paddies are considered to be one of the important sources of atmospheric CH_4 (up to 90% of agricultural methane production) which is passively transported through the plant's vascular system into the air, by passing potential oxidation which would occur during bubbling or diffusion through paddy water (IPCC, 1992). Methane emission from irrigated rice fields is controlled by CH_4 production; CH_4 oxidation and CH_4 transport processes. The CH_4-oxidizing bacteria probably became limited by nitrogen as indicated by the seasonal decrease of NH_4^+. Thus, CH_4 oxidation had little effect on CH_4 emission. Methane production in soil slowly increased after flooding. Also, intermittent irrigation of rice paddies, which causes anaerobic and aerobic cycling, is considered to be one of the options for reducing CH_4 emission. However, intermittent irrigation would lead to conflicting effects with respect to the contribution of rice fields to the greenhouse effect, i.e. there would be a trade off between the depressive effect on CH_4 emission. Methane emissions affected by nitrogen fertilizers were measured simultaneously in rice paddy fields under intermittent irrigation in 1994. CH_4 emission on the average, decreased by 42 and 60% in the ammonium sulphate than urea. In contrast, the CH_4 flux peaked during flooding and was significantly depressed by mid-season aeration (MSA). It has been demonstrated that the existence of NH_4^+ can stimulate CH_4 emission from rice paddy fields due to the competition of NH_4^+ for the oxidation with CH_4 by methanotrophs, while SO_4^{2-} acts as a proton acceptor under strong anaerobic conditions, which in turn depresses CH_4 production. After rice transplanting, CH_4 fluxes generally increased and reached peaks at about 40 days and then dropped off.

Keywords: Methane emission, mitigation, oxidation, integrated effect, anaerobic

CSPT: 125.

EFFECT OF DIFFERENT GROWING ENVIRONMENT ON GROWTH AND YIELD OF MUSTARD CULTIVARS (*Brassica juncea* L.)

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A field experiment was conducted during the *Rabi* season of 2018-19 to access the "Effect of different growing environment on growth and yield of mustard cultivars (*Brassica juncea* L.)" in silty loam soil at Agro-meteorological Research Farm, N.D. University of Agriculture & Technology, Kumarganj, Ayodhya. The experiment was conducted with RBD (Factorial) and replicated four times with nine treatment combinations consisted of three growing environment viz. D_1 (20th October), D_2 (30th October) and D_3 (09th November) and three cultivars *viz.* V_1 (Varuna), V_2 (Narendra rai-1) and V_3 (Kranti). Results revealed that 20th October sown mustard crop produced significantly higher growth and yield due to fulfilment of optimum heat unit requirement and solar light interception

for various processes of plant. Among the different cultivars of mustard, Varuna was more conducive for growth, development, grain yield and heat use efficiency as compared to Narendra rai-1 (NDR-8501) and Kranti. Higher seed yield (18.90 q/ha) was recorded under 20th October sowing as compared to 30th October sown mustard crop and 09th November. Among the different cultivars, maximum yield of Varuna was 18.90 q/ha and performed 10.20% and 26.58% higher yield than Narendra rai-1 (NDR-8501) and Kranti respectively. Heat unit (1660.6 ^{0}Cdays) and solar radiation interception (589 MJ/m^{2}) from sowing to maturity produced the high yield of Indian mustard.

CSPT: 126.

ISOLATION OF CADMIUM TOLERANT BACTERIA FROM WASTEWATER IRRIGATED AREA OF VARANASI TO DEVELOP CONSORTIUM FOR FIELD APPLICATION

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Heavy metal contamination of the agricultural soils leads to diverse environmental and ecological problems including reduction in plant growth and yield, deterioration of soil properties and entry of toxic metal in food chain. Cadmium (Cd) one of the most toxic element among heavy metals is widespread pollutant in agriculture soil. Many studies have shown that applications of Cd resistant bacteria enhanced the agricultural yield of crops without Cd accumulation in plant tissues at toxic level. Therefore, in the present an attempt was made to isolate Cd tolerant bacteria from agricultural field contaminated with heavy metal due to long-time irrigation with sewage water in the peri-urban areas of Varanasi. The bacterial isolates from the peri-urban areas were screened for Cd tolerance on the nutrient agar plat (pH 7±.2) amended with Cd (50 µg/ml to 500 µg/ml) as $CdCl_2.H_2O$ based on minimum inhibitory concentration, out of 40 bacterial isolates, five isolates only showed prominent survival on 250 µg/ml Cd. These five isolates were having synergistic relationship with each other. Therefore, they were used for consortium development at the ratio 1:1, 1:2 and 2:1 inoculants. The ratio of 2:1 of broth culture was found suitable for development of 4 of cadmium tolerant consortium viz: consortium A (Isolate No. 1+3) consortium B (Isolate No. 3+10) consortium C (Isolate No. 10+15) and Consortium D (Isolate No. 15+20). The field trial of these consortia is under process.

Keywords: Wastewater, Heavy metal, Peri-urban area, Cadmium Tolerant Bacteria, Consortium development

CSPT: 127.

SCREENING OF SIX VARIETIES OF MUSTARD (*Brassica compestris* L.) FOR CULTIVATION IN HEAVY METAL CONTAMINATED PERI URBAN AGRICULTURE ECOSYSTEM

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In the present study, a pot-based experiment was conducted to assess the response of six variety, of mustard (*Brassica compestris* L.) crop namely; Varuna, NRCBB 101, RH 749, Giriraj, Kranti and AK 56 grown on heavy metal contaminated soil collected from agricultural areas of Bhadohi exposed to mixed wastewater (domestic wastewater and industrial effluents) since long-term. The response of mustard crops grown on contaminated soil were evaluated in terms of leaf area, crop growth rate, root-shoot ratio (RSR), photosynthetic rate and water use efficiency. The samples of plants were collected in triplicates at 40 and 90 days after the germination of seeds. The results of the

present study revealed that the contaminated soil significantly reduced the biomass, photosynthetic rate and chlorophyll contents in the leaf of test plant as compared to non-contaminated soil ($p < 0.05$). RSR was found highest and lowest for Varuna (0.27) and RH 749 (0.19) variety of test crop, respectively. Whereas crop growth rate as well as photo synthetic rate were recorded maximum in NRCBB 101 (38.48 g/m^2/day and 29.38 μ mole $CO_2/m^2/s$, respectively) among all the test varieties of mustard plants. Percent reductions in water use efficiency were found as 34.8%, 32% in Giriraj and RH 749 and were 15.1%, 15.61% in NRCBB 101 and Kranti, respectively. From the above results, it can be concluded that NRCBB 101 is the most suitable variety of mustard crop for the cultivation in heavy metal contaminated soil resulting from long-term use of wastewater.

Keywords: Waste water, Contaminated soil, Mustard plants, Industrial effluents, Crop growth rate

CSPT: 128.

INCREASE THE CROP YIELD OF CITRUS VARIETIES IN SUMMER SEASON BY USING PLANT TISSUE CULTURE

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In summer season to fulfil the daily energy requirement of our body citrus fruits are suggested as these fruits comes with huge amount of vitamins, minerals, inorganic nutrients etc.These fruits are called citrus as the name suggest they are rich in high amount of citric acid in its pulpy core. Such types of citrus fruits are- lemon (Citrus limon), Orange (Citrus sinnensis), Pomelo. Of these lemon is majorly cultivated and used in all over the world because not only for its vitamin content but also for its broad medicinal purposes. But the cultivation of lemon in dry summer season is difficult as the seed dormancy does not break easily but it best grows in rainy season. So the need is not completely fulfilled in summer season, that why to prevent the pre harvest losses we can increase the crop yield of citrus fruits by using Plant Tissue Culture technique that imply the cultivation of citrus varieties in laboratory under aseptic conditions. The idea is to grow the seeds of a major citrus variety such as lemon in M.S media in three different variants. It means to culture seeds in three different types of M.S media differing in their vitamins concentration. One type of media contain Standard concentration of vitamins, next type of media contain 5X vitamins, and third type of media contain 9X vitamin. Then it is allowed to grow under aseptic conditions and after 2-3 days of cultivation we can observe different growth rates in the three types of media used. This was happened because the increased amount of vitamins in media supports very fast breakdown of seed dormancy in comparison with standard ones. So by this experiment it is clear that if we prepare a manure containing high amount of vitamins concentration and mix with soil so that it can increase the high temperature tolerance of citrus varieties in dry summer season.

Keywords: Citrus Fruits, Plant tissue culture, M.S media, Seed dormancy, Aseptic condition, Vitamins.

CSPT: 129.

SCANNING ELECTRON MICROSCOPY OF *Trichoderma* ISOLATES FOR ITS MYCOPARASITISM ACTIVITY AND EVALUATION OF ITS ENZYMATIC ACTIVITIES AGAINST *Fusarium oxysporum* f. sp. *Lentis*

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Lentil rhizosphere samples were collected from different environmental niche of India, and 6 isolates of *Trichoderma* were isolated and identified. Among 6 isolates, 2 isolates were identified as *Trichoderma harzianum*, 2

isolates were identified as *Trichoderma asperellum,* 1 isolate was identified as *Trichoderma viride* and remaining 1 isolate was identified as *Trichoderma hamatum*. These isolates were identified morphologically and molecularly by using ITS primers amplification by polymerase chain reaction and submitted to NCBI. All identified isolates with isolate 5595 collected from ITCC, New Delhi, were screened for their antagonistic activity using dual culture method. *Trichoderma* isolates (ThL-4, TaL-2 and 5595) were found to be more potent antagonist against *Fusarium oxysporum* f. sp. *Lentis*. *Trichoderma* isolates (ThL-4, TaL-2 and 5595) were selected for further study of biocontrol potential and production of cell wall-degrading enzymes. The mechanism of action of *Trichoderma* spp. (5593, TaL-2 and ThL-4) was observed microscopically by using Scanning Electron Microscope (SEM) and found coiling and super coiling structure of *Trichoderma* mycelium over *Fusarium* mycelium for controlling its growth. These selected *Trichoderma* isolates were inoculated in media containing basal media and mycelia of fungal pathogens for cell wall-degrading enzyme production. It was found that *T. harzianum* secretes two major cell wall-degrading enzymes, i.e., chitinase and β-glucanase. Optimum production of both enzymes was found at 96 hrs of incubation. The role of *Trichoderma* isolates (ThL-4, TaL-2 and 5595) in inducing defense enzymes (Peroxidase, Polyphenol Oxidase and Superoxidase dismutase) in lentil exposed to pathogen *Fusarium oxysporum* f. sp. *Lentis* were observed. It was found that the biocontrol agent, *T. harzianum* (ThL-4 and 5595) induced higher levels of defense enzymes in lentil during pathogenesis by *F. oxysporum*. Therefore, it was concluded that plant defense enzymes play a vital role in mitigating pathogen-induced stress.

CSPT: 130.

GENOME-WIDE ASSOCIATION MAPPING REVEALS CANDIDATE GENES GENOMIC REGIONS CONTROLLING VEGETATIVE STAGE SALT TOLERANCE IN WHEAT

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Salt stress is emerging a major constraint in wheat production around the world. We have performed GWA study to identify genomic regions/candidate genes associated with vegetative stage salt tolerance in wheat. An association panel of 135 diverse wheat accessions including indigenous, exotic and some released cultivars were used for this analysis. The association panel was evaluated under control (0mMNaCl) and salinity stress (100 mMNaCl) at seedling stage. Significant variation was observed for all the measured seedling stage traits. Genotyping of association panel using 35K Axiom SNP array revealed a total of 20,117 polymorphic SNPs. Out of these, only 17927 SNPs could be assigned exact chromosomal locations on wheat genome assembly IWGSC RefSeq v 1.0 and used in marker trait association analysis. Marker-trait associations (MTAs) was performed using two difference approaches MLM (mixed linear model and CMIM (compressed mixed linear model).A total of 48 MTAs for nine traits were identified using both the approaches and which included CHL (2), MSI (4), SDW (11), TBM (3), SL (2), R/S (1),Na+ (4), K+ (18) and N+/K+ (3). The analysis of associated genomic region revealed many potential candidate genes including some encoding for Ca, K and Na transporters. The associated markers are being validated for their suitability for use in MAS program for development salt tolerant variety.

Keywords: Salinity, Quantitative trait loci, 35K SNP array, GWAS, Linkage disequilibrium

CSPT: 131.

METRIBUZIN+CLODINAFOP-PROPARGYL EFFECT ON COMPLEX WEED FLORA AND ITS RESIDUAL EFFECT ON SUCCEEDING CROPS

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A field experiment was carried out at Agriculture Research Farm of Innocent Hearts Group of Institutions, Loharan ,Jalandhar, Punjab during *Rabi* season of 2017-2018 to test the efficiency of different doses of metribuzin 42% + clodinafop propargyl 12% WG against weeds in wheat. The soil of the experimental field was clay loam in texture, medium in organic carbon (0.67%), available phosphorous (29.6 kg/ha) and potassium (176.4 kg/ha) with pH 7.1. Result revealed that metribuzin + clodinafop-propargyl at 500-600 g/ha were as effective as two hand weeding at 30 and 45 DAS in reducing the weed density of *Phalaris minor* and *Chenopodium album, Cornopusdidymus, Melilotus*spp., *Rumex*spp. and *Fumaria parviflora* at 30 and 55 days after application as compared to rest treatments. Maximum grain yield was recorded in metribuzin + clodinafop-propargyl WG at 600 g/ha which was statistically at par with its lower dose of 500 g/ha due to effective control of grassy and broad-leaved weed in wheat.

Keywords: Wheat, Herbicide, Residual effect

CSPT: 132.

INVITRO PHENOTYPIC SCREENING FOR TOLERANT TO SALT STRESS AT SEED GERMINATION IN MUNGBEAN

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Salt tolerance is a polygenic, highly intricate trait dependent on genotype and plant developmental stage. Lack of trustworthy technique and suitable parameter for screening further restrict to develop salt tolerance in mungbean. Low productivity of mungbean highlights the need of its genetic improvement to maintain its production in salt affected soils. The development of salt tolerant cultivars is the most promising and efficient gateway to reduce the lethal effects of soil salinity on crop production. Hence this study was conducted in petri dish providing 0, 4, 8 and 12 dSm^{-1} (Deci Siemens) salinity. Based on the performances, genotypes were scored and grouped as highly tolerant (score 1), tolerant (score 3), moderately tolerant (score 5), susceptible (score 7) and highly susceptible (score 9). Salinity stress reduced the all the seedling parameters as the salinity level increased among the genotypes. Based on the score, the relationship between salinity level and tolerances of the different genotypes can be understood. The seedling characters of mungbean generally showed variable level of sensitivity to salinity and the genotype such as Pusa Vishal, VRMGG 1, VBN 3, ADT 3 exhibiting good seedling performance and can be selected for further screening for salt tolerance at later growth stages to develop salt tolerant genotypes.

Keywords: Mungbean, Salinity, Germination, Root Growth.

CSPT: 133.

INFLUENCE OF VARIOUS IRRIGATION LEVELS AND STRESS MANAGEMENT TOOLS ON GROWTH AND PHYSIOLOGICAL PARAMETERS OF BLACK GRAM

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An experiment was conducted to study the influence of various irrigation levels and stress management tools on enhancement of growth and physiological parameters in black gram. The treatments comprised of three levels of irrigation *viz.,* 6 irrigations (300 mm), 4 irrigations (200 mm) and 3 irrigations (150 mm) respectively and were tested with different stress alleviation tools viz., seed hardening with zinc sulphate @ 100 ppm, seed hardening with zinc sulphate @ 100 ppm + foliar application of KCl @ 1 % 2 times, seed hardening with zinc sulphate @ 100 ppm + foliar application of PPFM @ 1 % 2 times and control were no stress management tools were followed. The results revealed that 6 irrigation treatment among the irrigation treatments and seed hardening with zinc sulphate @ 100 ppm + foliar application of PPFM @ 1 % 2 times among stress allevation tools recorded higher plant height, DMP, root length, relative water content and chlorophyll content in blackgram. Interaction between these treatments recorded higher growth parameters and physiological parameters in blackgram. Significant finding to note was the interaction which received 6 irrigations with control was on par with the application of 4 irrigations along with seed hardening with $ZnSO_4$@ 100 ppm + foliar application of PPFM @ 1% in all the parameters recorded. This clearly indicates that stress management tools can alleviate water stress in blackgram.

Keywords: Irrigations, Stress management tools, Seed hardening, Foliar application, Growth parameters, Physiological parameters.

CSPT: 134.

ROOT TO SHOOT RATIO AND FIELD ESTABLISHMENT OF TERMINAL CUTTINGS OF MARIGOLD AS INFLUENCED BY ROOTING MEDIA IN MARIGOLD

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Marigold (*Tageteserecta*L.) is one of the most important commercial flower crops grown in India. The crop is said to be native of Mexico. It belongs to the family *Asteraceae.* The rooting media has been reported to influence the success of propagation in several crops through vegetative parts. A higher number of roots were seen in terminal cuttings of marigold than in case of seed propagation of marigold. Similarly, increased number of branches, leaves per plant, plant height, size of bloom than those plants propagated sexually. An experiment was carried out at College of Horticulture, Venkataramannagudem, in factorial concept with two factors *i.e.,* varieties at two levels and rooting media at eight levels thus making 16 combinations which were replicated twice. The effect of varieties, rooting media and their interactions were found to be significant on root to shoot ratio and field establishment of terminal cuttings. The variety Bidhan Marigold 1 exhibited highest root to shoot ratio and greater percentage establishment of rooted cuttings at 30 days after shifting into the main field than Bidhan Marigold 2. Among the rooting media, the highest root to shoot ratio, was recorded by M_6 – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza. and whereas the percentage establishment of rooted cuttings was recorded by M_8 – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza. The lowest root to shoot ratio and percentage establishment of rooted cuttings was recorded on M_1 – soil.

CSPT: 135.

MASTITIS CONTROL MEASURES IN NAMAKKAL DISTRICT OF TAMIL NADU: AN ECONOMIC ANALYSIS

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Livestock in general and dairying in particular play a major role in the Indian rural economy. Mastitis is considered as one of the most costly disease affecting dairy cows. Economic losses due to mastitis are recognized worldwide as a major problem on dairy farms. This study is planned to study the clinical mastitis control strategies in the randomly selected Namakkal District of Tamilnadu.The data collected were pertaining to the years 2017-18 and 2018-19. The study found that the incidence of mastitis was very high (95.73 per cent) among the animals where none of the control measures were adopted. Implementation of practising first set of control measures that include washing of udder before and after milking, teat dipping, cleaning of stalls twice every day, keeping cows standing after milking for at least 30 minutes, fore stripping and milking clinical cases last resulted in the mastitis incidence of mere 1.36 per cent. Practising of dry cow therapy (Measure II) alone resulted in the mastitis incidence of 33.33 per cent. The combination of control measures I and II were found to be highly effective with zero mastitis incidence. Adoption of all the three measures (Combining measures I, II and III) also resulted in zero mastitis incidence. Partial budget analysis revealed that first set of control measures (Measure I) resulted in a highest net returns of Rs, 1666.96 and implementation of dry cow therapy ensued a lesser positive return of Rs. 1115.83 which was largely due to higher drug cost, veterinarian's fees when compared to first set of control measures. Further, implementation of culling of chronic mastitic animals would lead to a net negative return of Rs, 2632.97.

Keywords: Mastitis, Partial Budget Analysis, Economic Analysis

CSPT: 136.

MICROBIAL GENES IN CROPIMPROVEMENT

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Microbes have played crucial role in agriculture since the beginning of the agricultural and crops and microbes have lived together on farms for millions of years. Traditionally, the native microbes have played both harmful and beneficial roles in farming. While on one hand, the microbes cause a number of diseases on crops and causing significant yield losses, and on the other, they play numerous beneficial roles in maintenance of soil fertility as well as providing options for biological management of diseases and pests. Despite, the beneficial or the destructive aspects of microbes in agriculture, one thing that clearly stands out is that crops and microbes are indivisible. Crop improvement through conventional plant breeding is longer and time consuming process but through modern plant breeding (GM), we can achieve new cultivar in short period with desired characters *viz.* hybrid seed production, herbicide resistant, insect resistant, nutritional improvement, abiotic stress tolerance *etc*. Many pathogen-derived genes have been utilized to develop disease-resistant crops through different strategies such as viral coat-protein gene, production of antiviral protein in transgenic plants or expressing antibodies specific to proteins involved in pathogenesis. The specific transferable genetic elements of microbes were first discovered in 1983 through human intervention using recombinant DNA and genetic engineering techniques. Genetic engineering is providing chance to use exact microbial properties in an accurate manner and built those properties into the crop genomes. Now days GM crops have been extensively cultivated by farmers in different parts of the world over the last two decades. So far, nearly 400 different events of transgenic crops have been permitted for cultivation throughout worldwide.

Keywords: Plant breeding, transgenic crops, viral-coat protein, Pathogenesis.

CSPT: 137.

USE OF SUGARCANE BAGGASE FOR BIOETHANOL PRODUCTION BY SIMULTANEOUS SACCHARIFICATION AND FERMENTATION THROUGH *IN-VITRO* PRODUCED CELLUASE COMPLEX

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The ever growing world population and global industrialization increased the world energy demand. Over the decades, the world population quadrupled and in turn increased the energy consumption by 16-folds. Lignocellulosic biomass including sugarcane baggasee is one of the most promising feedstock for production of second generation bioethanol, which is low cost renewable resource. But, due to various economic and technical obstacles, its development is still hampered. The sugarcane bagasse was pretreated using NaOH (0.5M and 1M) solutions. After treatment the concentrated hydrolysate was detoxified by addition of activated charcoal (2.4% w/v) followed by incubation for 1h at 200 rpm and 30 °C. On the other hand, thirty two cellulolytic microorganisms were isolated and screened (quantitatively and qualitatively) for maximum cellulase production from various natural habitats. Secondary screening revealed that a fungal strain, which was later identified as *Trichoderma longibrachiatum*, exhibited maximum CMCase (0.44 U); cellobiase (3.384 U) and FPase (0.082 U) activities. Later on, the fermentation condition for cellulase production using sugarcane bagasse as sole carbon source was optimized. Simultaneous saccharification and fermentation was carried out in 250 ml Erlenmeyer flask containing delignified SCB (30 g/100 ml) with the supplementation of 0.25g/l of KCl, 3.5g g/l of $MgSO_4.7H_2O$ and 10 g/l of yeast extract as a nitrogen source. The detoxified culture filtrate obtained after cellulase fermentation was added and final volume was made upto 100 ml. The fermentation medium was inoculated with *Saccharomyces cerevisiae.* The alcohol production was started in the fermentation broth at 24 h and reached maximum at 72 h. The alcohol percentage was estimated and found to be 8.1% with the productivity of 1.14 ml/l/h.

CSPT: 138.

ROOFTOP GARDENING IN TOWNS AND CITIES

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The continuous growth of human population on earth is creating a lot of social, economic and ecological pressure on environment such that availability of land is very less in urban areas. There is no exclusive need to construct a garden at ground level. Roof gardens can be splendid substitutes for natural looking, landscaped areas at ground level. With some imagination and fantasy, a flat roof can be transformed from a barren landscape into a living network of gardens. Rooftop gardening is a special type of urban agriculture or urban horticulture. Standing on one of the higher floors of the buildings, one can see how extremely large the surface of the roofs in the city is. These rooftops are generally unused. They often have good exposure to sunlight and rain, and they are always available, even in the densest urban areas. Whether in the rain or the sun, a roof garden always has a lot of character, changing with the season and the time of day, so it will be visited regularly. This paper aims to identify the potential for and barriers to urban agriculture with reference to rooftop gardening (RTG) and to explore strategies to promote food security in towns and cities in India.

Keywords: Urban agriculture, Roof gardening,

CSPT: 139.

POTENTIALITY OF SWEET SORGHUM [(*SORGHUM BICOLOR* (L.)] FOR JAGGERY PRODUCTION

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Sweet Sorghum is the best multipurpose crop for simultaneous production of grain as food, sugary juice from its stalk for making jaggery and concentrated syrup. Its green foliage is used as an excellent fodder for animals. Sweet sorghum has a great tolerance to a wide range of climatic and soil conditions. It is a short duration crop of 110-130 days as compared to 10-12 months in sugarcane. Sweet sorghum is a special purpose sorghum variety with a sugar-rich stalk like sugarcane. Besides having rapid growth, high sugarcane accumulation and biomass production potential, Sweet sorghum has wider adaptability. Sweet sorghum can be grown with limited irrigation and in low rainfall areas. The sugar content in the juice extracted from sweet sorghum varies from 16-23% brix. It has a great potential for jaggery. The paper is based on the secondary data collected from different published and unpublished sources.

Sweet sorghum with grain sorghum having high stalk sugar content and stay green trait is likely to improve the grain productivity without affecting stalk sugar content. Apart from grain and fodder, several alternate products such as jaggery, syrup, alcohol, sugar, wine, vinegar and sweetener can also be made by sweet sorghum. Thus, it can create demand through value addition to the sweet sorghum crop.

Jaggery and sugar can be produced from sweet sorghum using traditional methods. This is done by crushing the sweet sorghum stalk to extract the juice and then collecting, filtering and boiling it to produce jaggery. Most jaggery producers use a simple crusher consisting of three metal rollers driven by an engine. A 5 HP diesel pump could process around 300 kg of sweet sorghum stalk per hour usually; the crusher is connected by flexible hose to the drying vats where the juice is concentrated. The bagasse or dried sweet sorghum residue can be used as fuel for this process. Jaggery at 90-45 degrees brix can be produced with this process. The difference is in the boiling time as jaggery is produced after $3^{1}/_{2}$ hours of boiling.

Sweet sorghum can be used as a substitute for sugarcane for jaggery and syrup making and can be cultivated as a multipurpose crop round the year. The studies conducted at KVK, IISR, Lucknow has revealed that the cultivation of sweet sorghum is more economical than sugarcane. For popularising the sweet sorghum in Lucknow and adjoining areas, the KVK, IISR has been regularly conducting frontline demonstrations on sweet sorghum for the last five years by procuring the hybrid seeds from NRC on Sorghum, Hyderabad. The impact of conducting frontline demonstrations on sweet sorghum is evident from its large scale cultivation, but the produce is generally used as fodder in cane intensive areas. The dry areas like Bundelkhand have more potential for manufacturing jaggery from sweet sorghum. The research and extension activities must focus on exploiting the potential of sweet sorghum by development of entrepreneurship skills and adequate technological backstopping to earn more profits.

CSPT: 140.

FFECT OF BIO NPK WITH DIFFERENT DOSES OF FERTILIZERS ON WHEAT YIELD IN AZAMGARH DISTRICT

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The adverse consequences of excessive use of chemicals in agriculture have forced all the stakeholders to explore alternative options for keeping soil live and responsive. Microbe driven agro-ecological practices therefore,

can alternatively strengthen sustainability of the productive farm because of their prime focus on enriching biodiversity in the cultivated area. Being major inhabitants of normal, sub-normal and extreme habitats, microbes are evolutionary evolved with unique inherent capabilities of recycling, rehabilitating, managing and remediating their own habitats. Viable biological options that boost integrated management of crop production have great promise in minimizing threats of climate change on crop plants, losses due to indiscriminate use of agrochemicals and declining soil health. Microbial inoculants with their prominent capabilities of N-fixation, P-solubilization and K-mineralization are now available to the farming communities as an if not full, then partial alternative nutrient supplements for the soils. These inoculants, when introduced to the soils, keep on propagating themselves and subsequently, show their inherent properties that boosts soil fertility parameters. Front Line Demonstrations were conducted in collaboration with ICAR-NBAIM, Kusmaur, Mau (U.P.) to popularize microbe-mediated practices under "*Mera Gaon-Mera Gaurav*" program for creating farmers' awareness about the microbe-mediated methods. Farmers were promoted to apply Bio-NPK, a liquid formulation of N-fixing *Azotabacterchroococcum, P-solubilizing (Paenibacillustylopili) and K-solubilizing (Bacillus decolorationis) for production of wheat (var. HD-2967). Trials were conducted* with different recommended doses of fertilizers (RDF) during 2016-17 & 2017-18. Wheat seeds were inoculated with the Bio-NPK liquid formulation and sown in the fields. Demonstrations were laid on one hectare area each of 25 farmers selected from different villages of Jahanaganj block of Azamgarh district, Uttar Pradesh. Results have shown qualitative and quantitative changes in crop yield throughout the vegetative and reproductive growth of the crop. The yield recorded an increase of almost 9-16 per cent on half (1/2 RDF) and three fourth dose (3/4 RDF). The findings led to conclude that with the application of microbial consortium, up to 25 to 30% of the chemical farm inputs can be minimized and thus, saving the cost of production.

CSPT: 141.

INTEGRATED PEST MANAGEMENT FOR SUSTAINABLE AGRICULTURE

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Integrated Pest Management (IPM) is a leading complement and alternative to synthetic pesticides and a form of sustainable intensification with particular importance for tropical smallholders. Global pesticide use has grown over the past 20 years to 3.5 billion kg/year, amounting to a global market worth $45 billion. The external costs of pesticides are $4–$19 (€3–15) per kg of active ingredient applied, suggesting that IPM approaches that result in lower pesticide use will benefit, not only farmers, but also wider environments and human health. Evidence for IPM's impacts on pesticide use and yields remains patchy. We contribute an evaluation using data from 85 IPM projects from 24 countries of Asia and Africa implemented over the past twenty years. Analysing outcomes on productivity and reliance on pesticides, we find a mean yield increase across projects and crops of 40.9% (SD 72.3), combined with a decline in pesticide use to 30.7% (SD 34.9) compared with baseline. A total of 35 of 115 (30%) crop combinations resulted in a transition to zero pesticide use. We assess successes in four types of IPM projects, and find that at least 50% of pesticide use is not needed in most agro ecosystems. Nonetheless, policy support for IPM is relatively rare, counter-interventions from pesticide industry common, and the IPM challenge never done as pests, diseases and weeds evolve and move.

Keywords: Integrated Pest Management, Agriculture, Pesticides.

CSPT: 142.

BIOLOGICAL CONTROL AND ITS IMPORTANT IN AGRICULTURE

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Biological control is defined broadly as the use of natural or modified organisms, genes, or gene products to reduce the effects of pests and diseases. Physical control is the use of tillage, open-field burning, heat-treatment (pasteurization), and other physical methods, usually to eliminate pests or separate them from the crop. Chemical control is the use of synthetic chemical pesticides to eliminate pests or reduce their effects. The many approaches to biological control can be categorized conventionally into regulation of the pest population (the classical approach), exclusionary systems of protection (a living barrier of microorganisms on the plant or animal that deters infection or pest attack) and systems of self-defence (resistance and immunization). The agents of biological control include the pest-or disease-agent itself (sterile males or a virulent strain of pathogens), antagonists or natural enemies, or the plant or animal managed or manipulated (immunized) to defend itself. Principles of plant health care are offered, know the production limits of the agro-ecosystem, rotate the crops, maintain soil organic master, use clean planting material, plant well-adapted, pest-resistant cultivars, minimize environmental and nutritional stresses, maximize the effects of beneficial organisms and protect with pesticides as necessary.

Keywords: Biological control Agriculture, pest-resistant.

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ENHANCED PEST MANAGEMENT THROUGH SOIL HEALTH

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As we previously stated, agro ecosystem health can be optimized through management of two pillars: habitat ma- insulation and soil fertility. The resent paper focuses on the second pillar, namely the enhancement of soil quality through the management of organic matter and conservation of the belowground biodiversity component of agricultural ecosystems. Traditionally considered in isolation from one another, aboveground and belowground biodiversity components of ecosystems are increasingly being recognized as much more closely interlinked than previously supposed. Infect, the plant seems to function as an integrator of the aboveground and belowground components of agro-ecosystems, which are otherwise largely spatially separated, with the plant as a connector. This recognition of the eco-logical linkages between aboveground and belowground biota constitutes a key step on which a truly innovative ecologically-based pest management (EBPM) strategy can be built. EBPM considers belowground and aboveground habitat management as equally important, because enhancing positive ecological interactions between soils and pests can provide a robust and sustainable way for optimizing total agro ecosystem function The integrity of the agro ecosystem relies on synergies of plant diversity and the continuing function of the soil microbial community sup-ported by a soil rich in organic matter.

Keywords: Agro ecosystem, Agriculture, Soil.

CSPT: 144.

PEST MANAGEMENT CHALLENGE AND GLOBAL PESTICIDE

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Pathogens, weeds, and invertebrates cause significant crop losses worldwide, and in doing so present a barrier to the achievement of global food security and poverty reduction. Estimates of the scale of these losses vary by context and scope. Viewed in terms of food security, crops losses to pests may represent the equivalent of food required to feed over 1 billion people. However, the use of synthetic pesticides presents additional challenges and it is now clear that alternative methods need to be applied, which reduce pest damage while avoiding the cost and negative outcomes associated with synthetic pesticides. Integrated Pest Management (IPM) is the deployment of a variety of methods of pest control designed to complement, reduce or replace the application of synthetic pesticides. IPM incorporates the simultaneous management and integration of tactics, the regular monitoring of pests and natural enemies, the use of thresholds for decisions, and spans methods from pesticide product management/substitution to whole agro ecosystem redesign. Consequent reduction in the use of synthetic pesticides improves on- and off-farm sustainability, as well as reducing costs to the farmer.

Keywords: Pathogens, Agriculture, IPM, pesticides.

CSPT: 145.

BIOTECHNOLOGICAL INTERVENTIONS AND THEIR ROLE IN SUSTAINABLE HILL AGRICULTURE

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The ever increasing demand for food, feed, nutrition and other basic needs has put a lot of pressure on the agricultural and horticultural sectors in terms of addressing the accompanied challenges associated with increasing crop productivity in hills. At the same time, we are witnessing the potential benefits of the revolutions forced by the science of biotechnology. Biotechnology has played an important role towards the attainment of production sustainability of crops by using various biotechnological tools. Biotechnology has the potential to provide new opportunities for achieving enhanced crop productivity in a way that will alleviate poverty, improve food security and nutrition, and promote sustainable use of natural resources in hill farming system. Conventional and biotechnological research inputs have contributed in solving some of the constraints limiting crop productivity. However, limitations such as complex genome, narrow genetic base, poor fertility, susceptibility to biotic and abiotic stresses and long duration to breed elite cultivars, hinder crop improvement programmes. Several radiation induced mutants with agronomic ally desirable traits were isolated and evaluated under field conditions, besides studying abiotic stress responses using molecular tools. This article describes the developments in the in vitro culture systems and related biotechnologies tools such as marker-assisted selection (MAS), marker-assisted breeding (MAB), QTL mapping etc.

Keywords: Crop Productivity, Environment, food, Sustainable.

CSPT: 146.

INTEGRATING CONSERVATION ORGANIC FARMING IN AGRICULTURE

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Indian agriculture recorded all time high food grain production (272 million tons) in 2017-18 due to the concerted efforts of farmers, scientists and extension workers. In the previous decades, major research and development efforts were focused on enhancing production and productivity of food grain crops. Among the various issues, conservation of the resource base have assumed paramount importance in view of widespread resource degradation and need to reduce the production costs, increase profitability which made agriculture more competitive. The conventional agriculture through intensive agricultural practices was successful for achieving the goals of production, but simultaneously led to severe degradation of natural resources. The occurrence of multi-nutrient deficiencies and overall decline in the productive capacity of the soil due to non-judicious use of agro- inputs, have been widely reported. Such concerns and problems posed by modern agriculture gave birth to new concepts in farming, such as organic farming, natural farming, biodynamic agriculture, do-nothing agriculture, eco-farming etc. The essential feature of such farming practices 'back to nature'. The emerging concerns for sustainable agriculture have been seen as a positive response to limits of both low-input, traditional agriculture and intensive modern agriculture relying on high levels of inputs for crop production.

Keywords: Indian Agriculture, food grain production, food, Sustainable.

CSPT: 147.

SUSTAINABLE AGRICULTURAL DEVELOPMENT FOR FOOD SECURITY AND NUTRITION

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Sustainable Agricultural development for food security and nutrition" requires considering the dynamics of agricultural development: what it does, the outcomes, and how it performs vis-à-vis the two key objectives of sustainability and FSN. Agricultural development has a key role to play in relation to poverty reduction, in the context of economic development and growth as a whole. Also, given the economic and social importance of agriculture, which provides a livelihood to 38.3 percent of the world total labour force (FAO, 2015a), and the importance of food as a basic human need, agricultural development is a key domain for the universally agreed human rights framework, including the progressive realization of the Right to Food. Considering the crucial importance of agricultural development to ensure FSN, to reduce poverty, and to ensure sustainable management of natural resources, SAD is central for the implementation of the 17 Sustainable Development Goals (SDG) agreed in 2015.What are the relationships between food security, sustainable food systems and sustainable agricultural development? In line with HLPE (2014), "Sustainable food systems are food systems that ensure food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition of future generations are not compromised.

Keywords: Sustainable agriculture, climate change, FSN

CSPT: 148.

STUDIES ON THE PERFORMANCE OF GARLIC GENOTYPES IN BUNDELKHAND REGION OF UTTAR PRADESH

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The vegetables provide nutritional security, employment generation, soil and moisture conservation and generate tremendous potential for small scale vegetable based industries. Bundelkhand region comprising Banda, Chitrakoot, Mahoba, Hamirpur, Jhansi, Lalitpur, and Jalaun districts of Uttara Pradesh lags behind other region of the country in terms of various economic indicators. Over the years, horticulture has emerged as one of the potential agricultural enterprise in accelerating the growth of economy. Bundelkhand with its wide variability of climate and soil, is highly favorable for growing a large number of horticultural crops. The economy of Bundelkhand is largely agricultural, owing to its predominantly rural population. The uncertainty of rainfall along with poor quality soil makes agriculture difficult in many parts of Bundelkhand.

Garlic is widely cultivated for internal consumption as well as for the export. India, being major garlic producing country, produces 1721 MT from 303.0 thousand ha, with a very low productivity of 5.86 tones/ha. Garlic are used as spices, condiments and vegetables almost daily in every kitchen as a seasoning for wide varieties of dishes. The green leaves, immature and mature bulbs are eaten raw as well as in preparation of vegetables. Because of its special characteristics of pungency, it has more value than other vegetables. The garlic is grown during *Rabi* season and can be stored up to 7-8 month with meagre losses. It has very good export potential and demand increased day by day for export as well as internal consumption of the country.

The Bundelkhand region has very good potential for Garlic cultivation. The farmers of this area generally grow local varieties of garlic in *Rabi* season with reasonably low yield. However, intensive research work is required in relation to evaluation of high yielding varieties, soil amendments, standardization of nutrient doses and other cultivation practices. Keeping in view the importance of garlic the Banda University of Agriculture and Technology, Banda, UP collected the local garlic germplasm and conducted the experiment on 10 entries i. e Yamuna Safed-2, Yamuna Safed-3, Yamuna Safed-4, BUATG-1, BUATG-2, BUATG-3, BUATG-4, BUATG-5, BUATG-6, BUATG-7, along with three checks Yamuna Safed-2, Yamuna Safed-3 and Yamuna Safed-4. The trial was sown Randomized Block Design with three replications on experimental form of Banda University of Agriculture and Technology, Banda. The result showed that maximum bulb diameter (4.52 cm) was recorded in genotype BUATG-2 followed by BUATG-5 (4.40 cm) and Yamuna Safed-3 (4.22 cm). The minimum (149 days) were taken by check Yamuna Safed-3 followed by genotype BUATG-2 (151 days) and BUATG-5 (154 days). The highest marketable yield 128.75 q/ha was recorded in entry BUATG-2 followed by BUATG-5 (118.75 q/ha) and check variety Yamuna Safed-3 (112.50 q/ha).

CSPT: 149.

STUDIES ON THE PERFORMANCE OF GARLIC GENOTYPES IN BUNDELKHAND REGION OF UTTAR PRADESH

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country in terms of various economic indicators. Over the years, horticulture has emerged as one of the potential agricultural enterprise in accelerating the growth of economy. Bundelkhand with its wide variability of climate and soil, is highly favorable for growing a large number of horticultural crops. The economy of Bundelkhand is largely agricultural, owing to its predominantly rural population. The uncertainty of rainfall along with poor quality soil makes agriculture difficult in many parts of Bundelkhand. Garlic is widely cultivated for internal consumption as well as for the export. India, being major garlic producing country, produces 1721 MT from 303.0 thousand ha, with a very low productivity of 5.86 tones/ha. Garlic are used as spices, condiments and vegetables almost daily in every kitchen as a seasoning for wide varieties of dishes. The green leaves, immature and mature bulbs are eaten raw as well as in preparation of vegetables. Because of its special characteristics of pungency, it has more value than other vegetables. The garlic is grown during *Rabi* season and can be stored up to 7-8 month with meager losses. It has very good export potential and demand increased day by day for export as well as internal consumption of the country. The Bundelkhand region has very good potential for Garlic cultivation. The farmers of this area generally grow local varieties of garlic in *Rabi* season with reasonably low yield. However, intensive research work is required in relation to evaluation of high yielding varieties, soil amendments, standardization of nutrient doses and other cultivation practices. Keeping in view the importance of garlic the Banda University of Agriculture and Technology, Banda, UP collected the local garlic germplasm and conducted the experiment on 10 entries i. e Yamuna Safed-2, Yamuna Safed-3, Yamuna Safed-4, BUATG-1, BUATG-2, BUATG-3, BUATG-4, BUATG-5, BUATG-6, BUATG-7, along with three checks Yamuna Safed-2, Yamuna Safed-3 and Yamuna Safed-4. The trial was sown Randomized Block Design with three replications on experimental form of Banda University of Agriculture and Technology, Banda. The result showed that maximum bulb diameter (4.52 cm) was recorded in genotype BUATG-2 followed by BUATG-5 (4.40 cm) and Yamuna Safed-3 (4.22 cm). The minimum (149 days) were taken by check Yamuna Safed-3 followed by genotype BUATG-2 (151 days) and BUATG-5 (154 days). The highest marketable yield 128.75 q/ha was recorded in entry BUATG-2 followed by BUATG-5 (118.75 q/ha) and check variety Yamuna Safed-3 (112.50 q/ha).

CSPT: 150.

MAPPING ASSOCIATION OF MOLECULAR MARKERS AND SHEATH BLIGHT(*RHIZOCTONIA SOLANI*) DISEASE RESISTANCE IN RICE.

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Rice is one of the important crops grown worldwide and is considered as an important crop for global food security. Rice is being affected by various fungal, bacterial and viral diseases resulting in huge yield losses every year. Deployment of resistance genes in various crops is one of the important methods of disease management. However, identification, cloning and characterization of disease resistance genes is a very tedious effort. In present study, diverse rice landrace were phenotyped against R. solani and resistant and moderately resistant sources were identified from the panel of 450 germplasm pool.

For Phenotyping work 450 rice genotypes including one resistant check “Tetep” were evaluated in α- lattice design at the Agricultural Research Farm, U.P.College,Varanasi. A virulent strain of *R. solani* 'MTCC-12227' was used for artificial inoculation of test genotypes. Second leaf sheath (from the top) at growth stage 21(GS 21) were inoculated with a bit (approx. 0.25 mg) of four-days-old immature sclerotium in 1st and in 2nd replication. *R. solani* grown on PDA at 28 ± 30C. From each line 5 plants were randomly selected and tagged before inoculation. For inoculation leaf sheath was opened carefully and inoculum was placed inside the sheath. A few drops of sterilized water were also added to inoculated sheath. Inoculation was done in the evening and inoculated plants were sprayed with water next morning. *R. solani* infected rice genotypes showing different level of disease infections (lesion length). 400 rice genotypes were evaluated in α- lattice design at the Agricultural Research Farm Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during kharif 2014 and 2015. A virulent isolate of *R. solani* 'MTCC-12227' was used for artificial inoculation of test genotypes. Second leaf sheath (from the top) at growth stage

21 (GS 21) were inoculated with a bit (approx. 0.25 mg) of four-days-old immature sclerotium in 1st and in 2nd replication. *R. solani was* grown on PDA at 28 ± 30C. From each line 5 plants were randomly selected and tagged before inoculation. For inoculation leaf sheath was opened carefully and inoculum was placed inside the sheath. A few drops of sterilized water were also added to inoculated sheath. Inoculation was done in the evening and inoculated plants were sprayed with water next morning. *R. solani* infected rice genotypes exhibited different level of disease infections (lesion length). The inoculated plants were regularly examined for appearance of symptoms starting from 48 hours after inoculation. Data on disease intensity was recorded on four different dates at seven days intervals after 7 days of inoculation. On the basis of AUDPC 29 promising germplasm were found relatively resistance to ShB than check. In *kharif* 2016 these 29 germplasms were again inoculated and rigorously evaluated. The genotypes CR- 3488-1-2-1-2 (982.94), IC-256649 (1050.06), HUR LC-22 (1020.80), CR 3635-1-1 (1080.90) and CRR 599-5-1 (1091.20) were found to be moderately resistance for sheath blight. The marker RM 336, RM 209, RM 251 and RM 224 were found to be more appropriate marker for sheath blight to discriminate the genotypes owing to high PIC value of 0.743, 0.694, 0.668 and 0.656, respectively. The genotype CR-3488-1-2-1-2 harboured 8 sheath blight resistance genes, followed by HUR LC-22 and IC-256649 had 7 sheath blight resistance genes offer a potential source of gene for improving Sheath blight resistance gene in rice.

CSPT: 151.

KNOWLEDGE AND ADOPTION OF AONLA PRODUCTION TECHNOLOGY BY FARMERS

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The Aonla (Emblica officinalies L.) one of the most important minor fruit and a crop of commercial significance, in quite hardly, prolific bearer and highly remunerative even without much care . It belongs to the family Euphorbiaceae and in known as amla, amlaki, amali, ambala, amala kannu and nelli in different parts of India.

The fruit is highly nutritive and the richest source of vitamin C. The fruits are made into preserves (Murabba), Sauce, candy, dried chips, tablets, Jellies, pickle, tophies, powder etc. The stability of ascorbic acid and presence of astringency in anola fruit may be assign to the presence of pohyphenols or leucoanthocyanins.

Aonla can be grown in light as well as heavy soil except very sand one. However well-drained fertile loaming soil in the least. The plant has capacity for adaptation to dry regions and can be grown in moderately saline and alkaline soil. It is most popular in Uttar Pradesh where it is largely cultivated in commercial orchard in Azamgarh, Pratapgarh, Varanasi, Bareilly and Raebareli districts. In view of its diverse uses, its cultivation is increasing fast and the tree is becoming popular with the orchardists. A full grown grafted aonla tree with good bearing has yield from 187 to 299 kg fruits per year. Aonla cultivation concentrated in Raebareli district showed a yield of 1.8 quintals from the 10 years old tree of Chakaiya and Banarsi varieties. The low yields might be due to lack of technical knowledge about technical knowledge and non adoption of aonla production technology by farmers.

CSPT: 152.

SCOPE AND POTENTIAL OF MEDICINAL PLANTS IN NORTH INDIA

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The northern part of India harbours a great diversity of medicinal plants because of the majestic Himalayan range. The traditional medicine systems of northern India such as Ayurveda and Unani are part of country's culture and honoured by people still today. Over 200 species of medicinal plants apart from their ethnobotanical purposes are also

consumed raw, roasted, boiled, fried, cooked, or used in the form of oil, spices, jams or pickles. Many medicinal plant species are used in curing more than one disease. *Gloriosa superba, Aegle marmelos*, *Hemidesmus indicus, Phyllanthus emblica*, etc. are used to cure several diseases. Medicinal plants have strong acceptance in religious activities of north Indian native communities, who worship the plants in the form of various gods, goddesses and minor deities. *Aegle marmelos, Cedrus deodara, Cynodon dactylon, Ficus benghalensis, Ficus religiosa, Juniperus communis, Musa paradisiaca, Ocimum sanctum* and *Origanum vulgare* are examples of the medicinal plants highly used for medicinal as well as a religious purposes by the Hindus in northern India. In India, of the 17,000 species of higher plants, 7500 are known for medicinal uses. This proportion of medicinal plants is the highest proportion of plants known for their medical purposes in any country of the world for the existing flora of that respective country. The most important advantage of herbal medicine is the minimal side effects. Apart from health care, medicinal plants are mainly the alternate income-generating source of underprivileged communities. The continuous increase in human population is one of the causes for concern in meeting the daily requirements of food and medicine as the economy and livelihoods of human societies living in developing countries primarily depend on forest products.

CSPT: 153.

MICRO IRRIGATION A POTENTIAL AREA IN GARDENING

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Micro-irrigation technology uses a network of plastic pipes to carry a low flow of water under low pressure to plants. Water is applied much more slowly than with sprinkler irrigation. Plants grow better with this favourable air-water balance and even soil moisture. Water is applied frequently at low flow rates with the goal of applying only the water plants need. Sprinkler irrigation results in a greater wet-to-dry fluctuation in the soil and may not produce optimal growth results. Micro-irrigation systems are more widely available and better designed for use in home gardens than ever before. Drip irrigation exceeds 90 percent efficiency whereas sprinkler systems are 50 to 70 percent efficient. It is so efficient that many water utilities exempt landscapes irrigated with drip from restrictions during drought. Low volume application of water to plant roots maintains a desirable balance of air and water in the soil. Traditionally used for growing commercial vegetables, orchards, windbreaks, greenhouse and nursery plants, micro-irrigation systems are well-adapted for home use also. They can be effectively used for irrigating landscapes, flower gardens and for small pots. They are well-suited to irrigate container plants as well. When combined with a controller, drip irrigation systems can be managed with ease. Micro-irrigation is ideal for mound plantings. Slopes are inefficient to irrigate because gravity pulls water downhill, causing runoff and water waste. The slow rate of water applied through drip irrigation is more likely to soak in before it runs off. The mold spots on house siding and the staining and deterioration of wood privacy fences experienced with overspray from sprinkler irrigation is eliminated with the use of drip. Because water doesn't leave the landscape with drip irrigation, pavement deterioration associated with sprinkler irrigation run-off is eliminated. Lawns of India are generally irrigated through flood irrigation, where sprinkler irrigation can be used and huge water can be saved.

CSPT: 154.

RESPONSE OF PERIPHYTIC ALGAL COMMUNITY TO ARSENIC STRESS

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In situ effect of arsenic (As) stress on periphytic algal community of the river Ganga was studied using chemical diffusing substrates. Arsenic stress induced significant reduction in periphytic biomass and a maximum inhibition in growth was recorded at highest arsenic concentration. Various periphytic groups responded differentially to metal stress. The diatoms exhibited tolerance against As treatment whereas cyanobacteria showed sensitivity. The relative abundance of Chlorophyta increased in all the tested concentrations of arsenic. Arsenic treatment caused

significant reduction in species richness and diversity of periphytic algae. Periphytic algae that were tolerant to arsenic treatment included *Aulacoseiragranulata*, *Aulacoseirapusilla*, *Nitzschiapalea* and *Navicularacens*.

Keywords: Heavy metal, Periphyton, Arsenic, Biomass, Metal stress

CSPT: 155.

EFFECT OF CHEMICAL SEED ENHANCEMENT TREATMENT ON SEED YIELD AND QUALITY IN RAGI cv. TRY 1

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Finger millet (*Eleusinecoracana*), one of the minor cereals, is known for several health benefits and some of the health benefits are attributed to its polyphenol and dietary fiber contents. It is an important staple food in India for people of low income groups. Seed is the basic input for agriculture. Seed quality is vital to sustainable crop production and food security. No agricultural practice can improve a crop beyond the limits set by the seed. Quality seed production is the main goal for successful agriculture, which demands each and every seed should be readily germinable and produce a vigorous seedling ensuring high yield. Seed enhancement technologies are gaining increasing attention for their potential to confer greater disease resistance in seeds, improve seed vigor and modify seed emergence capabilities. For any crop, the time from sowing to seedling establishment is crucial, in which the seeds are exposed to wide range of environmental stresses. With this background the present investigations were carried out at the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University to study on the effect of various chemical seed enhancement treatments on seed yield and quality in ragi cv. TRY 1. The seeds of ragi cv. TRY 1 were given with various pre sowing chemical seed treatments i.e., $ZnSO_4$ @ 3%, $MgCl_2$ @ 3%, $MgSO_4$@ 3%, $FeSO_4$ @ 3%, KOH @ 3%,KCl@ 3%, $NaHCO_3$@ 3%, $CaCl_2$@ 3%, CH_4N_2S @ 3%, KH_2PO_4 @ 3% along with control. All the pre sowing treatment seeds were evaluated for the initial quality characteristics. The $CaCl_2$ @ 3% pre sowing treatment registered significantly higher values for initial seed qualities and lower electrical conductivity. In field evaluation, $CaCl_2$@ 3% pre sowing treatment seeds recorded higher growth, physiological and growth parameters, when compared with other treatments.

Keywords: Ragi, Chemical Seed enhancement, Seed quality

CSPT: 156.

MECHANISMS AND APPLICATIONS OF PLANT GROWTH PROMOTING RHIZOBACTERIA: CURRENT PERSPECTIVE

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Using the expertise of farmers to productively work the land as well as to promote the self resilience and self sufficiency of farmers. One of the major concern in today's world is the harmful effect of abiotic stresses like flood, drought, salinity, temperature and heavy metal toxicity on plants, which is mainly due to change in climate, pollution and contamination of soil. These stresses adversely affect growth, development and productivity of plants as well as fertility of soil and also reduce the quality of food. Thus the one possible solution is the use of Plant growth promoting rhizobacteria, having multiply activities directed toward plant growth promotion vis-s'-vis exhibiting bioremediation potentials by detoxifying pollutants like, heavy metals and pesticides and controlling a range of phytopathogens as biopesticides. Generally, PGPR promote plant growth directly by either facilitating resource acquisition (nitrogen, phosphorus and essential minerals) or modulating plant hormone levels, or indirectly by decreasing the inhibitory effects of various pathogens on plant growth and development in of various pathogens on plant growth and

development in the forms of biocontrol agents. The direct mechanism involves N2 fixation, phosphate solubilization, siderophore production, phytoharmones production, ACC-deaminase. Indirect mechanism includes control disease, biocontrol activity and induced systemic resistance. The application of PGPR in mitigation of different abiotic stresses has been successfully achieved from several years, because PGPR have the ability to promote plant growth by various mechanisms as we discuss above. The wide scale application of PGPR may decrease the global dependence on agricultural chemicals. The various species of bacteria which are generally found to have plant growth promoting abilities mainly belongs to genera Pseudomonas, Bacillus, Azospirillum, Azotobacter, Arthrobacter, Acetobacter etc.

Keywords: PGPR, ACC-deaminase, Phosphate solubilization, N2 fixation, Sustainable agriculture

CSPT: 157.

NOVEL AND FEASIBLE STRATEGIES FOR REMEDIATION OF WATER CONTAMINATED WITH ARSENIC

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Arsenic (As) is a toxic metalloid affecting an estimated population of over hundred million around the world, especially Southeast Asia. Arsenic exposure occurs mainly through consumption of food and drinking water. The problem is widespread in Indian states of West Bengal, Bihar and Uttar Pradesh and is also reported from Assam and other states. There is a need to remediate As from drinking water and food through low cost sustainable technologies. To this end, As transforming and accumulating micro-organisms can find a pivotal role in bioremediation of As. A number of bacterial, microalgae and fungi based technologies have been tested at laboratory level and even in simulated field conditions. Recently, a novel fungal-algal pellet was developed and was standardized for optimum condition for removal as accumulation and transformation were compared among *chlorella vulgaris*, *Aspergillus oryzae* and fungal-algal pellets under different arsenate and phosphate concentration. It was found that nitrogen and phosphorus are critical nutrients that promote growth of algae while fungi have ability to utilize various carbon sources such as glucose as a good substrate. Fungal-algal pellets had the highest removal and accumulation capacity of As. Even higher plants like *Pteris vittata* which is a hyper accumulator of As have been successfully used in As remediation studies. The problem of As-laden biomass of plants has been tackled through efficient removal of As and biomass reduction in recent experiments. This presentation gives a brief overview of prospective technologies that can be applied at low cost and sustainably in As affected areas of India.

CSPT: 158.

GREEN SYNTHESIS OF BIOACTIVE NANOPARTICLE FROM TWO MORPHOLOGICALLY AND BIOCHEMICALLY DISTINCT ACCESSIONS OF *Withania somnifera*

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Withania somnifera is a highly valuable medicinal plant of family Solanaceae and commonly known as Ashwagandha. It is well known for different types of Withanolides (triterpenoid steroidal lactone) and flavonoids. There are several accessions of this plant which are either wild or cultivated. The present study was conducted for comparative analyses of *W. somnifera* (cultivated) and *W. somnifera* var. *ashwagandha* (wild) having differential morphological features as well as their ability to reduce Ag ions during the synthesis of green silver nanoparticles. The seed samples of two accessions were grown under uniform in-vitro condition. One week old seedlings were

transferred in hydroponic system until the emergence of forth leaf. After that, the plantlets were acclimatized and transferred in field condition. Plants were irrigated daily upto 2 months for the analysis of comparative further differential morphological features. Trichome density was also analyzed by fluorescent microscopy showing distinctly high density of trichomes in the wild accession. Third and sixth leaves from each accession were collected for synthesis of AgNPs. Differential biomass of leaves (3g and 5g) from each samples were boiled in 100 ml water for six min. Plant extracts were mixed with 1 mM AgNO3 solution in ratio of 1:3 and 1:5 and incubated under shaking condition. Comparative synthesis of nanoparticles were analyzed by visible colour changes and UV- VIS spectra. The cultivated accession was superior in morphological traits in comparison to the wild type. However, total no of branches, berries per cluster and trichomes were found more in wild variety. UV- VIS spectra revealed that AgNPs were synthesized by leaf extracts of both samples and peaks were obtained at 450 and 445 nm with cultivated and wild variety, respectively. Synthesized nanoparticles showed differential antimicrobial potential against pathogenic bacteria.

CSPT: 159.

EFFECT OF BIOCHEMICAL SUBSTANCES LINKED TO YELLOW MOSAIC VIRUS IN GREENGRAM GENOTYPES [*Vigna radiata* (L)]

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Vigna radiata (L.) Wilczek commonly known as green gram or mungbean, is an important food legume that has low flattulence protein, which makes it indispensable in Indian vegetarian diet. The present investigation was carried out using the 40 germplasm accessions of greengram. The crop was raised in Randomised Block Design with three replications at Jayankondapattinam. The present study focused on visual screening of selected crop cultivars against the Yellow mosaic virus and its biochemical correlation with sugars, phenols content activities. From the field studies, it was observed that selected crop was found with Yellow mosaic virus incidence. This disease incidence data was correlated with biochemical changes and sugars, phenols activities. The genotypes G3 (IC76417), G19 (IC119020-1) and G27 (PLM490) can be used for incorporating YMV resistance. Hence these genotypes could be used in further breeding programme.

Keywords: Green gram, germplasm, Biochemical characters.

CSPT: 160.

CHICKPEA SEED ENDOPHYTIC MICROBES IMPROVE THE PLANT GROWTH ATTRIBUTES AND INHIBIT THE GROWTH OF *FUSARIUM* PATHOGEN

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Chickpea have a great economic importance as well as nutritional value among all the pulses around the world. It has a high amount of proteins, vitamins, minerals etc. Different biotic and abiotic factors are responsible to decrease the production of chickpea, among them pathogens greatly affects the chickpea production. Chickpea seed inoculated with beneficial seed endophytic microbes have well defined role in plant growth promotion and biotic stress management. Here we analyzed the biocontrol activity and plant growth-promoting effects of chickpea seed endophytic bacterial strains. The bacterial strains of *Enterobacter*, *Bacillus*, *Pseudomonas*, *Staphylococcus*, *Pantoea* and *Mixta*family, were identified based on their 16S rDNA gene sequencing from the chickpea seed. The bacterial

strains showed a high degree of antagonistic activity against the chickpea pathogens *Fusarium* spp. during dual culture assay. The seed of chickpea was treated with best plant growth-promoting (PGP) bacterial strain and recorded *significantly* increase the total biomass of root and shoot, number of leaflets, total plant length and chlorophyll status as compared to control. The most important thing is that the root hairs of bio-primed seed are surprisingly increased as compared to untreated seed. The isolates are able to inhibit the pathogen growth as well as promote the plant growth by production of some important metabolites like indole-3-acetic, phosphatase, siderophores, proteases, catalase and ammonia. Conclusively seed inoculated with these *Pseudomonas* strains potentially promotes the plant growth and induces the plant defence mechanism in chickpea. Therefore, this effective endophytic *Pseudomonas* strains can possible to use as potential bio-inoculant for enhancing chickpea production under sustainable agriculture.

Keywords: PGPR, Seed endophytes, Biocontrol, Chickpea

CSPT: 161.

FLOOD RECESSION FARMING: A SUSTAINABLE PRACTICE OF FOOD PRODUCTION IN THE GANGA RIVER BASIN

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Rivers have been the pathways of human civilizations. World's great civilizations have originated and flourished within floodplains. Riverine floodplains are the home of high population densities due to availability of fertile alluvial soils and freshwater which are integral to food production. Farmers have been utilizing the fertility of floodplains for food production since antiquity. Flood recession farming is a traditional form of food production that utilizes natural irrigation and fertilization of floodplain. In this practice farmers use moisture and nutrient rich soil of the floodplains for growing crops after water levels recede and harvest them before flooding in the river. It is a low-input agricultural practice. Flood recession farming is prominent among the floodplains of various major rivers such as the Nile, the Amazon, the Euphrates, the Tigris, the Yangtze, the Ganga, the Mekong, and the Danube. The Ganga River is the lifeline of India and forms one of the most fertile alluvial plains of the world. Flood recession farming is an ancient practice of food production in the Ganga River basin. The Ganga River enriches the fertility of floodplain though flooding every year. Flood recession agriculture plays a key role in the food security, livelihood, and health of the poor and marginal farmers of the Ganga River basin. Mainly vegetable and fruit crops with short life cycle are grown through this unique method of farming. In the changing global scenario, this old-style farming system can play a pivotal role in all dimensions of sustainability including environment, society and economy. Despite substantial role in human well-being, flood recession farming has received little attention by scholars and policy-makers and therefore, this article aims to explore the potentials of flood recession farming and advocate it as a sustainable approach of food production.

Keywords: Floodplain, Flood recession farming, Food security, Ganga River basin, Sustainable agriculture

CSPT: 162.

REMOVAL OF TEXTILE DYES WITH THE USE OF *Aspergillus niger* (MTCC1344) AND THEIR EFFECT ON GROWTH OF TOMATO (GAYTRI F1 HYBRID) SPECIES

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Large quantities of wastewater which contains toxic organic residues are generated from the textile and dye manufacturing processes. Excessive use of these synthetic dyes in textiles may lead to serious health hazards and

disturbances in eco-balance of nature. Present work has been carried out the removal of textile water by the use of Aspergillus niger in different growth condition. The effect of time, dye concentration and pH were examined in this study. The results showed that the Aspergillus niger decolorized effluent water up to79% with increasing time. pH also play significant role in decolorization with increasing time. Substantial decrease in chemical oxygen demand (COD) also reported in seven days by Aspergillus niger. Impact of textile water at different concentration and duration of growth on tomato were also studied. The germination %, seedling growth, steam height and number of leaf showed a gradual decline with increase in effluent concentration. The study suggested waste water from textile industry could be utilized for irrigation purpose after proper dilution and treatment.

Keywords: Textile, Hazards, Aspergillus niger, Removal, Tomato, Germination.

CSPT: 163.

MICROBE-MEDIATED ACTIVATION OF DEFENSE NETWORK IN RICE (*Oryza sativa*) UNDER DROUGHT STRESS

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Abiotic challenges always result in the loss of agricultural production. Drought or water deficit, with its inherent capability to restrict crop growth and development has been considered as one of the most prominent stresses in agriculture. Crops like rice that remain in high demand for water face severe challenge at physiological, biochemical and productivity levels. Among strategies that have been used for stress mitigation or minimizing the impact of drought, application of microbial inoculants are gaining importance due to their ability to modulate crop physiology, protein and enzyme regulation and gene expression profile. Root colonization with the inoculated microbial inoculants establish intimate interactions for mutualistic benefits and boost intrinsic mechanisms in plants to gain strength against stress burden. We inoculated rice seeds with the microbial inoculants (*Pseudomonas, Trichoderma* and combined inoculation) (untreated rice seeds served as control) and grew them in different sets of pots up to flowering stage. Before the onset of flowering stage, the drought was applied on one set of plants, while other set was normally irrigated. Plants leaves were used for various enzymatic, non-enzymatic, biochemical and molecular analysis after 7 days of drought stress. Results indicated that microbial inoculation minimized the H_2O_2 production under drought stress. It further enhanced antioxidant activity in inoculated plants grown under drought. The antioxidant activity reflecting parameters like ABTS, DPPH, Fe-ion reducing power and Fe-ion chelation increased in microbe inoculated plants. The higher enzyme activity of peroxidase, superoxide dismutase, glutathione reductase and catalase was observed in microbe-inoculated rice plants. Microbial inoculation also enhanced expression of stress responsive defense genes such as *DHN*, *OSPiP*, and*DREB* in rice plants grown under stress conditions. In an cumulative way, the present study showed that microbial inoculation improve the intrinsic biochemical and molecular capabilities of rice plants to mitigate in impact of drought stress.

CSPT: 164.

PLANT GROWTH PROMOTING RHIZOBACTERIA: AGRICULTURALLY INFLUENTIAL MICROBES TO ALLEVIATE SALINITY STRESS IN PLANT

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Soil salinity is a serious land degradation issue in world which significantly threatens agriculture productivity and food security. Salinity adversely influences the growth, development and crop productivity. Globally, 22% of the total cultivated and 33% of the total irrigated agricultural area is subjected to salt stress. In addition, salinity is

increasing rapidly by an average of 10% per year. Due to this reason, 50% of cultivatable area will be salt-affected in coming years. Salts have detrimental effects on plants such as damage to photosynthetic machinery, growth retardation and ultimately yield loss. Salinity stressed agricultural soils also adversely influence soil health and microbial biome. However, plant under stress conditions can modify its root exudates and recruit beneficial rhizobacteria to minimize the toxicity effects. Development of transgenic crops resilient to salinity stress is indispensable to ensure food security around the globe. The increasing demand for crop production has become a big challenge at present with a significant reduction of synthetic chemical fertilizers and the adverse effects of saline stress. To maintain growth and development in saline condition microbes of plant rhizosphere have such potential to withstand in saline condition. Plant growth promoting rhizobacteria (PGPR) has attribute to tolerate salt stress and promote nitrogen fixation, exopolysaccharide production(EPS), hydrogen cyanide (HCN), Indole-3-acetic acid (IAA), and 1-aminocyclopropane-1-carboxylate (ACC) deaminase activity,volatile organic compounds (VOC), antioxidants etc.The salinity tolerant PGPR have the potential to work as defensive agents of plants by enhancing growth, productivity, tolerance and defense system under saline environments.

Keywords; Salinity stress, PGPR, Sustainable agriculture, Salinity tolerant bacteria.

CSPT: 165.

ESTIMATION OF HETEROSIS OF QUALITY PROTEIN MAIZE HYBRID UNDER IRRIGATED AND RAIN-FED ENVIRONMENTS

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A field experiment was conduct for estimation of heterosis at two different environments (E1 and E2). The E1 environment was irrigated and E2 was irrigation control as like rain-fed. After 50% flowering five randomly selected maize crops, analysis following traits such as, days to 50% tasseling, days to 50% silking, plant height (cm), ear height (cm), ear length (cm), days to 75% brown husk, ear diameter (cm), number of kernel rows per ear, number of kernels per row, 100-grain weight (g), shelling percentage, grain yield per plant (g). On the basis of maize crop yield and yield components observation mid parent and better parent heterosis were analysis. Better parent heterosis ranged from 0.78 to 19.53 in E1, 5.89 to 18.22 in E2 during *Rabi* season 2015-16 while, 0.60 to 16.14 in E1 and 0.22 to 10.24 in E2 showed better heterosis during *Kharif* season 2016. Such types, only 17 crosses in E1, 14 crosses in E2 showed better parent heterosis during *Rabi* season 2015-16, while, 15 crosses in E1 and E2 showed better parent during *Kharif* season 2016.

Keywords: Maize Hybrid; Breeding; Environment interaction; Heterosis; Yields

CSPT: 166.

CHRONIC RESPIRATORY DISEASE OF POULTRY: A CAUSE OF MAJOR CONCERN IN AYODHYA DISTRICT OF EASTERN UTTAR PRADESH

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The present study describes different attributes of chronic respiratory disease of chickens namely the clinical signs, gross and microscopic lesions in various organs particularly trachea, air sacs and lung with special reference to immunohistochemical diagnosis and also records the incidence, morbidity and mortality rate due to chronic respiratory disease of chickens in Ayodhya district of Eastern Uttar Pradesh. The overall incidence of the chronic

respiratory disease was 12.24%. The incidence varied from 4.5 to 14.71% in different farms. In the present study, the overall mortality was 8.43%. The mortality varied from 0.66 to 10.67% in different farms. The birds of 4-7 weeks of age was more susceptible to the disease than adult birds. The morbidity and mortality rate was higher in the layers than broilers.

Keywords: Chronic respiratoy disease, incidence, pathology, poultry

CSPT: 167.

SOCIO ECONOMIC STATUS OF GOAT FARMERS IN VINDHYAN ZONE OF EASTERN UTTAR PRADESH WITH SPECIAL REFERENCE TO DISEASE PREVENTION STRATEGIES

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Goat farming is mainly in hands of landless and small holder farmers, where females mainly take care of farms contributing 55% as goat rearing incharge. Around 72.5% respondents had small herd size. Maximum respondents reared there goats on grazing and stall feeding and did not give any special nutritional supplement. There was no separate house or special provision for new born was provided by respondents. Also, in case of disease only (23.33%) respondents called the veterinarians, instead of the fact that, in 47.5% situation hospitals were located within 0-5 km of range in most of the villages. Medical stores were located at 1-5km distance. Outbreak of disease was witnessed by 22.5% respondents with maximum outbreaks (75.83%) in winter season. Deaths were reported by 27.5% of the respondents. The main reason for this was that maximum respondents (74.17%) were not aware of vaccinations in goats, advantage of cold chain (87.5%) and deworming (68.33%). Deworming was mainly performed by Veterinary doctor (55.26%) annually (76.67%). 78.33% respondents used Ethno-veterinary medicines. The incidence of strongylus (22.22%) was highest among all G.I parasites in this zone and in incidence Moneizia (5.56%) was least. The need is to identify all possible short comings in feeding or housing management and look for a solution to overcome these short falls with minimum input. All the problems faced by these goats farmers need to be addressed. A small change in mindset by constant education and training is the best solution but needs rigorous exercise by extension workers or veterinarian. If achieved a small change will trigger bigger changes carried for generations.

Keywords: Socio Economic Status, Goat Farmers, Health status

CSPT: 168.

ALTERATION IN MILK QUALITY ON FEEDING EMBILICA OFFICINALIS IN SUBCLINICALLY AFFECTED COWS

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Embilica Officinalis or Indian gooseberry is perhaps the single most often mentioned herb in "Charak Samhita", the Ayurvedic medicine literature (500 BC). Ayurveda, which is the oldest health system in the world, appreciates and uses amla to treat a host of diseases and promote positive health. Thirty two animals positive for subclinical mastitis were randomly divided into four different groups containing 8 animals each and supplemented

with various doses of deseeded fresh amla. Changes in milk yield, fat %, solids not fat, total solids and total bacterial count were studied. Supplementation of amla @ 250 gms and 200gms increased the milk yield by 14.58% and 14.28%, significantly decreased total bacterial count but did not have any significant changes in fat %, total solids and solid not fat, although an increase in fat was recorded. Supplementation at 150gm too increased milk yield, decreased total bacterial count but the changes were statistically non significant. In un supplemented group, an increase in somatic cell count, total bacterial count and decline in milk yield was recorded indicative of development of mastitis. Thus amla can be used as an alternate to conventional therapy and can be supplemented to cattle in routine feeding especially in areas where it is surplus.

Keywords: Subclinical mastitis, Cattle, Embilica Officinalis, Milk quality

CSPT: 169.

CLINICO-PATHOLOGICAL STUDY OF LANTANA CAMARA TOXICITY IN SHEEP

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Lantana camara is an exotic weed brought to India as an ornamental plant but is now considered toxic in most parts of the country. This plant is not readily eaten by cattle but when ingested leads to hepatotoxicity and photosensitization. Lantana camara poisoning in sheeps has been described in this paper. Animals were part of a farm located in Ayodhya district. This study focuses on clinical signs and postmortem examination with emphasis on pathological changes in liver, kidney, gall bladder on the account of Lantana camara poisoning.

Keywords: Lantana camara, sheep, hepatotoxicity, photosensitization

CSPT: 170.

IN VITRO EFFICACY OF *EMBILICA OFFICINALIS* AGAINST MULTI DRUG RESISTANT *S. AUREUS*

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The present study was undertaken to study the *in vitro* efficacy of *Embilica officinalis* against muti drug resistant *S. aureus isolated from* 102 samples (88.70%) animals found positive for sub clinical mastitis. Antibiotic sensitivity test was performed to determine the sensitivity and resistant pattern of different antibiotics namely Oxytetracycline, Ampicillin, Streptomycin, Erythromycin, Methicllin, Gentamicin, Cloxacillin and Ofloxacin. Diffusion technique was used to asses *in-vitro* efficacy of *Emblica officinalis.* The results indicated that the sensitivity pattern for *Emblica officinalis* at 200 mg/ml and 175 mg/ml DMSO concentration was comparable with those of standard antibiotics in Methicillin sensitive *S. aureus*. In Methicillin resistant *S. aureus* isolates, the zone of inhibition was in the order Oxytetracycline followed by EO-200 (13 mm), and Methicillin, Ampicillin, Gentamicin, Ofloxacin, E.O- 50 were resistance.

Keywords: *Embilica officinalis, S. aureus, Buffaloes*

CSPT: 171.

IMPACT OF PROPER DEWORMING AND CHELATED MINERAL MIXTURE WITH PROBIOTICS SUPPLEMENTATION ON FERTILITY IN COWS

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India is having the largest cattle population of the world but majority of animals are being maintained in unorganised sector with little or no scientific feeding and management practices; resulting in poor performance of the animals. A study was conducted in the Sonbhadra district of Eastern Utter Pradesh to observe the effect of proper deworming and chelated mineral mixture with probiotics on regularization of estrus in cows. In present study, 24 cows between 4-5 years age were selected with history of repeat breeding having poor health status like reduced body weight, rough hair coat and low milk production. The animals were divided in two groups (12 each). Group-I was treated with Fenbendazole @ 5 mg/kg body weight on day first of start of experiment and from next day, all the animals of treatment group were supplemented with mineral mixture @ 40 gram/day for 120 days from February to May, 2018. Group-II, animals were kept as untreated control. The observations revealed that 58.3% (7/12) cows came in heat and conceived. The feed intake and health status like body weight, hair coat and production performance of the animals also improved by supplementation of mineral mixture and proper deworming. On the basis of above findings, it can be concluded that anthelmintic drugs decreases the parasitic load and mineral mixture being a good source of essential minerals improved reproductive performance of cows along with enhanced dry matter intake, milk yield and health status of the animals.

CSPT: 172.

ETHNO VETERINARY PRACTICES ADOPTED BY GOAT FARMERS IN EASTERN UTTAR PRADESH, INDIA

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Ethnoveterinary practices used by goat farmers in different districts of Eastern Uttar Pradesh were studied for commonly encountered problems. The information regarding ethno veterinary practices used to treat various ailments was collected. In case of rhinitis commonly used ingredients were neem (*Azadirachta indica)* oil, mustard oil, ajwain (*Trachyspermum ammi*), ginger (*Zingiber officinale*), jaggery, garlic (*Allium sativum*) and asafoetida. Neem oil was used by all the respondents. For treatment of Bronchitis characterized clinically by coughing, mostly respondents used Neem oil and Ajwain. Goat farmers from different districts used neem oil, mustard oil, ajwain, salt, ginger, jaggery and garlic to treat pyrexia. Most of the respondents used asafoetida, sesam leaves, ghee, jack fruit, guauava leaves and neem oil for treatment of Enteritis. For treatment of skin disorders local application of neem oil and neem leaf paste was the most common practice adopted in all the districts. For treatment of mouth ulcer maximum respondents used neem oil and 40% respondents used neem leaf. Alum, salt, neem oil and amla were used to treat udder abnormality. Majority of respondents used alum followed by salt, amla and neem oil.

Keywords: Goats, Ethno veterinary, Eastern Uttar Pradesh

CSPT: 173.

MICROBIOME MULTI-FUNCTIONALITIES DRIVE SOIL AND PLANT HEALTH

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Accumulating evidences strongly suggest that the soil and plant health are interactively influenced by the microbiome they inhabit. A microbiome represents collective genome of all the microbial life forms in any given static or dynamic habitat. Although the taxonomic diversity of microbial life forms in any habitat is crucial for reflecting the representatives structural communities, their metabolic diversity is rather more dynamic to governing biogeochemical functions due to specific multi-functionalities in the micro-environment. Both the culturable and non-culturable (meta-omics) methods were applied to cumulatively reflect microbial taxonomic and functional diversity in any specific niche. However, owing to the limitations of culturable methods, meta-omics (metagenomics, metatranscriptomics, metaproteomics and metabolomics) studies have come forward to take major stake in identifying microbial life forms and their multi-functions in the agricultural soils, rhizosphere and other habitats. Metagenome and metatranscriptome (total environmental DNA or RNA) were harvested from the habitats and sequencing was performed using various platforms like Illumina Hi-Seq. Similarly for metaproteomic and metabolomic data generation, metaproteome (total proteins) and metabolome (total metabolites) were harvested from crop rhizosphere. Bioinformatics analysis reflected how microbial communities have changed in normal and stressed rhizosphere soils, what impact such changes have on the physiological and metabolic functions and how this could impact basic to applied cellular biological processes like energy, protein, carbohydrate and amino acid metabolism, enzymes, carbon sequestration, nutrient recycling, mineralization, nutrient use efficiency, stress responses, oxidative stress metabolism, decomposition, degradation of chemical pesticides, xenobiotics, heavy metals and industrial pollutants. Although metagenomic survey with 16S rRNA gene reflected taxonomic structure of the communities inhabiting the rhizosphere, whole meta-analysis of functional transcripts, proteins and metabolites showed metabolic community functions. During last 4 years, we have performed such studies and analyses with the rhizosphere of different crops like wheat, rice, mustard, gram and kodo (millet crop) and saline and non-saline soils. Besides, various datasets (varying from 4-6 Gb in size) comprising more than 130 crop rhizosphere metagenomes or metatranscriptomes were analyzed *in-silico* (bioinformatics analysis) for taxonomic and functional annotations. The overall exercise has established facts that crop rhizosphere microbiome possesses great diversity and reflect varying multi-functions that are supposed to help crop plants during their growth and development in the fields.

CSPT: 174.

EFFECT OF ULTRAVIOLET IRRADIATION ON THE ACTIVITY OF SINPV AND THE EFFECT OF PROTECTANTS AGAINST ULTRAVIOLET LIGHT

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UV Protectant is a very sensitive factor which affects the NPV working on larvae. Both activated charcoal and metallic aluminum suppressed the impact of UV radiation on NPV .However the extent of protection was different particularly , when the NPV solution was exposed for more than 10 minutes. The differential impact of protection was not prominent at less exposure time (i. e. 5 min.) This may be due to the non – significant effect of UV on virulency of NPV at less exposure period. The main aim of this review paper is to provide the knowledge of less effect of NPV on pest due to UV radiation.

Keywords: Spodoptera litura, UV protectants, SINPV, virulacy.

THEME 2: ADVANCES IN FOOD SCIENCE & POST-HARVEST TECHNOLOGY

FSPT: 1.

EXTRACTION OF TANNIN FROM BARK, LEAVES AND PODS FROM BABUL (Acacia nilotica)

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Acacia nilotica (Babul, Kikar) is a pioneer species, relatively high in bioactive secondary compounds and is important for a variety of functions used as a source of tannins, gums, timber, fuel and fodder. Babul plant is a therapeutic used as Anti-cancer, anti- tumours, antisorbutic, astringent, anti- oxidant, nerve stimulant, cold, coughs, and many more. Tannins are polyphenols that are obtained from various parts of plants belonging to multiple species. Babul, an indigenous plant of Rajasthan, contains high amount of tannin levels ranging from 18 to 27 percent in deseeded pods from sub- species indica whereas species nilotica reached up to 50 percent. The tannin is mainly found in bark, leaves and pods of the babul tree. The bark is obtained mainly as a by-product when trees are felled for timber or fuel. It is separated by beating the logs with wooden mallets and the strips obtained are dried in the open chipped into smaller pieces. The proportion of bark to wood is roughly 1:5 by weight. The leaves contain about 25% total extractable tannins and 5 percent condensed tannins and pods contain about 12-19% tannin and that removed of seeds is 18-27% tannin. Tannins can be classified mainly in two groups, hydrolysable and condensed. Hydrolysable tannins yield various water-soluble products, such as Gallic and protocatechuic acids; and sugars. Gallo tannin, or common tannic acid, is the best known of the hydrolysable tannins. Condensed tannins, the larger group, form insoluble precipitates called tanner's reds, or phlobaphenes. Tannis are multipurpose such as in leather manufacturing, dyeing, in boilers to prevent scale formation and several medicinal uses such as treating tonsillitis and diarrhoea and one hand and antidote to poison at other. Hence, extracting tannins from Babul would increase tannins availability.

Keywords: Green technology; sustainable development; extraction; waste reusage

FSPT: 2.

AYURVEDIC PRINCIPLES ON GOOD AGRICULTURAL AND COLLECTION PRACTICES FOR MEDICINAL PLANTS- A REVIEW

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Ayurveda, traditional health care system of India, has its own established fundamental principles which guide the system for rational use of medicinal plants for the maintenance the individual's health as well as providing customized patient care. Demand of Herbal medicines predominantly used in Ayurveda has increased considerably over the past few years due to seeking solution of health issues from alternative system and thereby markets for medicinal herbs have been growing rapidly. Because of lack of quality parameters and standardization of herbal products, numerous reports show that these products available in market are of variable quality. Objective of this study was to explore the Ayurvedic principles mentioned for good collection and collection practices of medicinal plants. Guideline for collection, processing and storage practices mentioned in Ayurvedic texts were reviewed, explored and interpreted accordingly. Main text of Ayurveda, recent literature on collection and harvesting practices and research data about these techniques are considered while compiling the information. Ayurvedic texts provided certain guidelines on collection, processing and storage practices. Season selection for harvesting/collection, Soil selection, recommended place of the collection, Concept of Desha (climates), post harvesting technics are few important ideas

of guidelines mentioned dispersedly in texts of Ayurveda. Specific collection and processing techniques are also explained for *Catunaregum spinosa*, *OperculanaTurpenthum*, *Cassiafistula*, *Viburnum Nervosum*, *Eurphobianeriifolia*, *Euphorbia pilosa*, *Baliospermummontanum* and *Croton tiglium*. These collection and post-harvesting procedures are aimed either to increase the desirable quality or reduce the undesired quality of drugs. Researches also support Ayurvedic collection, post-harvesting and storage guidelines. Further, various experimental studies need to be conducted to evaluate effect of various collection and post harvesting techniques on the phytoconstituents and secondary metabolites of these drugs and its effect on biological systems of body.

Keywords: Ayurveda, herbs, good agricultural and collection practices, *Desha*, *Kala*.

FSPT: 3.

CHEMICALLY CHARACTERIZED *Levisticumofficinale* Koch. ESSENTIAL AS A SAFE PLANT BASED GREEN PRESERVATIVE AGAINST POST HARVEST MOLDS AND AFLATOXIN CONTAMINATION IN FUNCTIONAL FOOD SAMPLES

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The antifungal and anti-aflatoxigenic efficiency as well as their potential mode of action *in vitro* and *in vivo* of *Levisticumofficinale* essential oil (LOEO) against *Aspergillus flavus* was intensively investigated. The gas chromatography-mass spectrometry analysis of LOEOdepicted terpineol (24.03 %) as major compound followed by α-terpinyl acetate (23.43%), citronellal (16.44%) and terpinolene (9.19%). Minimum concentration for inhibition of toxigenic strain *Aspergillus flavus* LHPR14 cell growth and AFB_1 secretion was recorded at 2.0 and 1.75 µL/mL by LOEO, respectively. Furthermore, the probable antifungal mode of action was related to the reduction in membrane ergosterol biosynthesis, enhanced leakage of cellular ions and 260, 280 nm absorbing materials and increased fluorescent intensity as evidenced through propidium iodide (PI) dye assay in all the LOEO fumigated AF-LHP-SH1 cells confirmed fungal plasma membrane as possible antifungal site of action. The down-regulation profile of LOEO on the methylglyoxal biosynthesis (an AFB_1 inducer) revealed its anti-aflatoxigenic mechanism. LOEO exhibited remarkable antioxidant activity measured through $DPPH^{\cdot}$ assay. Moreover, negligible phytotoxicity on *Salvia hispanica* seed germination and non-mammalian toxicity as represented through high LD_{50} value on mice demonstrates its practical application with wide consumer's acceptance as a potent green preservative for protection of post-harvest functional foods from wide range of molds infestations and aflatoxin B_1 secretion.

Keywords: Levisticumofficinale essential oil; Aspergillus flavus; Methylglyoxal; Antioxidant; Preservative;

FSPT: 4.

FOOD PROCESSING AND VALUE ADDITION FOR NUTRITION SECURITY

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India is an agricultural based country and its economy largely depends upon agriculture. India is the second largest food producer in the world after China. Food processing has an important role to play in linking Indian farmers to consumers in the domestic as well as international markets. Food processing is a method used to turn fresh foods into food products. This can involve one or a combination of the following – chopping, washing, freezing, packing etc. A variety of things can happen during the growing, harvesting, storage and preparing the food that can affect its nutritional contents. There are so many losses incurred during the processing activities cause the loss of essential

nutrients from the food products. Food processing and value addition are important steps in the food value chain. The increase in global population during the past decades has made food processing one of the deliberated subjects in the food chain. Value addition is a process in which for the same volume of the primary product a high price is released by means of processing, packing and upgrading the quality of the product. Value addition is one of most important part of nutritional security. Nutrition security is a global challenge and a pre-requisite for a healthy society. Nutrition security for value addition of food products is the need of the hour.

Keywords: Food Processing, Value Addition, Nutrition Security, Health.

FSPT: 5.

ADVANCES IN FOOD SCIENCE AND POST HARVEST TECHNOLOGY

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Minimally processed fresh produce is one of the fastest growing segments of the food industry due to consumer demand for fresh, healthy, and convenient foods. However, mechanical operations of cutting and peeling induce the liberation of cellular contents at the site of wounding that can promote the growth of pathogenic and spoilage microorganisms. Processing of fruits and vegetables generates physiological stresses in the still living cut tissue, leading to quality deterioration and shorter shelf life as compared with fresh intact produces. Several strategies can be implemented with the aim to reduce the rate of deterioration of fresh-cut commodities. low temperature maintenance from harvest to retail and the application of physical and chemical treatments such as modified atmosphere packaging (MAP) with low O_2 and high CO_2 levels and antioxidant dips. applications of postharvest technologies for instance; use of ethylene, 1-methylcyclopropene (1-MCP) and temperature management has proved to reduce postharvest losses of FV. Also, chemical and non-chemical methods are useful for controlling spoilage and pathogenic microbes especially on ready to eat FV products. Postharvest technologies such as controlled ripening, edible coating, temperature management, and chemical treatment methods are potential tools to reduce FV postharvest losses, increase food and nutritional security and alleviate poverty in SSA. At the same time, sanitizing chemicals and pesticides malpractice should be avoided to ensure final consumer safety.

Keywords: Controlled ripening, hypobaric storage, minimally processed produce, MAP, MCP

FSPT: 6.

NUTRACEUTICAL FOODS: THEIR ROLE IN DISEASE PREVENTION AND HEALTH PROMOTION

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Nutraceuticals are items, which other than nourishment are likewise utilized as prescription. A nutraceutical item might be characterized as a substance, which has physiological advantage or gives security against incessant illness. Nutraceuticals might be utilized to improve wellbeing, postpone the maturing procedure, avoid perpetual infections, increment future, or bolster the structure or capacity of the body. These days, nutraceuticals have gotten impressive enthusiasm because of potential healthful, wellbeing and remedial impacts. Late investigations have demonstrated promising outcomes for these mixes in different intricacies. In the present survey much exertion has been committed to exhibit new ideas about nutraceuticals dependent on their illnesses adjusting signs. Accentuation has been made to show home grown nutraceuticals compelling on hard healing issue identified with cardiovascular, cancer growth, diabetes, just as corpulence. The papers about various parts of Nutraceutical foods: their role in disease prevention and health promotion were looked through utilizing logical destinations, for example, Medline, PubMed,

and Google Scholar. The utilized terms included nutraceutical and cardiovascular, disease, diabetes, corpulence. FDA directed dietary enhancements as nourishments to guarantee that they were protected. In 2006, the Indian government passed Food Safety and Standard Act to manage the nutraceutical business. Home grown nutraceutical is utilized as a ground-breaking instrument in keeping up wellbeing and to act against healthfully instigated intense and unending ailments, subsequently advancing ideal wellbeing, life span, and personal satisfaction.

Keywords: Antioxidants, ailment modifiers, home grown nutraceuticals, nutraceutical items, guidelines.

FSPT: 7.

HARNESSING MEDICINAL PLANT MICROBIOME FOR SUSTAINABLE AGRICULTURE

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Amidst climate change, feeding a growing world population requires resource use, optimizing the reliability, and environmental impacts of food production. Plants harbor distinct microbial communities on and inside their tissues and designated as the plant microbiota. An important part of the plant microbiome includes plant growth-promoting bacteria (PGPB) that commonly reside in the rhizosphere and phyllosphere, and as endophytic bacteria and perform various plant beneficial activities including biocontrol of potential phytopathogens and promotion of plant growth. Several approaches may lead to success such as designing smart microbial consortia, the selection of agricultural management practices favoring microbiota with beneficial functions. Individual microbes are keys for the regulation of microbial community structure and stability and their soil microbial communities would assist in advancing the agricultural system. This integration will require a large-scale effort among academic researchers, industry researchers, and farmers to understand and manage plant-microbiome interactions in the context of modern agricultural systems. Medicinal plants provide an enormous bioresource of potential use in modern medicine and agriculture, yet their microbiome is largely unknown. To reach this goal a fundamental understanding regarding the functioning of the medicinal plants microbiome through microbe-microbe and plant-microbe interaction is required, as well as a deeper understanding of the soil microbial community structure. Thus our work involvesisolation of plant growth promoting bacteria (PGPB) from few medicinal plants of Garhwal region of India, their molecular and phylogenetic characterization for plant growth promoting traits and their evaluation in plant growth promotion. This may lead to uncover a distinct set of microbes which can open new avenuesfor promoting plant growth, biocontrol activities and stress management for development of eco-friendly sustainable agriculture.

Keywords: Sustainable agriculture, microbiome, medicinal plants, PGPB, bioresource

FSPT: 8.

FUTURE OF DRYING METHODS IN FOOD PROCESSING AND POST-HARVEST TECHNOLOGY

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Thermal drying technologies have attracted significant research efforts owing to the rising demand for improved product quality and reduced operating cost as well as diminished environmental impact. Drying materials may appear in the form of wet solid, liquid, suspension, or paste, which require drying to extend the period of storage, ease of transportation, and for downstream processing to produce value added products. Most of these materials are heat-

sensitive and require careful drying; conventional hot air drying can be detrimental to the retention of bioactive ingredients. This article briefly summarizes some of the emerging drying methods and selected recent developments applicable to postharvest processing. These include: - heat pump-assisted drying with multimode and time-varying heat input, low and atmospheric pressure superheated steam drying, modified atmosphere drying, intermittent batch drying, osmotic pre-treatments, microwave-vacuum drying, etc. Heat pump drying of sapota pulp to produce sapota powder was reported to be faster than hot air drying. Drying of Australian nectarine slices in a heat pump dryer was found to produce the dried product that was better than that from cabinet and tunnel dryers in terms of lactone and terpenoid retention. To avoid oxidation of the drying material and destruction of its bioactive ingredients, hot drying air, which contains 21% of oxygen, can be replaced with nitrogen or carbon dioxide. By eliminating oxygen, oxidation and some undesirable reactions which require oxygen are thus avoided. This in turn reduces/eliminates browning of products and improves retention of bioactive ingredients. In addition, modified atmosphere heat pump drying reportedly increases the effective diffusivities of some food products. Superheated steam is an attractive drying medium for some processes since the net energy consumption can be minimized if the exhaust (also superheated steam) can be utilized elsewhere in the plant and hence is not charged to the dryer. Superheated steam does not contain oxygen; hence, oxidative or combustion reactions are avoided. In addition, it also eliminates the risk of fire and explosion hazard. The quality of superheated steam-dried products tends to be better than that from conventional hot air dryer. Drying techniques for food processing and post-harvest technology is constantly evolving and food industry is spending a fortune to come up with the best streamlined technology that can help extend the shelf-life of vegetables and fruits.

Keywords: Dehydration, Preservation, Energy savings, Quality

FSPT: 9.

MEDICINAL AND AROMATIC PLANTS FOR ENHANCING INCOME OF THE FARMERS IN UTTARAKHAND

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Uttrakhand, located at the foothills of the Himalayas, is characterized by diverse geographical features ranging from snow-capped mountain peaks in the North to tropical forests in the South. The State is having about 61.1% area under forests. In 2012-2013 the state exported culinary herbs & aromatic produce worth 29.0 crore (shm.uk.gov.in). Uttrakhand state has great diversity of high value medicinal plants and therefore designated as Herbal state. The state has observed an increase in the area under cultivation of aromatic and medicinal plants. The State is blessed with thousands of species. About 320 species have been identified having medicinal value. The forest department has reported about 175 species being commercially exploited and traded. The number of species reported for Kumaon is 304 while 288 is reported for Garhwal region. It is estimated that the state is well positioned to generate revenue of about 1, 000 crore annually through medicinal herbs trade. (NRIF, 2004). The National Medicinal Plant Board has identified about 32 species for mass cultivation out of which Government of Uttarakhand laid emphasis on about 10 species, which have been chosen for cultivation in Uttarakhand. The number of farmers engaged in cultivation of aromatic plants in the state has dramatically increased from 3409 in 2009-10 to 18341 in 2014-15 and the area under aromatic plants has increased hundred-fold.

FSPT: 10.

DEVELOPMENT AND QUALITY EVALUATION OF PINK OYSTER MUSHROOM (*Pleurotusdjamor*) AND BARNYARD MILLET (*Echinochloafrumentacea*) INCORPORATED CUTLET MIX

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Mushrooms are called 'white vegetables' or 'boneless vegetarian meat' and possess significant nutritional and medicinal properties and often are referred as “Neutraceuticals”. One of the greatest challenges today is to develop inexpensive food that are nutritionally superior having therapeutic value and at the same time highly acceptable to the consumer.Therefore, among the different cultivated species of mushroom for food purpose pink oyster mushroom (*Pleurotusdjamor)* was selected because of its unique taste, flavour, high nutritional values, anti-oxidant, anti-microbial and medicinal properties.The mushroom is highly perishable due to its high moisture content. Hence, there is a need to preserve the mushroom in the dried form for enhancing its nutrient density and increase its shelf life. Keeping this in view, the present research work was carried out to optimize the process for drying of the mushroom and develop a nutritionally rich product cutlet mix by incorporating barnyard millet with the mushroom flake. The nutritional quality, anti-oxidant activity and the *in-vitro* hypoglycemic and hepato-protective activity of the mushroom powder was studied. The results revealed that optimized dried mushroom powder contained 5.52g moisture, 21.73g crude protein, 1.91gcrude fat, 5.47gtotal ash, 21.42gcrude fibre, 43.81g total carbohydrate, 26.66mg calcium,4.54mg iron and 280kcal energy per 100g. The mushroom powder also contained high amount of total dietary fibre (36.74g). Thetotal phenol, total flavonoid and the DPPHfree radical scavenging activity of mushroom powder was1.14mg GAE/g, 1.48mg QE/g and6.22 %, respectively. The result of *in-vitro* hypoglycemic and hepato protective effect of the mushroom powder in thehepatocytes of PBS-liver slice suspension revealed that 2ml of the mushroom extract have found significant effect ($p \leq 0.05$) which may be due to the presence of phenolic constituents and anti-oxidants in the mushroom. The optimized dried mushroom flake and barnyard millet was used for development of cutlet and the product was optimized. The product was highly acceptable on the organoleptic quality parameter.The nutritional composition of cutlet revealed that the moisture of cutlet ranged from 40.01- 43.29, crude protein 4.34-5.40, crude fat10.03-13.83, total ash 4.41-5.75, crude fibre 2.89-4.31 and total available carbohydrate 28.33-38.15g. On the basis of optimization of cutlet the cutlet mix was standardized and its nutritional, antioxidant and storage study was carried out.The 100g cutlet mix constituted 50g potato flour, 28.30g mushroom flake, 11.70g barnyard millet flour, 6g spice mixture and 4g salt. The 100g cutlet mix contained moisture 6.88, crude protein 12.25, crude fat 1.27, total ash 3.56, crude fibre 8.56, total available carbohydrate 67.91g, calcium 23.33mg and iron 3.90mg, respectively. The anti-oxidant activity of the cutlet mix showed that the total phenol and total flavonoid content was 1.96mg GAE/g and 2.78 mg QE/grespectively.The inhibition of DPPH free radical scavenging activity was 7.03%. The shelf life study of the cutlet mix was carried out for 3 months at room temperature using silver pouch packaging material. The result revealed that during the storage period the water activity ranged from 0.232 to 0.468 and the microbial load was within the safe limit. The present study concluded that due to the nutritional and therapeutic value the mushroom powder it can be used in formulation of various value added products which will help in alleviating the protein calorie malnutrition and also for lowering the risk of degenerative diseases.

FSPT: 11.

VALUE ADDITION OF PRODUCTS

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The increase in global population has made food processing as one of the most deliberated subjects in the food value chain during the past two centuries. Developing countries are producing a wide variety of agricultural products,

but have not yet optimized the economic benefits. This is due in part to inadequate knowledge of appropriate value-adding technologies coupled with poor infrastructure facilities especially in rural areas. The need for processed food is increasing wittingly by taking into consideration the world.Now a day's Food processing and value addition are considered as key steps in the food value chain. Though India has been pinned as the greatest agriculture based country, it has not been able to harness food processing and value addition. Value-added products are defined as the physical segregation of an agricultural commodity or product in a manner that results in the enhancement of the value of that commodity or product (according to USDA). It simply means any product or action that helps you raise the value of your product or business or something . Value addition reduces the post harvest losses, increases income, enhances food security and increases array of convenient foods. Value addition is the common marketing tool used by entrepreneurs. The growth in agro based industries has a big potential to trigger development through adding value to the produce, generating employment opportunities and increasing farmer's net income. This in turn motivates the farmers for better productivity and opens up possibilities of industrial development.

Keywords:-Value addition, Food processing, Value chain, Agricultural commodity, Food security, Post harvest losses, Convenient foods, processed foods and Entrepreneurs

FSPT: 12.

MATHEMATICAL MODELING OF THIN-LAYER DRYING OF RED AMARANTH LEAVES (Amaranthus cruentus)

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Red amaranth leaves are nutritious, excellent source of antioxidant, protein, vitamin C, beta-carotene and easily digestible minerals i.e., iron and calcium. But leafy vegetables are highly perishable in nature and get spoiled easily. Therefore processing of it without much change in nutritive value, texture, color and flavour is very much needed for preservation. Hence optimization of parameters for processing is very important to get best quality product. Dehydration of fruits and vegetables is one of the cost effective methods of food preservation and thin layer drying was studied at 50^0c, 60^0c and 80^0c for processing and preservation of pretreated red amaranth leaves. The present study reveals the effect of pretreatment on drying kinetics. Mathematical modeling of the drying process is based on equation to describe the system as accurately as possible. Modeling inter-relates the physical nature of the water content and the product to be dried within the system for improving, designing and operation of the drying system. In current investigation different mathematical models as a function of three different temperatures 50^0c, 60^0c and 80^0c and three different pretreated samples were used. Among the Models studied the statistical indicators showed that Midilli model was the most suitable model to describe the drying kinetics of red amaranth leaves.

Keyword: Drying kinetics, Mathematical modeling, total phenol, antioxidant, thin layer drying.

FSPT: 13.

NUTRACEUTICAL AND HUMAN HEALTH

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Fruits, vegetables and other plant-based food are rich in bioactive phytochemical that may provide desirable health benefits beyond basic nutrition and prevent from chronic diseases.it consist of food supplements, herbal product, dietary fiber,probiotics and prebiotics medical foods meant for prevention and treatment of diseases. Lifestyle of human beings have changed drastically due to the industrial age, increasing work, living speed, longer

work schedule, and various psychological pressure which have led to an increased incidence of diabetes, obesityvarious cancer and vascular diseases. Therefore, nutraceutical are vegetable or animal food deriving molecules with help in the prevention and assist the treatment of human diseases. The effects on human health go beyond nutrition and substance can be displayed by including these substances in the daily diet by using food supplements. Nutrients substance which have stablished nutritional function.eg: - vitamins, minerals, amino acid and fatty acid. Herbal products (herbs or botanical products) and processed food (cereals, soups, beverage) may be included under the umbrella of nutraceuticals.

People do not know much about nutrition security in India, despite historically high level of food production after that under nutrition and micronutrient deficiencies persist. It is differed from food security as it is about community's access to essential nutrients, not just calorie. Zinc, selenium, iron and all kind of vitamin should be present in human diet. Undernutrition in regions that primarily produce cash crops is among the worst in most developing countries, resulting in poor productivity levels, low school performance of children and apoor health situation for farming families. So, nutraceutical is very compromising components of our diet, as demonstrated by the high number of in vitro and preclinical studies, regulation by defining a new category of products we may have the possibility to a step forward.

Keyword: Supplements, dietary, nutrients, community

FSPT: 14.

BIOFORTIFICATION IN HORTICULTURAL CROPS TO TACKLE HIDDEN HUNGER

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Biofortification refers to enhancement of nutrition in food crops with increased bioavailability to the human population that are developed and grown using modern biotechnological techniques, conventional plant breeding and agronomic practices. It is an upcoming, promising, cost-effective, and sustainable technique to provide micronutrients to a population that has limited access to diverse diets and other micronutrient interventions. Unfortunately, major food crops are poor sources of micronutrients required for normal growth. It involves modern breeding, transgenic approaches, improved agronomic practices and microbiological interventions towards altering genetic architecture, improving micronutrient uptake, and proper distribution in edible tissues to safe levels. The nutritional impact of horticultural crops using biofortification programme have been carried out in potato, cassava, sweet potato, beans, cow pea, bananas through the joint effort of national and international organizations. Among the malnourished population, vitamin A, iron, zinc and iodine deficiency are predominant. Modern plant breeding has been focused primarily towards achieving high agronomic yields rather than nutritional quality. Success stories of biofortification include lysine and tryptophan rich quality protein maize (World food prize 2000), Vitamin A rich orange sweet potato (World food prize 2016); generated by crop breeding, oleic acid, and stearidonic acid. The biofortified food crops, especially vegetables, fruits cereals and legumes are providing ample levels of micronutrients to malnourished populations. Although a greater emphasis is being laid on transgenic research, the rate of success and acceptability of breeding approaches is much higher. Transgenic approach can be applied to create any transgenic food crop when there is limited or no variation in nutrient content among the genotypes/varieties at genotypic level. Besides the challenges biofortified crops hold a bright future to address the hidden hunger challenge for nutritional security.

Keywords: Hidden hunger, Micro-nutrients, Biofortification, Transgenic, Agronomic practices and Breeding.

FSPT: 15.

DESIGNING OF SIZE REDUCTION TECHNIQUE'S EQUIPMENT

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The size reduction process involved a lot of physical labor and material wastes. Therefore, in order to improve the processing method and enhance its hygienic level, there is the need of mechanization of the slicing method. The present work focuses on development of an improved portable multipurpose slicer cum shredder that takes care of the problems mentioned above. Multipurpose vegetable slicer cum shredder constitutes mainly of the feeder assembly, cutter assembly and the power transmission assembly.The performance of developed slicer cum shredder was evaluated for slicing of potato and cucumber and for shredding of carrot and bottle gourd. The known amount of peeled product was sliced / shredded at four different rpm and three replications were made. The machine performance was evaluated with regard to the capacity, breakage per cent, thickness of sliced vegetables and wastage during processing. On 500 rpm, maximum performance efficiency (86.33 per cent), slicing efficiency (85.67per cent), capacity (94.33 kg/h), and effective capacity (81 kg/h) was observed and on the other hand minimum mechanical loss (5 per cent) and breakage per cent (14.33 per cent) was observed. Potato slices for producing chips have 0.92 RI. The developed machine operated at 500 rpm gives best result for carrot shredding. On this rpm, maximum performance efficiency (98.66 per cent), capacity (70.63 kg/h) was observed and on the other hand minimum mechanical loss (2 per cent) was found. The cost benefit ratio for processing of potatoes was found to be 2.28 with a payback period of 4 years. It can be inferred that the processing unit for potatoes processing is techno- economically viable industry. The main goal is to create a quick, safe, and easy way to slice vegetable with increased productivity and cost effectiveness.

FSPT: 16.

NUTRITIONAL IMPACT OF SPIRULINA ON HUMAN HEALTH

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Spirulina are microscopic, thin prokaryotes (unicellular organisms that lacks membrane, nucleus, mitochondria), unbranched, helicoidal, blue chlorophyte and additionally called “Cyanobacterium”. It's been found in numerous aquatic environments. Spirulina is taken into account as vital therapeutic food because it has high concentration of useful nutrients. Spirulina has many pharmacologic activities like antimicrobial (including antiviral andbactericide), anticancer, metalloprotective (prevention of heavy-metal poisoning against Cd, Pb, Fe, Hg), also as immunostimulant and inhibitor effects thanks to its wealthy content of macromolecule. Multiple studies work the effectiveness and also the clinical applications of Spirulina in treating many diseases are performed. A few randomised controlled trials and systematic reviews counsel that thisalgae that's spirulina could improve many symptoms and will even have an antitumor, antiviral and antiallergic effects. it's been the topic of intense investigation in the main to use as food, supplement and useful foods. Spirulina have additionally shown to perform restrictive roleon lipid and supermolecule metabolism by exhibiting aldohexose and lipid profile correcting activity in experimental studies on diabetic patients. Preparations are found to move against many enclosed viruses as well as animal virus, herpes virus, grippe virus and HIV. they're capable to inhibit carcinogenesis thanks to anti-oxidant properties that shield tissues and additionally cut back toxicity of liver, urinary organ and testes. Notably, it's been found to possess numerous bioactivities, as well as inhibitor, anti-infammatory, antiallergic, anticancer, antiobesity, medicine, antiviral, antibacterial, and antihepatopathic activities. This chapter presents a short summary of the overall characteristics of Spirulina, also as its organic chemistry elements and pharmaceutical properties. Recently, manylines of studies have provided insight into its alimental and health helpful effects.

FSPT: 17.

NUTRIGENOMIC FOODS AND THEIR NUTRITIONAL ASSESSMENT, EFFECT ON LIFE STYLE RELATED DISEASES

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'Nutrigenomics' is one of the exciting scientific advancement influencing mankind around the world. Food or more precisely 'nutrition' has the major impact in defining the cause response interaction between nutrient (diet) and human health. In addition to substantial understanding of nutrition human health interaction, bases of 'nutrigenomic' development foster on advent in transcriptomics, genomics, proteomics and metabolomics as well as insight into food as health supplement. Interaction of selected nutrient with associated genes in specific organ or tissue necessary to comprehend that how individual's genetic makeup (DNA transcribed into mRNA and then to proteins) respond to particular nutrient. It provided new opportunities to incorporate natural bioactive compounds into food for specific group of people with similar genotype. It covers the general overview of nutrigenomics, and the role of SNP in gene alteration, diet supplementation and public awareness. It is understood that with the increasing changes in the food habits and life styles, people are becoming more prone to diet related disorders. Therefore, there is an urgent need to boost more research in this field to help people in understanding the relationship between diet and health, and to ensure that everyone benefits from the genomic revolution, various aspects of R&D in nutrigenomics are reviewed to ascertain its impact on human health, especially with lifestyle related diseases.

Key words: Nutrigenomics, nutrient, proteomics, genomics, food habits

FSPT: 18.

POST – HARVEST MANAGEMENT OF DAHLIA

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Dahlia flowers are cut with long stem early in the morning before the sun gets hot and cut end of the stalk placed in water. The container with cut-flowers is to be placed in a cool and dark place for conditioning. Pretreatment of the cut end in boiling water for 30 seconds prevent blocking of water channels and thus flowers can be held for 3-5 days. Semiopened flowers with leafless stalks are placed for 24 hours in glucose or sucrose solutions containing preservatives and then transferred to containers with distilled water or they are held in these solutions. Vase-life was longer (8.7 days) with 10% glucose + 0.2 mM $AgNO_3$or with 10% glucose + 0.2 mM $AgNO_3$ + 8-HQC at 200 mg/l (8.2 days) compared to 4.3 days in the control. In addition to preservation of bulbs, dahlias can be satisfactorily preserved by late cuttings. Tender basal shoots from the plants in flower are taken as cuttings and the resultant plants (stock plants) are kept in growing condition. Cuttings from these stock plants are made during the rainy season in order to make additional stock plants. Pinching off the growing tips of the stock plants should be done regularly as these helps to produce better cuttings in a much larger number. During summer months the stock plants must be kept in such a place where they get only the morning sun at least for two hours. Late cutting method of dahlia preservation is particularly suitable for the plains with the advantage that there may be plenty of stock plants (from one single plant) which may produce large number of best quality green plants.This method of stock plant production for propagation was standardized by Swami Vinayananda.Tubers from plants, grown on the ground or in big containers, are large and hence inconvenient to handling, specially for long-distance transport. Small tubers are good in this respect. These can be raised by growing cuttings in small pots (8-12 cm in dai.).

Keywords: Dahlia, spikes,propagation, post harvest quality and vase- life.

FSPT: 19.

NUTRITIONAL STATUS OF FISHES FROM THE PARENT STREAM OF RIVER GANGA: A CONTRIBUTION TOWARDS FOOD AND NUTRITION SECURITY

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The present study is aimed at to access the biochemical and mineral composition of different food fishes found in Alaknanda, a parent tributary of Ganga river of Uttarakhand. The study was conducted on six cyprinid fishes namely, *Schizothorax richardsonii, Schizothorax plagiostomus, Schizothoraichthys progastus, Barilius bendelisis, Crossocheilus latius latius* and *Garra lamta*. The results revealed *G. lamta* and*C. latius latius* to be rich in protein content (21.22% and 20.45%) as compared to other studied fish species. Among the macroelements, highest amount of Na (155.89 mg/100gm), K (348.41 mg/100gm) and Ca (504.78 mg/100gm) was present in *G. lamta, C. latius latius* and *Berilius bendelisis*, respectively.Lowest amount of Na (89.11 mg/100gm), K (238.57 mg/100gm) and Ca (321.55 mg/100gm) was found in *S. plagiostomus, B. bendelisis and S. progastus*, respectively.Among the trace elements, highest amount of Fe (18.24 mg/100gm) and Cu (0.715 mg/100gm) was recorded in *S. progastus* while Zn (3.163 mg/100gm) and Pb (0.346 mg/100gm) in *B. bendelisis*. However, least concentrations of Zn (2.719 mg/100gm), Cu (0.609 mg/100gm) and Pb (0.136 mg/100gm) were found in *S. plagiostomus* while Fe (10.62 mg/100gm) was lowest in *B. bendelisis*. The abundance pattern for mineral elements was recorded as Ca>K>Na>Fe>Zn>Cu>Pb. The concentration of trace elements (Zn, Cu and Pb) in fish muscle tissue was recorded below the highest permissible limits set by FAO (1983). Therefore, all the studied food fishes from Alaknanda river were free from any toxicity, hence, may be recommended for daily intake to fulfill the nutrition requirement, their culture and augmentation. This study will directly or indirectly contribute towards food and nutrition security.

FSPT: 20.

TECHNICAL ASPECTS OF POST-HARVEST TECHNOLOGY: A REVIEW

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Postharvest science and technology aim to produce underpinning data for industries to deliver safe, alimental and safe recent farming product to shoppers at the top of the availability chain from farm to mouth. Aim of this study that focus on some key preharvest and postharvest factors that square measure vital or have potential, to contribute to product quality and safety and hence to the longer-term success of farming systems manufacturing for each native and export markets. After harvest, foods (e.g. Fruits, milk, vegetables, fish, meat) square measure susceptible to accelerated physiological, chemical, and microbial processes that invariably lead to deterioration and loss of whole someness. It is then necessary to institute some live of process like reduction in wetness content, denaturation of endogenous enzymes and microorganisms, or packaging in order to curtail perishability. Post-harvest technology has potential to create rural industries. India, wherever 80 % individuals sleep in the villages and 70 % of them rely upon agriculture has intimate that the method of industrialisation has shifted the food, feed and fibre industries to urban areas. Food things square measure marketed in numerous forms as raw, primary processed, secondary processed and tertiary processed. Removing foreign matter in raw material through purification, immature grain and then making the raw material eligible for processing by grading in different lots or conversion of raw material into the form suitable for secondary processing. Processing of primary processed staple into product that is appropriate for food uses or consumption when change of state, roasting, frying etc. conversion of secondary processed material into able to eat kind.

Keywords: Food Processing, Microorganism, Post-Harvest, Pre-Harvest, Technology.

FSPT: 21.

ENHANCING FOOD AND NUTRITION SECURITY FOR FOOD DONATION

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The significance of optimal nutrition for health and human advancement is well recognized. At the time of Independence, the nation confronted two noteworthy wholesome issues. One was the danger of starvation and the resultant intense starvation because of low agricultural production and the absence of a suitable food distribution network. The other was incessant vitality insufficiency because of low dietary intake due to poverty and low purchasing power, high prevalence of infection because of poor access to safe drinking water, sanitation, and medicinal services, poor use of accessible facilities because of lower education and absence of awareness. The major general medical issues were chronic energy deficiency (CED), kwashiorkor, marasmus, and micronutrient insufficiencies, for example, goiter, beriberi, visual impairment because of Vitamin-An inadequacy and anaemia. describe the food donation and civil liability risk will address worries that present and future industry nourishment givers may have about the potential for legitimate risk, especially when donating perishable food items. In food grain production to address the issue of the developing populace must be given. Locally produced and acquired coarse grains made accessible through the TPDS at a sponsored rate may significantly cut down the appropriation cost with no decrease in calories provided. Notwithstanding the general lawful understanding of food donor laws, there are hypothetical to represent circumstances in which liability questions may arise. The legal interpretation of the situations illustrates key issues prone to be applicable to in a common suit. Overall the interpretation suggests that businesses and associations that work in compliance with common decency and exercise due to ingenuity and thoughtfulness regarding food quality and safety are probably not going to experience issues with liability.

Keywords: Food Donation, Sustainable Food Security, Food Safety, Nutrition

FSPT: 22.

DEVELOPMENT OF FINGER MILLET (*Eleusine coracana*) INCORPORATED DIETARY FIBER ENRICHED FISH CUTLET FROM MARINE FISH MRIGAL (*Lutjanus* spp.)

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Andaman and Nicobar Islands are known for the pristine beauty of emerald seas throbbing with life and vivacity being the home for a great multitude of marine fishes. Mrigal (*Lutjanus* spp.)is a marine fish consumed by the Islanders due to more availability, less price, good quality, high production, taste and high nutritional value. Despite of the high nutritional value, the fish do not contain any dietary fibre. Fish cutlets are generally prepared from minced fish, potato with spices and condiments which contain high fat and low dietary fibre. Dietary fibre plays an important role in proper digestion of food and gut health in human beings. Finger millet is quite rich in calcium, dietary fibre, protein, niacin, Vitamin B_6, folic acid, iron, potassium, magnesium and zinc. The carbohydrate present in finger millet is slowly digestible with low glycemic index. In the present arena, people are more health-conscious and due to increased purchasing power, time and the trend are towards foods that offer convenience and health benefits shifting from protein consumption of non-vegetarian in origin. This shift in consumer eating habits has led to a great demand for fish and convenient fishery products. They usually prefer foods with reduced fat, balanced protein and recommended levels of dietary fiber. Keeping all these points in view the present research work was carried out to develop a finger millet incorporated fish cutlet and study of its nutritional and organoleptic qualities. The result showed that cooking yield of fish cutlet was 87.87% and contained 57.82% moisture. The crude protein, crude fat, total ash, crude fibre and total carbohydrate content of fish cutlet (g per 100 g) was 8.46 ,12.10 , 2.70 , 0.81 and 18.12 ,

respectively and provides 215 kcal of energy. The organoleptic parameters i.e. appearance, colour, flavour, taste, texture and overall acceptability of the fish cutlet were 8.3, 8.0, 7.8, 8.0, 8.2 and 8.0, respectively on nine point hedonic scale. The fish cutlet was highly acceptable to the consumers with benefit cost ratio of 2.41. The fish cutlet incorporated with finger millet flour contained dietary fibre, increased the cooking yield and less fat content. Hence, fibre enriched fish cutlet could be a healthy convenience snack food for non-vegetarian population.

FSPT: 23.

ASSESSMENT OF PHENOLOGICAL, MORPHOLOGICAL AND BIOCHEMICAL CHARACTERISTIC OF MEDICINAL PLANT *Sida cordifolia* L. (Bala) UNDER ELEVATED OZONE

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Medicinal plants are widely distributed around the globe and are used in treatments of various diseases since ancient time. In India, plants have been traditionally used for human and veterinary health care needs. Abiotic stress such as tropospheric ozone (O_3) is a major secondary air pollutant and greenhouse gas affecting growth, carbon dynamics, ecological interactions and quality of medicinal products across the world. The peak O_3 concentration has been increasing in Asia and the mean yearly concentration of O_3 is around 70 ppb in India which is exceeded from the threshold (40ppb) value for sensitive plants. However, the effects of elevated O_3 on medicinal plants have not been comprehensively studied. Therefore, a field study was conducted on a medicinally important plant *Sidacordifolia* L. grown in open top chambers (OTCs). The overall reduction was observed for most of the morphological parameters, except the number of branching. Plants under O_3 stress showed significant reduction in most of the reproductive parts except the size of the pollen. Photosynthetic pigments showed significant reductions under elevated O_3. The phenolic content reduced while protein content increased significantly at all the growth ages due to elevated O_3. The *S. cordifolia* maintained its non-enzymatic and enzymatic defence successfully under elevated O_3 through the cost maintenance of growth and compound have medicinal values were also affected significantly due to O_3 stress. It can be concluded that morphological, phenological and biochemical parameter were significantly affected by elevated O_3 exposure in test plant of *S. cordifolia*.

Keywords: Elevated O_3, metabolites, morphology, phenology, biochemical, *Sida cordifolia* L.

FSPT: 24.

VERTICAL FARMING –INTRODUCING SUSTAINABLE AGRICULTURE WITH FOOD SECURITY – A REVIEW

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By 2050, the world's population is expected to grow by another 2 billion people and their feeding it will be a huge challenge. Increasing food demand due to a growing population along with ever decreasing arable lands poses one of the greatest challenges in food production. So that vertical farming can be the answer to this. Vertical farming is the practice of producing food on vertically inclined surfaces. The method helps mountainside towns, deserts and cities where grow different types of fruits and vegetables instead of farming vegetables and other foods such as in a field or a greenhouse, this method produces foods in vertically stacked layers commonly integrated into other structures like a skyscraper, shipping container or repurposed warehouse. Using Controlled Environment Agriculture (CEA) technology, this modern idea uses indoor farming techniques. The primary goal of this is to produce more

foods per square meter. Secondly, a perfect combination of natural and artificial lights is used to maintain the perfect light level in the room. Thirdly, instead of soil, aeroponic, aquaponic or hydroponic growing mediums are used. Peat moss or coconut husks and similar non-soil mediums are very common in vertical farming. In fact, vertical farming uses 95% less water. Vertical farming offers a plan to handle future food demands, it allows crops to grow year-round, weather doesn't affect the crops, more organic crops can be grown and there is less exposure to chemicals and disease. However, there are a few drawbacks like very costly, involve higher labour costs. It would reduce the amount of farmland needed, which could decrease deforestation and pollution.Vertical farming technologies are still relatively new. The performance of farms like Aero Farms will determine how important a role vertical farming will play in the future to face the challenge of growing food demand.

Keywords: Vertical farming, Food security, Sustainable

FSPT: 25.

FOOD AND NUTRITION SECURITY THROUGH HOMESTEAD GARDENING

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Agriculture sector growth has contributed mainly to economic growth in India over the past several decades but improvements in nutrition remains a major concern. Fruits and vegetables are best way to make health better, overcoming hunger and malnutrition. Cultivation of these at homestead level in systematic manner contributes to household food security as well as income also. Therefore, Kitchen gardening is a good means to improve household food security, it should be encouraged and adopted in the entire county. Kitchen garden provides an opportunity to farm women to earn money and engage themselves in work along with proper utilization of place and water. The present investigation was carried out to collect data regarding the nutritional and food security status of farm families selected from a village Upani in Sidhi district situated in Madhya Pradesh, India. A total of 50 families were selected for the study. As compare to their traditional practice of gardening they found 240 kg more vegetable through planned kitchen garden in a year and earned Rs.3400/- . The availability of vegetables increased by 186 at house hold level. % change in Consumption gm/day was 41.6. With the availability of vegetable in the diet, farm families can reduce problem of malnutrition.

Keywords: Malnutrition, Food security, Dietary intake, Anthropometric measurement

FSPT: 26.

NON CHEMICAL APPROACHES FOR SAFETY AND QUALITY OF FRESH-CUT VEGETABLES

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Consumption of fresh-cut vegetable is spreading out worldwide primarily owing to convenience in use and its health goodness like lowering the threat of cancer and cardiovascular disorders. To assure consumer's liking and acceptability of the product, it is important to study and also keep definite key factors of fresh-cut fruit and vegetable produce in mind i.e., flavour, colour texture and the nutritive value. In recent years, fresh cut vegetables commence to be received in the market because of the competitiveness for quality and emerging risk of food-borne pathogens. To adhere the present market of fresh vegetables in the world, the primary challenge factors are related to quality and safety of fresh vegetables, and some current non chemical approaches that can be used are disinfection, biotech measures, biological control, non-thermal processing technology and hurdle technology etc. In addition, quality and safety ensuring system for fresh vegetables is also required for assuring the quality and safety of fresh cut vegetables

products. To ensure the safe usage of cut products the challenge lies for controlling the major pathogens which effects the quality. In order to develop new technologies to keep the products safe and free from pathogens the non chemical approaches are the need of hour. The demand for these fresh cut/minimally processed vegetables is increasing day by day as they are advantageous in time saving, space saving, saving of manpower and less use of equipments and being very handy to use. The major players in this market are Germany, Netherland and Spain. They have higher research and development advancement in the field of fresh cut vegetables. India being on the verge of adoption of this technology needs advanced and thorough approaches which are non chemical to conquer the attentive urban as well as rural consumers demand for fresh cut/minimally processed vegetables.

FSPT: 27.

SOLATION AND ANTIMICROBIAL SCREENING OF FUNGAL ENDOPHYTES FROM MEDICINAL PLANT ANDROGRAPHIS PANICULATA

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With the resurgence in demand of sustainable development, fungal endophytes have become a pivotal source of bioactive medicinal and aromatic products, as they are able to asymptomatic, mutually beneficial survival inside the host plants and synthesize array of host origin compounds. Current pharmaceutical industries have 25% drugs derived from medicinal plants and their synthetic derivatives. This renders endophytes of such plants as a primary target for medicinal compounds bioprospecting. The proposed work aim to isolate, screen and characterize the bioactive secondary metabolites of fungal endophytes from medicinal plant *Andrographis paniculata*. *A. paniculata* hasandrographolide, neoandrographolide and dehydroandrographolide compounds with medicinal values, such as antioxidant, antibacterial, antimalarial, antiinflammatory, anti-HIV, anticancer, immunomodulatory, neuroprotective, hepatoprotective, hypoglycemic, hypolipidemic, and hypotensive activities. Ninteen fungal endophytes were isolated from 25 segments of each leaves and stem of *A. paniculata* and identified morphologically and microscopically. Each endophyte was cultured in potato dextrose broth (PDB) and metabolites were extracted in ethyl acetate and dried. Crude compounds were dissolved in methanol and screened against 5 human pathogenic Gram negative bacteria *viz*. *Escherichia coli* (*ATCC 25922*), *Klebsiella pneumoniae* (clinical strain), *Morganella morganii* (clinical strain), *Proteus vulgaris* (clinical strain) and *Shigella boydii* (clinical strain), and 2 Gram positive bacteria *viz.Enterococcus faecalis* (*ATCC 25923*) and *Staphylococcus aureus* (clinical strain). Total 17 endophytes showed the inhibition zone against at least one tested pathogen. AS11 (*Xylaria* sp.) showed antimicrobial activity against all tested pathogens. At the concentration of 1mg/disc fungal endophytes AS7 and AS10 respectively showed the 18 mm and 15 mm clear zone against *S. aureus* and MIC value of 100 µg/ml. The future work is to screen the crude of potential endophytes for the presence of host mimetic compounds andrographolide, neoandrographolide and dehydroandrographolide, purify them by TLC and CC, and characterize them by HPLC and GC-MS techniques.

FSPT: 28.

DEVELOPMENT AND EVALUATION OF OLEOGEL AS A SHORTENING AGENT FOR BAKERY PRODUCT

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Over the past few decades, there have been great advances in our knowledge of dietary fatty acids and their effect on human health. In particular, the suspected deleterious effects of *trans* and saturated fatty acids have been well

documented. In this work, oleogels was prepared using rice bran oil (RBO) as base material and ethyl cellulose (EC), sorbitan monostearate (SMS) and *kokum* fat as gelator. Mixture design was applied to optimize the formulation by balancing the properties of the oleogels, *viz*. firmness, adhesiveness, cohesiveness and springiness. Optimized concentrations of the gelators for oleogels from RBO oleogels at 30ºC was i) 3:1 combination of EC: SMS at 8%, respectively, and ii) *kokum* fat at 12%. From the phase diagram, it was found that *kokum* fat showed a synergistic effect with the combination of EC: SMS. Effect of oil type was studied using olive oil (OO) and flaxseed oil (FSO) at same concentration of EC: SMS and *kokum* fat at 8% and 12%, respectively, for all oleogels. The hardness of the oleogels was in the order of FSO >RBO > OO. FSO, RBO and OO based oleogels were stable and showed a peak temperature of 68.3ºC, 71.94ºC and 66.84ºC, respectively, in DSC. FSO, RBO and OO oleogels showed shear thinning behavior. FSO and OO showed viscoelastic while RBO based oleogels showed elastic behavior. All the three oleogels were studied by FT-IR studies and XRD analysis. Optimized RBO oleogel was evaluated as a replacement for bakery shortening in cookies at 25%, 50%, 75% and 100% followed by textural analysis of the dough as well as the cookies as well as sensory analysis of the cookies.

Keywords: Oleogel, Flaxseed oil, Rice bran oil, Ethyl cellulose, olive oil, *Kokum* fat

FSPT: 29.

RISK OF EATING DISORDER IN ADOLESCENT GIRLS HAVING PREMENSTRUAL SYNDROME

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Premenstrual syndrome is combination of symptoms includes abdominal bloating, breast tenderness, changes in appetite, alteration in mood, weight gain, abdominal pain, sore breast, anxiety, which appear in luteal phase, before onset of bleeding. Premenstrual syndrome comprise both physiological and behavioral changes which could cause eating disorder. Changes in appetite and eating behavior have been found in women suffering from premenstrual syndrome. Current study was undertaken to determine the risk of eating disorder in adolescent girls suffering from premenstrual syndrome. A case – control study was conducted with 223 adolescents (case & control) aged 11 to 19 years. Premenstrual syndrome was diagnosed using the premenstrual syndrome scale. Eating attitude test-26 scale were used to evaluate eating attitude. Anthropometric measurement was done by weighing machine and stadiometer. Majority of girls 132 have experience of premenstrual syndrome among them 93 (70.45 %) respondents score above 20 on EAT-26 scale which represent risk of developing eating disorder. 23 (25.27 %) respondents from control group scored above 20 on EAT-26 scale. The findings suggest that Girls suffering from PMS have higher risk of developing eating disorder due to fluctuation in food intake.

Keywords: Eating disorder, Mood Swing, Nutritional Assessment, Stress

FSPT: 30.

KNOWLEDGE ASSESSMENT OF RESPONDENTS REGARDING CHRONIC RENAL FAILURE DISEASE

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For centuries man has known that there are direct casual relationships between nutrition and disease. Nutrition is very essential part in our daily life and it is directly correlated with diet, health and diseases. The nutritional situation of any community is based on certain socio-economic conditions such as occupation, education, background and their eating

habits. Having knowledge of any disease and their causes, dietary precautions, as well as treatment is a very important aspect to fight against diseases. The study was conducted at nephrology unit, Institute of Medical sciences, Banaras Hindu University Varanasi. 209 chronic renal failure patients were selected for the study, out of which 105 patients were nutritionally counselled and 104 were not nutritionally counselled. To collect the data questionnaire cum schedule method were used. It was found that out of total 52.2% respondents had sufficient knowledge regarding symptoms of disease while 69.4% respondents had sufficient knowledge regarding special nutrients required in chronic renal failure. Out of total 51.2% were having sufficient knowledge regarding restricted food items in chronic renal failure,43.1% knew about balanced diet and 65.6% had knowledge about low sodium and protein diet. Knowledge of 57.9% , 55%,67%,78.9% respondents having low potassium diet in Chronic renal failure, water balance, health education and green leafy vegetarian respectively. The finding is that among those patients most have not the complete knowledge about the chronic renal failure disease.

FSPT: 31.

IMPACT OF SUPPLEMENTATION OF AVALA (INDIAN GOOSEBERRY) POWDER ON THE HEMOGLOBIN STATUS OF WOMEN OF REPRODUCTIVE AGE (15-45 YEAR)

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Thirty women belonging to reproductive age (15year-45year) without any disease were identified from Pratappur Village of Arajiline Block of Varanasi District. The dietary survey and Hb estimation of selected subject was done during the first week of study. The dietary survey revealed that the studied subjects were consuming inadequate protective foods like green leafy vegetables, other vegetables, fruits and milk, which resulted in deficit of Calories, protein, Iron and Folic acid manifested in poor Hb level with different grades of anemia. The studied sample was divided into two groups. 15 subjects (Experimental group) were advised to take Avala powder, 5gm/day with Albendazol tablet while rest of 15 subjects (control group) was not advised to do any change in the diet. The severity of anemia was decreased significantly ($P \leq 0.05$) as percentage of samples having normal Hb level has increased from 20.8% to 42.8%. A part from this, their physical problem like weakness, shortness of breath and exhaustion after little physical work, hair fall and indigestion also improved.

FSPT: 32.

BIOFORTIFICATION OF HORTICULTURAL CROPS

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The food produced is not enough to feed the expanding population and malnourishment is a major problem among the masses which leads to several health hazards and even deaths. According to a status report of ICDS (Integrated Child Development Services) 2015, around 17.8 lac children below 6 yrs age are suffering from severe malnourishment. Deficiency of nutrients results in disorders like blindness, decreased mental health, mortality and Vitamin A and zinc are essential components for developing the immune system. There is a need to enrich our food crops in order to deal with this unpleasant situation. Biofortification is a sustainable way of providing nutritious, minerals and vitamins rich food to the people in a cost effective manner. 'Fortified' means strengthening and bio fortification of horticultural crops that addresses towards strengthening the horticultural crops with more minerals, vitamins and micronutrients. Moreover, this is a best way to contract the micronutrient deficiency. It can be done

using conventional practices, transgenic breeding or biotechnology. Some examples of biofortified horticulture crops includes Ca rich carrot by altering the transport gene, enhanced folic acid level in tomato, Pro vitamin -A rich nutri-banana, beta carotene rich bio-cassava, anthocyanin rich sweet potato variety named Bhu Krishna, beta carotene rich cauliflower variety Pusa Beta Kesari-1, Ca rich lettuce, Super broccoli created by classical genetics contains 3.4x sulphoraphane, an anti-cancer agent. Thus, Biofortification aims to improve the nutrition in the underprivileged parts of the population.

Keywords: biofortification, malnourishment, sustainable, transgenic, biotechnology.

FSPT: 33.

INCREASING THE IRON CONTENT OF COOKIES FROM DIFFERENT BLENDS OF WHEAT FLOUR,MORINGA OLEIFERA AND SPINACH POWDER

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In most parts of the world, baked goods based on wheat flour alone, are popular food stuffs. Wheat is a major source of raw material for the production of these baked products such as cookies. Cookie is a small flat, baked food product usually contains mainly fat, flour, egg and sugar .Cookies are mostly baked until crispy and just long enough that they remain soft, but some kind of cookies is not baked at all. Cookies are made in a wide variety of styles by arranging the ingredients in different proportions including sugar, spices, chocolate, butter, pea-nut butter, nuts or dried frost. Cookies are convenient snack product dried to a very low moisture content taken by childrens, young people and adult to provide energy and satisfy hunger. This is made from dough which is made from a mixture of flour and other ingredients, mixed together into dough which is rested for a period and passed between rollers to make a sheet.

Blends of wheat flour (WF), Moringa oleifera leaf powder or flour(MO) and spinach powder(SP) were processed into cookies in the following ratios (WF:MO:SP)::(100:0:0),(90:05:05), (80:10:10) , (70:15:15) , (50:25:25) respectively. The sensory evaluation of the cookies samples from the blends was performed. The results of the sensory evaluation showed that there were significant differences in the different attributes that were determined such as in colour, crispiness, taste, flavour and general acceptability. The sensory general acceptability scores showed that the best Moringa flour and Spinach powder substitution level for making cookies was 10% each i.e (80:10:10). Consumption of these cookies will results fulfil the Recommended Dietary Allowances(RDA) by 22% in childrens between aged 2-11 years,21% in chidrens between aged 12-19 years,16% in adults men and 18% in women and 22% in pregnant women.

Keywords: Blend,Wheatflour,MoringaOleifera,Spinach, Cookies.

FSPT: 34.

A STUDY ON CO-CULTURE OF *Spirulina platensis* and *Porphyridium purpureum*

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An attempt to grow freshwater *Spirulina platensis* (SP) and marine *Porphyridium purpureum* (PP) as a co-culture was made. SP (strain CFTRI SP6) and PP (strain 112.79) co-culture as well as mono-cultures as control incubated in Zarrouk media at 25±1 °C with a photoperiod of 16:8 h light and dark. Dry biomass and lipid content of mono-cultures of SP (98.2 mg/100mL; 6.11%), PP (56.5 mg/100mL; 14.34%), and of their co-culture (152 mg/100mL; 18.8%) were recorded. Fatty acid profiles of SP and PP mono-cultures revealed the presence of □-linolenic acid (16.91%) and traces of (EPA & AA), respectively. □-linolenic acid (GLA) and linoleic acid were present in fatty acid profile of co-culture in addition to eicosapentanoic acid (EPA) and arachidonic acid (AA) in

traces. Leaching of green pigments was observed in PP mono-cultures on 10th day of growth. PP was grown further in CFTRI-modified Zarrouk medium at 20±1 °C and 25±1 °C with a photoperiod of 16:8 h light and dark. An increased biomass was recorded without any pigment leaching. This modified medium can be used to grow co-culture of SP and PP for enhanced benefits. At one place PP would provide carbohydrates and in other SP would add proteins in a single food matrix along with EPA (□-3 fatty acid), GLA (polyunsaturated fatty acid) and bioactive compounds - phycobiliproteins and carotenoids.

Key words: Spirulina, Porphyridium, Zarrouk media, Co-culture, Gas Chromatography.

FSPT: 35.

EMERGENCE OF FLAXSEED AS FUNCTIONAL FOOD

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Flaxseed is cultivated in many parts of the world including India for fiber, oil as well as for medicinal purposes and also as nutritional product. Consumption of flax seed has been increased due to its possible functional properties in health. Flaxseed has the properties of super food as well as functional foods being good source of alpha lenolenic acid, lignans, high quality of protein, phenolic compounds and soluble fiber. The paper will focus on nutritional composition as well as health benefits of flaxseed.

Keywords: Alpha Lenolenic Acid, Lignans, Phenolic Compounds, Functional Food

FSPT: 36.

NUTRACEUTICALS - THE ADVENT OF NATURE AND PHARMA GIFT TO HUMAN KIND FOR HEALTHY LIFE

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The growing needs of nutritional security in order to combat the prevalence of various health issues are advancing towards nutritional supplements intake, thus, for the past decade the focus is shifted to Nutraceuticals. Nutraceuticals are popularly known as the combination of nutrients and pharmaceuticals. In wide-range, they are foods or part of food that play a greater role in transforming and upholding standard physiological function preserving precious human lives. Universally, the utmost reasons for advancing of the nutraceutical arcade are the changes in lifestyles of the population and their decreased fitness levels are of urban concerns, and also in rural India in spite for their vigorous occupational activities. The major products of nutraceuticals are considered as antioxidants, dietetic fiber, polyunsaturated fatty acids, prebiotics, probiotics and further diverse forms of natural or herbal foods. Nutraceuticals helps in combating with most of the health problems in their life span such as obesity, cholesterol, cardiac diseases, tumors, osteoporosis, inflammation, diabetes, etc. In complete, 'nutraceutical' has run to the novel era of medicine and well-being, where the food trade has turned out to be a research oriented segment in order to step towards the nutritional security among the people with respect to healthier diet.

Keywords: Nutraceuticals, Prebiotics, Probiotics, Healthy diet, Nutrients, Lifestyle, Human health.

FSPT: 37.

SCIENTIFIC AND TECHNICAL ASPECT OF FUNCTIONAL PROBIOTIC YOGURT FORTIFICATION: A REVIEW

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Foodfortification is the process of adding micronutrients (essential trace elements and vitamins) in food. As defined by the World Health Organization (WHO) and the Food and Agricultural Organization of the United Nations(FAO), fortification refers to "the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals (including trace elements) in a food, so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health", whereas enrichment is defined as "synonymous with fortification and refers to the addition of micronutrients to a food which are lost during processing". Foods based on fruits and vegetables, such as its juices and pulp represent a new potential carrier and source of probiotic microorganism. Yogurt, the best carrier of probiotics, traditionally is manufactured *streptococcus thermophiles* and *lactobacillus deldrueckii ssp. Bulgaricus (L. bulgaricus*) as starter cultures. Raw and fermented fruits represent an excellent vehicle for probiotics due to their natural structure that allows the easy availability of usual nutrients for microbial growth. Majority 70% of people in India do not consume enough micronutrients such as vitamins and minerals in day to day life. Due to the high consumption rate of dairy products such as probiotic yogurt, fortification of these products will effectively reduce or prevent diseases associated with nutritional deficiencies. The aim of this investigation is to study the technical aspects involved in production of different types of fortified yogurts, firstly, fortification is defined and the main reasons behind carrying out this process are presented and then yogurt production process and a variety of minerals, vitamins, and functional ingredients which are used in the process are briefly discussed.

Keyword: probiotic yogurts, micronutrients, yogurt fortification functional food.

FSPT: 38.

NUTRITIONAL VALUE IN HUMAN DIET THROUGH QUALITY VEGETABLES PRODUCTION

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India is second largest producer of vegetables in the world next to China. Area under vegetables 10.29 million ha and total production 176.17 million tonnes. These are the products of herbaceous plants which are annuals, biennial and perennials whose plant parts such as leaves, fruits, roots, stems, petiole, flower etc. are used for culinary or consumed as raw. The researchers are now being directed for improvement in quality of horticultural produce. Self-sufficiency in true sense can be achieved only when each individual is sure of a balanced diet. Dietician's supporter intake of 300g of vegetables every day to make our diet balanced along with other diets. There are 125 g leafy vegetables, 75 g other vegetables and 100 g root and tuber vegetables. With the projected inhabitants of 133 crores in 2020 and 165 crores in 2050, we have to produce at least 190 and 240 million tonnes respectively. Vegetables are productive foods are carbohydrares, protein, roughages and rich source of vitamins and mineral i.e. called protective food. They maintain better health and protect against progressive diseases. Theycanneutralise the acids produced during digestion of proteins and fats. Nutrients which are present in vegetables vary from crop to crop.Vegetables are rich sources of vitamins A, B, and C which helps to lower liability to infection. e.g.: Carrots, sweet corn, amaranthus and celosia provide Vitamin A; Bitter leaf, water leaf, tomato and celosia provide Vitamin B; Tomatoes, carrots, lettuce, cabbage and amaranthus provide Vitamin C. Peas and beans are enriched with proteins. Some of the vegetables are rich in carbohydrates e.g. potatoes, sweet corn, carrot etc. Green beans and peas are cheap sources of protein. Bitter leaf, Amaranthus and spinach provide some amount of protein in human diet. Vegetables make our staple food more appetizing and enhance their intake.

Keywords: Vegetable, Vitamin & minerals, Productive food, Population

FSPT: 39.

RISHI KRISHI TO EMPOWER FOOD AND NUTRITIONAL SECURITY AND IMPROVE SOIL HEALTH

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The study aims to evaluate the efficiency and efficacy of some *cowpathy*and *Rishi krishi*inputs, *viz.*Vrkshayurveda, Panchagavya, Kunapajala, *Beejamrit*, Jeevamirit, Compost tea, Matkakhad, Vermiwash and Amritpani with the objectives to enhance the biological efficiency of horticultural crop plants for eco-friendly nutrient and disease management and improve soil health in organic farming. *Vedic krishi*techniques are low input costs, which comply well with the ecological and socioeconomic conditions of vast segment of farming community comprising of small and marginal farmers. All the *Vedic Krishi* inputs were found quite effective in enhancing the productivity of different crops and suppressing the growth of various plant pathogens by producing antibacterial and anti-fungal compounds, hormones. Application of *vermiwash*is found to contain major and micro nutrients, vitamin (B_{12}) and hormones (gibberellins) secreted by the earthworms.

Panchagavya 6 per cent spray recorded significantly rich in nutrients, auxins, gibberellins and microbial fauna and acts as tonic to enrich the soil to induce plant vigour with quality production. It is equally effective for all types of plants, milch animals, goat, poultry, fish and pet animals. Its remarkable effects have been demonstrated in fruits like mango, guava, acid lime, banana, spice-turmeric, flower-jasmine, tuberose and vegetables such as cucumber, spinach etc. The effective micro-organisms in Panchagavya were the mixed culture of naturally occurring, beneficial microbes, mostly lactic acid bacteria (*Lactobacillus*), yeast (*Saccharomyces*), actinomycetes (*Streptomyces*), photosynthetic bacteria (*Rhodopsuedomonas*) and certain fungi (*Aspergillus*).

Keywords: Rishi Krishi, micro-organisms, Vrkshayurveda, Panchagavya, Kunapajala, *Beejamrit*, Jeevamirit.

FSPT: 40.

PRODUCTION OF POWDER FROM SHANKHPUSHPI LEAVES BY HEAT-PUMP ASSISTED DRYING

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Shankhpushpi is a very significant and important drug in Indian traditional medicine. It has been recognised in Ayurveda as 'MedhyaRasayana', which is a prominent memory improving drug. The four main varieties of Shankhpushpi are,*Canscora decussata, Clitoreaternatea, Convolvulus pluricaulis, and Evolvulusalsinoides*. It is mainly found in southern India, Sri Lanka, tropical Africa and South-eastern Asia, wasteland in the plains of Punjab, Bihar and Chhotanagpur plateau. With growing awareness and demand of Ayurveda globally, it has become a necessity to cultivate this crop for its medicinal value to meet global demand. Drying is an ancient method of food preservation. But drying represents 30 to 50% of the total costs in medicinal plant production and, hence, it is important to identify the factors determining the rise in cost.

This study was aimed to develop an energy saving and cost efficient way of drying and production of powder from Shankhpushpi leaves, which was carried out at low temperature so as to keep the bioactive compounds intact. Shankhpushpi leaves were procured from local farm. They were washed and then steam blanched (1.2 bar, 40-50 s). The blanched leaves were then loaded on perforated trays especially designed for heat- pump assisted dryer. The leaves were subjected to varied temperatures ranging from 40-50^{0}C at air flow velocity of 1-1.6m/s, and 8-10% RH. The drying time, colour and biochemical constituents of Shankhpushpi leaves were examined at different temperatures. It was found that using a Heat-pump assisted dryer was energy efficient at lower temperatures as compared to traditional methods of open sun drying or tray drying which are commonly practiced. Heat pump dryers

use low-temperature dehumidified air as the convective drying medium. Hence, drying in heat pump dryer can be carried out at relatively low temperature as compared to conventional hot air dryers.

Keywords: Shankhpushpi leaves, powder, Heat-pump assisted dryer, low temperature, energy efficient

FSPT: 41.

NANOTECHNOLOGY IN FOOD SCIENCE

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Applications of nanotechnology have emerged with increase in demand of nanoparticles in various spheres of food science. Nanotechnology has demonstrated its applicability in the areas of food production, processing, food microbiology, functional food development, packaging and safety. It can be applied to food technology for production, processing, storage and quality assurance of food products. Nanomaterials are having unique new characteristics which can improve organoleptic aspects of foods by imparting enhanced texture, color and appearance. With applications of nanotechnology, nanosensors are used to detect harmful components in food and to recognize microbial contamination easily and rapidly and sensitively. A dimethylsiloxane micro fluidic nano sensors integrated with specific antibody immobilized on an alumina nonporous membrane was developed for rapid detection of food borne pathogens in *Staphylococcus aureus* with electrochemical impedance spectrum. Nanoencapsulation can play pivotal role in food technology. So like this pathogens can be easily detected. This technology is very beneficial for bioactive ingredients and developing flavors. Flavors degrade due to various food processing techniques therefore flavor particles are encapsulated by using nanocarriers to provide chemical stability. Further, biochemical compounds like phytochemicals not6 only improves sensory profile but also give various health benefits but due to poor water solubility, GI absorption, low digestion stability and influence by external conditions they are having high risk of degradation. So, Nanoencapsulation is best strategy to combat such issue. When designing an encapsulation system, factors which are considered are the physicochemical properties of the flavor (solubility) and the carrier (viscosity). In this review current applications of nanotechnology are discussed like flavour control, enriching bioavailability of bioactive compounds and detection of deleterious substances in foods. The harmful contaminants are detected by checking biological interactions using biochemical signals. The paper also discusses challenges faced by nanotechnology and the future opportunities of nanotechnology.

FSPT: 42.

UTILIZATION OF BYPRODUCTS OF FRUITS AND VEGETABLES: WASTE TO WEALTH APPROACH

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The fruit & vegetable processing industries generated 10-60% waste or by-products in both solid and liquid form. Waste from fruits & vegetables can be used as such or after some treatments. They are rich in nutrients, therefore, have many health benefits. In addition to its use for livestock feed, Fruits & vegetable waste can be converted into value-added products like essential oils, edible oil, polyphenols, enzymes, pigments, anti-carcinogenic compounds, single cell proteins, bio-degradable films etc. A large number of by-products are produced from food industries. These are the secondary products generated during manufacturing of primary products. This includes peels, seeds, leaves, residual pulp, stems, stones, and discarded pieces from a variety of sources. These by-products are the good source of bioactive compounds, nutraceuticals, and other functional foods. Therefore, there is a healthy trend towards by-product utilization and value addition. As fruits & vegetables are perishable, their wastes get rotten

quickly. So, waste disposal is a serious problem as it causes flies & rats around. Therefore, waste needs to be utilized properly and efficiently. Reducing waste and using it for by-products a have a good impact on climate. By-products from food industries are rich in nutrients so have many health benefits. They generally comprise of polyphenols, carotenoids, alkaloids, saponins, etc. Polyphenols are classified into flavonoids, xanthones and phenolic acids including hydroxybenzoic and hydroxycinnamic acids. By-product utilization gives another source of income to industries, so it helps to increase economic productivity.

Keywords: Food waste, Byproducts, neutraceuticals, seeds, waste management

FSPT: 43.

CULTIVATED CUCURBITS ARE SECURE HUMAN HEALTH THROUGH NUTRITIVE VALUE AND MEDICINAL PROPERTIES

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Cucurbits are the popular name of the family Cucurbitaceae, commonly known as gourd family. A family of about 110 genera and between 650 to 850 species, Cucurbitaceae are distributed mainly in tropical and subtropical regions of the world. These are used as fruits and vegetables, and most of them have considerable economic value. Economically the family is fairly important. The fruits of *Benincasa, Cucurbita, Cucumis, Lagenaria, Momordica, Luffa* and *Trichosanthes* are thecommon vegetables. Fleshy fruits of *Citrullus* and *Cucumis* are edible. The fruits of cucumber are alsoused in salad.Cucurbitaceae is the largest group of summervegetables crops. These include cucumber, muskmelon,watermelon, tinda, bottle gourd, luffa, bitter gourd,pumpkin, squases, parwal and snake gourd.The cucurbits are large hectar area worldwide andseveral countries their culture is done. Cultivated cucurbits, which are really useful in human health, also take attention in terms of acid, vitamins, mineral substances i.e.purification of blood, remove of constipation, good fordigestion and give energy in them. By observing the usefulness of cultivated cucurbits, which can grow in our country mainly cultivated, our main aims is to convince that we should grow them more in country wide.

Key words: cucurbits, human health, country, economic value

FSPT: 44.

खाद्य पदार्थो का संरक्षण अतिआवश्यक

संजय कुमार एवं पूनम सिंह

मनोविज्ञान विभाग महाराजा कालेज, वीरकुवर सिंह विश्वविद्यालय आराविहार,
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भोजनमानव की मूलभूत आवश्यक आवश्यकता है इसके बिना वह अधिक दिनो तक जिंदा नही रह सकता है भोजन से हमे उर्जा शक्ति व ताकत मिलती है जिससे हम विभिन्न शरीरिक एव मानसिक क्रियाओ को सम्पन्न करते है अत; भोजन को संरक्षित करने महती आवश्यकता है सभी भोज्य पदार्थ सभी मौसम मे नही पाये जाते है जैसे़ रबी के मौसम मे सभी प्रकार की दाले तेजवीज गेहूँ जौ आदि खरिफ के मौसम मे धान उगाए जाते है समय से सस्ते भी होते है क्योकि इनका उत्पादन अधिक होते है अतः इन भोज्य पदार्धको सुचित तरीके से रखना आवश्यक होता है ताकि वर्श भर इन का उपयोग किया जा सके।

भोज्य परिरक्षण वह तकनीक एवं विधियॉ है जो खाद्य पदार्थोको सूक्ष्म जीवाणुओं फफुदी विशाणुओ कीड़े, मकोड़े , चुहे, एन्जाइम्स तथा स्वतः आक्सीकरण होने से बचाती है तथा खाद्य पदार्थ को लम्बे समय तक सुरक्षित रूप से संरक्षित करके रखती है। खाद्य संरक्षण के निम्नलिखित तरीके है प्रशीतन, रवमीरीकरण , निर्जलीकरण बोतलो में संरक्षण, डिब्बो में संरक्षण , जैम , जैली तथा मुरब्बा बनाकर संरक्षण खाद्य वस्तुओं की आर्द्रता को बनाये रखने के लिए व्यापारिक स्तर पर जमाकर कोल्डस्टोरेज, चिलस्टोरेज तथा

घरों में रेफ्रीजरेटर का प्रयोग किया जाता है। फल, अण्डा, दुध, मांस, सब्जी आदि ताप के कारण जम जाते है जिसमें निहित सड़ाने वाले शुक्राणु की क्रिया शून्य हो जाती है। शुक्राणु की वृद्वि 40F] से नीचे रूक जाती हैं।

FSPT: 45.

ADVANCES IN FOOD SCIENCE AND POST HARVEST TECHNOLOGY

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Food safety is a scientific discipline which covers handling, transportation, storage and retailing of food in ways that prevents foodborne illnesses. As the economies of many countries are increasing, the consumers have started using processed food more than the staples. Recent advances in food processing and Technology is not only important to meet the increasing productivity demands but to adopt sophisticated automation, control and monitoring methods and techniques. New food stuffs include Biotechnology based methods based food products e.g. genetically modified food, Organic crops and food stuffs, Protein based diet. Most food wastage occurred in developed countries at the retail/consumption end of the chain, while in developing countries high losses occur at the production/processing end. Such losses could be ameliorated by enhanced postharvest research, development, education and training. Increased awareness of the limited horizon of synthetic pharmaceutical products to control major diseases, high cost of currently available synthetic medicines, reported cases of adverse side-effects of modern medicines and perceived gentleness of natural medicines; There is therefore, a strong need to develop new products from medicinal plants. In general, adding value is the process of changing or transformation of a product from its original states to a more valuable state. Adding value to product can be accomplished in a number of different ways but generally falls into two main types: innovation and coordination. In general, the problem is to evaluate what, where, how and who can efficiently perform the marketing function.

Keywords: Nutritional security, Medicinal and aromatic product, Food and health, Value Addition.

FSPT: 46.

ADVANCEMENT IN POSTHARVEST TECHNOLOGIES TO INCREASE SHELF LIFE OF MINIMALLY PROCESSED FOOD

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One of the fastest growing segments of the food industry is the development of minimally processed fresh produce to meet consumer demand for fresh and healthy foods. However, mechanical operations of cutting and peeling leads to the liberation of cellular contents at the wounding site which can lead to the growth of pathogenic and spoilage microorganisms. Chlorine is widely used in disinfection and washing procedures of fresh-cut produce due to its low cost and efficacy against a broad spectrum of microorganisms. In high organic wash water continuous replenishment of chlorine can promote formation of compounds, which threaten human and environmental health. So innovative postharvest treatments such as ozone, electrolyzed water, hydrogen peroxide, ultraviolet radiation, high pressure processing, and ultrasound can achieve reduction of microorganisms without the production of harmful compounds or compromising with quality. For example, Chitosan-based edible coatings are effective methods for postharvest life of different foods as it creates an atmosphere around the fruits that slow down water loss, gas exchanges, microbial growth, etc.

FSPT: 47.

POST HARVEST PRESERVATIVE POTENTIAL OF PLANT BASED PRODUCT AGAINST GROWTH AND AFLATOXIN PRODUCTION

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Contamination of moulds in food may cause spoilage and reduction in quality and quantity of food. *Aspergillus* spp are most responsible for contamination of food and feed. In the *Aspergillus* spp. *A. flavus* and *A. parsiticus* are produce aflatoxins in food and foodstuff. Aflatoxins are hepato-carcinogenic and kept in class 1 carcinogenic. Hence, presence of these aflatoxins and mycotoxin in food and foodstuff is resulting a potential hazard to human and animal health. Considerable interest of food industries to used preservation in food. Synthetic preservation are hazardous for human health. Alternative of synthetic preservative, plant based product used as preservative, because e biodegradable and safe to humans and the environment. The study result of plant based products has good antimicrobial and Aflatoxin inhibitory potential and mode of actions against *A. flavus* was elucidated targeting the ergosterol and vital cellular ion content in the cell membrane.

FSPT: 48.

CLIMATE RESILIENT VILLAGES: AN APPROACH FOR ATTAINING FOOD SECURITY & UN SDGS

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India lives in its Villages, with 68.84% of Indians or 833.1m Peoples live in 6.4 lacs different villages (Census 2011), they are the backbone of country providing 17,97,210 sq. Km around 52% of total land cover as arable land. Agriculture is the largest source of livelihoods in India. 70 percent of its rural Population still depend on agriculture for their livelihood. This review is focuses on the methodology, framework and feasibility of climate resilient villages, a sustainable way to improve agrobiodiversity by achieving quality crops with maximum yield. Also ensuring health, gender equality & profitable livelihood, making people self-reliable & eradicating poverty among them (Srinivasa Rao *et.al*., 2016). To identify germane literature searched two electronic databases (Science direct, Google scholar).

Climate resilient Agriculture or Sustainable Agriculture is the main facet of CRVs to make agroecosystem resilient toward ill effects of climate change. It includes various Crop, Farm & Landscape level resilient techniques & interventions to ensure better yield with quality insurance of crop. These approaches address UN SDGs *viz*, SDG-1,2 and 3 (No poverty, Zero hunger & Good health). Dynamic cluster of UN SDGs *viz*; SDG-6,7,8,12,13,14 & 15 will be attain by Adaptive Agricultural Practices (Dubey *et.al*., 2019) including better farming practices, water & energy management interventions, low external inputs to sustain the overall health & balance of soil, water & energy nexus in agricultural system. It also gives an opportunity to mitigate GHGs emission & increases carbon sequestration in farm land. VCRMCs, CHCs & other village level committees led major socio-economic reform among people, ensuring active participation of women in decision making so addressing SDG-5(Gender Equality) & SDG-10 (Reduced Inequality).The end of poverty can only be achieved with the end of gender-based discrimination (UN Women,2017). Women's upliftment also led toward healthier & better society. Transfer of such techniques and dissemination of Indigenous & Local knowledge (ILK) among different people by institutional & individual efforts will be crucial for achieving SDG-17 (Partnership for the Goals) for successful implementation of CRVs in whole country.

Keywords: Sustainable Development Goals, Sustainable Agriculture, Climate Resilient Village, Food Security.

FSPT: 49.

POSTHARVEST MANAGEMENT OF FRUITS AND VEGETABLE: A POTENTIAL FOR REDUCING POVERTY, HIDDEN HUNGER AND MALNUTRITION

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Fruits and vegetable (FV) production is an emerging horticulture sub-sector in India despite the fact that, almost one-third of the produced FV is lost before reaching the plate. FV postharvest losses in SSA range from 30 to 80%, depending on a crop. Lack of postharvest management skills and technology such as temperature control to maintain the cold chain, value addition, and packaging have caused several economic and food security setbacks among them are high levels of poverty, hidden hunger and malnutrition. Use of postharvest technologies such as application of ethylene and 1-MCP to enhance and delay ripening, respectively can significantly reduce FV postharvest losses throughout the value chain. Globally, applications of postharvest technologies for instance; use of ethylene, 1-methylcyclopropene (1-MCP) and temperature management has proved to reduce postharvest losses of FV. Also, chemical and non-chemical methods are useful for controlling spoilage and pathogenic microbes especially on ready to eat FV products. Postharvest technologies such as controlled ripening, edible coating, temperature management, and chemical treatment methods are potential tools to reduce FV postharvest losses, increase food and nutritional security and alleviate poverty in SSA. At the same time, sanitizing chemicals and pesticides malpractice should be avoided to ensure final consumer safety. Using combined methods is more beneficial for FV postharvest losses reduction, particular with minimally processed FV. Proper use of postharvest technologies such as, controlled temperatures, sanitizing chemicals, edible coating and controlled ripening will lead to increased safety of FV and adherence to quality standards for local and international markets.

Keywords: Fruits, vegetables, postharvest, losses, technologies, temperature, ethylene, edible coating.

FSPT: 50.

VALUE ADDITION IN MEDICINAL AND AROMATIC PLANTS

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Since time immemorial plants are used for healing purposes in various systems of folk medicines and still 80% of the population in developing countries rely largely on plant based drugs for their health care needs.Nearly, 30% of the drugs sold worldwide contain compounds derived from plant origin. There is an expanding interest in medicinal and aromatic plants (MAPs) as new income generating opportunities are opening up for rural populations and many extremely poor households who collect MAPs from wild and sell which provide complementary source of cash for them. India is gifted with 8000 medicinal and 2500 aromatic plants, many of which can be mined for natural chemicals and processed for commercial products with export value. Biomass from wild and cultivated sources is the basic raw material of medicinal and aromatic plants subjected to processing for value addition. Further value-addition is carried out utilizing biomass derived natural or semi-synthetic products. Value addition at low or medium to high levels through simple or highly complex processing technologies is available for commercial utilization in India and several other countries. Simple value addition technologies employing locally available equipment which the farmers and small entrepreneurs can afford with limited investment are peeling and drying, cutting MAPs into pieces of convenient size and grading, powdering, preparation of concentrates, health drinks, etc. High level value addition requires sophisticated technologies, technical personnel, costly equipment, electrical supply, government approvals,

quality testing, accreditation, etc. Herbal extracts, pure chemicals, aroma chemicals and a range of consumer products are the end products of these processing technologies medicinal and aromatic plants sector is a sunrise industry with plenty of opportunities for new, young and innovative entrepreneurs for starting successful, eco-friendly and natural product industries.

Keywords: Medicinal and aromatic plants, value addition, herbal extracts, biomass.

FSPT: 51.

VALUE ADDITION OF MINOR FRUITS

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Minor fruits are those fruits which are known for their wider adaptability to climatic and soil conditions in India. This strength of minor fruits is particularly useful in a country like India, where a majority of the farmers are poor in resource and carry out farming under not so favourable condition. Apart from this, they are a rich excellent source ofantioxidants, essential vitamins and minerals and play an important role in maintaining livelihood security for many people in developing countries and it constitutes significant portion of a daily diet of the people in the country. These fruits have local or regional importance but generally, lack national recognisation. Lack of interest on minor fruits crops may be due to many of fruits have astringency, acidic nature of fruits like aonla, bael, karonda, jackfruit, jamun, mangosteen, durian, rambutan, avocado, passion fruit, kokum, malabar tamarind, macadamia nut, pummel longan, etc. Commercial production and processing for value addition of these crops have great scope and would enhance the income of small and marginal farmers, while food processing and supply of raw material for preparation of value added product *viz* preserve, candy, juice, jam, jelly, powder, squash, chips, pickles, syrup, sauce, nector, ice-cream, toffee, murabba, etc would popularize these fruit crops among farmers. Value-addition of these fruits can help to meet the nutrition requirement of the people & economic sustainability.

Keywords: Value addition, Minor fruits, Processing

FSPT: 52.

INNOVATION IN FOOD PROCESSING AND POST- HARVEST TECHNOLOGY (PACKAGING)

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Total horticultural production of India is 306.818MT, along with there is tremendous losses of 20-40% due to improper post-harvest management. According to ASSOCHAM 2014, losses reported is 2.5mt annually in term of both quantitative and qualitative. Wrapping the product for the consumer in the late 1800s was not a science, but the recent world shows the introduction of several innovations in the field of Food processing and Post-harvest technology i.e., packaging materials based on science and technology. Improper packaging is one of the impactable reason which contributes losses in great amount .Global consumer flexible packaging consumption by region, 2011(% share by volume). Asia holds the top position i.e. 29.1% followed by Western Europe 27%. In order to overcome such problems we are focusing to foster innovative packaging methods like Active packaging, Intelligent packaging, Nanotechnology in packaging, Antimicrobial packaging, etc. Active packaging materials are designed to actively maintain or improve the condition of the products either by eliminating unwanted components from the packaged headspace and from the product itself or by releasing active components into the processed products and its

surroundings by using several scavengers like O_2,CO_2,Ethylene.Intelligent packaging especially when integrated with science-based principles, is a useful tool for tracking products and monitoring their conditions, facilitating real-time data access, enabling rapid response and timely decision making. Nanotechnology in polymer based packaging that used nanoparticles. Antimicrobials packaging reduce the growth rate and population of microorganisms by extending the lag phase of microbes or inactivating them. The future vision of packaging will operate as a smart system in adding value and benefits across the supply chain.

Keywords: Oxygen Scavengers; Antimicrobials; Intelligent packaging, Nanotechnology.

FSPT: 53.

NUTRACEUTICAL AND NUTRITION SECURITY FOR FOOD AND HEALTH

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The term "nutraceutical" was coined from "nutrition" and "pharmaceutical" in 1989 by Stephen DeFelice, MD, founder and chairman of the Foundation for Innovation in Medicine (FIM), New York. Nutraceutical are food or part of food playing a significant role in modifying and maintaining normal physiological function that maintains healthy human beings. The principal reasons for the growth of the nutraceutical market worldwide are the current population and the health trends. Nutraceuticals must not only supplement the diet but should also aid in the prevention and/or treatment of disease and/or disorder. It used as conventional foods or as sole items of a meal or diet. The food products used as nutraceuticals can be categorized as dietary fibre, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants and other different types of herbal/ natural foods. Examples of nutraceuticals include fortified dairy products (e.g., milk) and citrus fruits (e.g., orange juice). These nutraceuticals help in combating some of the major health problems of the century such as obesity, cardiovascular diseases, cancer, osteoporosis, arthritis, diabetes, cholesterol etc. In whole, 'nutraceutical' has led to the new era of medicine and health, in which the food industry has become a research oriented sector.

Keywords: Nutraceutical, Dietary fiber, Probiotics, Prebiotics, Polyphenols, Spices, Human diet

FSPT: 54.

SENSORY AND NUTRITIONAL ATTRIBUTES OF MUFFINS DEVELOPED BY THE UTILISATION OF GHEE RESIDUE

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Ghee residue is the by- product of dairy industry it is charred light to dark brown and moist Residue which is obtained during manufacture of ghee from cream and butter. It is good source of good quality of protein, fat, minerals and vitamins which signifies its competence to be an excellent food item for human nutrition. The present study was carried outwith the objectives to evaluate the Organoleptic quality, nutritive value and the cost of the prepared food products utilize the Ghee residue for the preparation of muffinsby utilization of Ghee residue incorporated in different proportions and served as treatments T_1, T2,T_3 and T_4 respectively. T_0, without incorporation of utilization of Ghee residueserved as control. Chemical analysis of carbohydrate, protein, energy, calcium was done by AOAC (2005) methods and the values obtained from analysis of prepared products. Sensory evaluation was carried out using the nine point Hedonic scale. Data obtained were statistically analyzed by using analysis of variance (ANOVA), (t) test and critical difference (CD) techniques. On the basic of findings, it was observed that in *muffins* 60 percent refined flour and 40 percent ghee residue incorporation level scored the best with regard to colour, body and texture, taste and flavour and overall acceptability..

Four replications of control and treatments for muffins were carried out and mean values were obtained. Utilization of Ghee residue was used for preparation of bakery products like *muffins* waswell acceptable, based on sensory evaluation. In Muffins T_4 (wheat flour refined + Ghee residue in the ratio, 60:40) was the best. In Muffins, Calcium (131.35mg/100g), Protein (56.48g/100g) and Fat (90.72g/100g) were increased as compared to control. Cost of the products on the basis of raw ingredients per 100g ranged between Rs 31.00 for *muffins*. It is concluded that Ghee residue can be incorporated in the preparation of *muffins* in addition to improving the nutrient content.

Keywords: Ghee Residue, Organoleptic Evaluation, Utilization, *Muffins*

FSPT: 55.

ACRYLAMIDE REDUCTION IN FRIED POTATO CHIPS: REVIEW PAPER

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Acrylamide is a potential carcinogenic, mutagenic and neurotoxic chemical compound formed during cooking or frying of potatoes at high temperatures. A white, odourless , crystalline compound formed as a by product of maillard reaction taking place between amino acids (asparagine) and reducing sugars. Various approach has been made to reduce the acrylamide content either by decreasing asparagine content or reducing sugar content. Potatoes have approximately 93.9mg/ 100g asparagine content, which may lead to higher level of acrylamide formation. Blanching before frying, reduces on an average 76% glucose and 68% asparagine content in potatoes. Soaking and rinsing reduces acrylamide content as it leaches out sugar and asparagine. Frying temperature should not reach above 120°C. More browning will lead to higher acrylamide formation. As potato attains maturity its reducing sugar content decreases, so they should be harvested after attaining proper maturity. Acrylamide content in final product also depends on oil used for frying. Like palm oil and olive oil exhibits higher acrylamide formation than corn oil. Addition of rosemary herb to olive oil reduces acrylamide formation up to 25%. Acrylamide formation also depends on pH, lower pH levels results in lower acrylamide formation. Addition of amino acids such as lysine, glycine, cystine, helps in reducing acrylamide formation in fried potatoes. Acryalamide content may be reduced by treating the potatoes by treating them with polymeric acid compounds like pectin or pectate. Acidity of pectate mitigates acrylamide formation. Acrylamide formation can be reduced by treating the potatoes with ultrasound waves before frying which lowers the reducing sugar content of potatoes. Liquid chromatography is the standard technique for determining the presence of organic trace compounds in food analysis.

Keywords: Acrylamide, Asparagine, Reducing sugars, Amino acids.

FSPT: 56.

PROCESS OPTIMIZATION FOR FORMULATION OF PINK OYSTER MUSHROOM (*Pleurotus djamor*) AND BARNYARD MILLET (*Echinochloa frumentacea*) INCORPORATED CUTLET MIX

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The greatest challenge today is to develop inexpensive food that is nutritionally superior having therapeutic value and at the same time highly acceptable to the consumer. *Pleurotus djamor* of family Pleurotaceae is known as

pink oyster mushroom. It is famous for its taste, flavour, high nutritional values, anti-oxidant, anti-microbial and medicinal properties. The mushroom is highly perishable due to its high moisture content. Hence, there is a need to preserve the mushroom in the dried form for enhancing its nutrient density and increase its shelf-life. Millets are at par with cereals for protein, energy, vitamins and mineral contents. Barnyard millet (*Echinochloa frumentacea*) is nutritionally important as it contains 12% highly digestible protein, 58.56% carbohydrate, dietary fiber, vitamins and minerals and it can be used in most common cereal based traditional foods.

Keeping this in view, the present research work was carried out to optimize the process for drying of the mushroom and develop a nutritionally rich cutlet mix by incorporating barnyard millet with the mushroom flakes. The mushroom cutlet was optimized using response surface methodology (Box-Behnken design) and organoleptic evaluation was carried out. The organoleptic evaluation of the cutlet showed that appearance, colour, flavour, texture, taste and overall acceptability was 8.3, 8.0, 7.8, 8.0, 8.2 and 8.0 respectively on nine point hedonic scale. The product was well accepted by the consumer. The nutritional composition of cutlet (g/100g) showed that moisture, crude protein, crude fat, total ash, crude fibre and total available carbohydrate was 42.39, 4.96, 12.82, 5.23, 4.26 and 30.32, respectively on dry weight basis. On the basis of optimization of cutlet the cutlet mix was standardized and its nutritional quality was evaluated. The 100g cutlet mix constituted 50g potato flour, 28.30g mushroom flakes, 11.70g barnyard millet flour, 6g spice mixture and 4g salt. The cutlet mix (100g) contained moisture 6.88 g, crude protein 12.25 g, crude fat 1.27 g, total ash 3.56 g, crude fibre 8.56 g, and total available carbohydrate 67.91 g, calcium 23.33mg and iron 3.90mg, respectively. The present study concluded that mushroom cutlet mix can be a convenience snack food which will alleviate protein calorie malnutrition and also lower the risk of degenerative diseases due to its nutritional and therapeutic value.

FSPT: 57.

ADVANCES IN FOOD SCIENCE AND POST-HARVEST TECHNOLOGY

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In the early 1800's, Frenchman Nicholas Appert has developed a method for preserving food in glass jars (now-a-days canning). In olden days, potatoes were kept for one month and stored in a cool, dark place called "ROOT CELLARS". In modern days, refrigerators came into availability for storage of roots. Food system has evolved advances in science and technology and has helped to provide a huge variety of foods. Modern food science however involves much more than food preservation. Food scientists helped develop new products, designing the manufacturing of the food products, packaging materials, study the shelf life of products, sensory evolutions, microbiological, chemical testing, food science engineering technology, nutrition, salting, drying fruits in oven or sun.

As a result of rapidly growing global population and limited agricultural area, sufficient supply of cereals for food and animal feed has become increasingly challenging. Consequently, it is essential to reduce pre and post-harvest crop losses. Extensive research, featuring several physical treatments, has been conducted to improve cereal post-harvest preservation, leading to increased food safety and sustainability. Various pests can lead to post-harvest losses. Physical treatments have gained popularity making chemical preservatives unnecessary. Even under optimal processing conditions, it is unlikely that cereals can be decontaminated of all naturally occurring spoilage organisms with a single treatment. Future research should aim for the development of a combination of treatments to harness their synergistic properties and avoid grain quality deterioration.

Keywords: Root cellars, Synergistic property

FSPT: 58.

IMPORTANCE OF NUTRACEUTICAL IN HUMAN HEALTH

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The term "Nutraceutical" was introduced as a hybrid of nutrition and pharmaceutical in 1989 by Dr. Stephen De Felice, Chairperson of the Foundation for Innovation in Medicine. "Nutraceutical" is a substance that may be considered as a food or part of a food which provides medical or health benefits, encompassing prevention and treatment of diseases. In a broader term, nutraceuticals are food products or part of food products playing a significant role in modifying and maintaining normal physiological function that maintains healthy human beings. Products are diverse as isolated nutrients, dietary supplements and diets to genetically engineered "designer" foods, herbal products, and processed foods (cereals, soups, beverages) may be included under the umbrella of nutraceutical. This has rendered the nutraceutical and functional food industry in a special place to focus on the benefits of their terminal users, that is, the consumers. Frequency of nutraceuticals use is 50%–70% in developed countries' population and this number is increasing by the age. Women use more nutraceuticals than men. From a safety point of view, nutraceuticals are trusted products even if they are not approved by authorities like pharmaceuticals. With a lot of nutraceuticals clinical studies have been carried out and results originating from these trials support their effectiveness as well as their general safety. However, nutraceuticals represent a certain risk if they were to be used without medical control as interactions with medication can be harmful, especially to vulnerable (old, very young, chronically sick) populations. Examples from fish oil preparations, prebiotics and probiotics are reviewed. The importance of nutraceuticals expanding globally in terms of scientific services, legal aspects, and marketing strategies for health promotion, reduction of disease, and health care costs. An increasing nutritional interest in promoting good health and life expectancy created a growing segment of the food industry. However, regulations regarding the quality and safety of nutraceuticals are still being debated in governmental bodies are expected to develop strategies together with the public to enlighten the benefits supported by solid scientific evidence. With the ever-changing lifestyle of humans, the antioxidant defense systems are often overloaded resulting in oxidative stress. Moreover, the levels of antioxidant defense mechanism decrease appreciably with age which ultimately resulting to the development of a many severe diseases. Hence, over the past several decades researches have primarily focused on different nutraceuticals. Antioxidant products may either function intrinsically to scavenge free radicals (e.g. vitamins, PUFA) or specifically stimulate the body's defense system. However, an individual's susceptibility to any particular disease predominantly depends upon genetic predisposition and lifestyle disorders like smoking, high alcohol consumption. So, the response of nutraceuticals can vary from person to person. Nutraceuticals have proven health benefits and their consumption (within their acceptable Recommended Dietary Intakes) will keep diseases at bay and allow humans to maintain an overall good health.

FSPT: 59.

EVALUATION OF STREET FOODS AND ANALYSIS OF FOOD SAFETY STANDARDS PRACTICED BY STREET FOOD VENDORS & HOUSEHOLD WOMEN IN VARANASI DISTRICT

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India is a developing country and varieties of street foods are available and eating out has become a practice of common man, due to changing life style and busy schedule. Street food denotes foods and beverages which are served

quickly at outlets. The objective of the study was to analyze and evaluate the food safety standards practiced by street food vendors and household women. The sample for the study consisted of fifty household women and twenty vendors operating in busy street of Varanasi through purposive cum random sampling technique.

The analysis of food safety standards practiced by household women revealed that the food was cooked three times daily followed by protection of ready-to-eat (RTE) foods to eat stored food from contamination. In terms of health and hygiene requirements, majority of them did not allow the workers to handle food if they were suffering from food borne disease. Cleaning, sanitation and maintenance showed importance of maintaining water purifiers. The analysis of food safety standards practiced by vendors had less knowledge about Food Safety Standard Act. In terms of health hygiene they followed personal hygiene moderately. In maintain cleanliness of equipment washing with warm soapy water is only 26%. The study was concluded that food safety standards are greater followed by household women rather than vendors.

Keywords: Street Foods, Vendors, Food Safety Standards, Hygiene Practices, food borne disease.

FSPT: 60.

NUTRACEUTICAL AND NUTRITION SECURITY FOR FOOD AND HEALTH

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Nutraceutical is the hybrid of two terms, 'nutrition' and 'pharmaceutical'. Nutraceuticals is a food or may be a part of food that provides medical or health benefits which results in the prevention and treatment of diseases by increasing immunity. The food products used as nutraceuticals can be categorized as dietary fibre, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants and other different types of herbal/ natural foods. These nutraceuticals fight against some of the key health problems such as obesity, cardiovascular diseases, cancer, osteoporosis, arthritis, diabetes, cholesterol etc. Nutraceuticals cover a wide range of products, from sports drinks available on supermarket shelves to prescription drugs for patients with serious medical conditions. Nutraceuticals are critically important for improving food security and nutrition in sustainable agriculture. For upcoming generations, human nutrition is one of the most important areas of investigation, with wide-raging implications for consumers, health-care providers, regulators, food producers and distributors which is possible by development and use of nutraceuticals. It is used as an alternative for pharmaceuticals which provides health security by decrease in the consumption of medicines. Research and growth of nutraceuticals is of utmost importance as the challenges for fulfilling the need of food for increasing population and their nutrition security are increasing day by day. Another principal reason for the growth of the nutraceutical market worldwide are the current population which is being more conscious about their health and also the change in health trends.

Keywords: Nutraceuticals, sustainable agriculture, health and food security.

FSPT: 61.

PROCESS OPTIMIZATION FOR THE MANUFACTURING OF MANGO ENRICHED ICE CREAM

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Ice cream is a sweetened frozen food product that may be considered as an excellent vehicle for the nutrient fortification by adding different fruits as it contains milk protein, fat, skim milk powder, cream, sugar, stabilizer and emulsifiers. Now-a-days the demand for product diversification has encouraged the development of traditional frozen dairy product like ice cream. So, the present study was conducted to increase the functional value of ice cream by incorporation of mango pulp that makes it more interesting which would help the organized sector to undertake

commercial production and marketing of ice cream. During the preparation of Mango enriched ice cream, fresh ripened fruit pulp was used at the rate of 6, 8, 10, 12 and 14% of the ice cream mix and Sensory analysis techniques have developed into powerful tools for understanding the effect of different rate of mango pulp addition in ice cream, for this expert panelist were asked to evaluate the samples on a nine point hedonic scale, where a score of nine represents 'extreme liking' and one denotes 'extreme disliking'. It was used for colour & appearance, flavour, texture, sweetness, melting property and sweetness. It was found that ice cream containing 10% mango pulp had the highest score for colour and appearance, flavor, body and texture, melting quality and sweetness. The overrun % of ice cream was ranged from 42.5 to 48.6 and ice cream containing 10% mango pulp had highest overrun score i.e. 48.6%. Thus, on the basis of above findings, manufacturing of Mango Enriched Ice Cream is being recommended for commercial production purpose to obtain value added Ice cream.

Keywords- diversification, traditional, sensory analysis, hedonic scale, overrun

FSPT: 62.

STUDY ON THE DIETARY PATTERN & NUTRITIONAL STATUS OF LACTATING MOTHER AND DEVELOP DIETARY AWARENESS

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As the nutritional requirements are maximum during lactation, the diet should be balanced and meet the daily physiologic requirement. Lactating mother from low socio economic settings are considered as nutritionally vulnerable group. The main objective of the study is to access the dietary pattern and nutritional status of Lactating mother. A community based cross sectional study was conducted on hundred lactating mother of several villages of Kandhamal district, Odisha. Data on socio demographic characteristics, anthropometric mesurements, frequency and pattern of dietary intake was collected using self structured questionnaire. Anthropometric measurements were taken and BMI was calculated to know the health status. The dietary pattern and food intake was accessed using 36 hours recall method. The nutrients and energy content of foods consumed by the mothers was calculated by using food composition table given by NIN (ICMR). Most of the lactating mother was taking low amount of energy, protein, calcium and iron in comparison to the RDA. The intake of food was low both in quantity and quality. Also 54% of respondents were unaware about their diet during this period. The study reveals that low socio-economic status, less availability of food in that locality, unawareness on nutritional needs and requirements leads to low intake of food, play a major role in low nutritional status of the mothers. The need of dietary awareness and monitoring the practices of good dietary habits are essential in rural areas to maintain good health.

Keywords- BMI, Anthropometric measurements, 36 hour recall methods, RDA

FSPT: 63.

POST HARVEST MANAGEMENT OF AGRICULTURE PRODUCE

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In agriculture, postharvest handling is the stage of crop production immediately following harvest, including cooling, cleaning, sorting and packing. Postharvest treatment largely determines final quality, whether a crop is sold for fresh consumption, or used as an ingredient in a processed food product. Postharvest activities include harvesting, handling, storage, processing, packaging, transportation and marketing. India is the second largest producer of vegetables and fruits after China. In India 25-30% of horticulture produce, 10-25% of vegetables and 30-40% of flowers losses occur due to improper post-harvest management. Vegetable and fruits are available only in a particular

season therefore, to fulfill the requirement and permote the availability throughout the year need its post-harvest management. Horticultural produce including flowers also earns good in export earnings for the country. The minimization of these post-harvest losses may be reduced by extending the shelf life of fresh horticultural produces either through pre or post-harvest management practices or by processing it into different value added products. By adding value to farm products, this food processing sector is seen as a key element for rural growth, as well as a way to enhance farm income and provide rural job. It is envisaged that India should be the food factory of the world so as to generate income, employment and foreign exchange in a big way, through significant increase in level of processing and achieve higher growth through value addition.

Keywords: Post Harvest Management, Self- life, Employment, Value addition, Food processing

FSPT: 64.

NUTRITIONAL ANEMIA, A NEGLECTED PUBLIC HEALTH PROBLEM IN MARRIED WOMEN (NON-PREGNANT/NON LACTATING) OF REPRODUCTIVE AGE GROUP IN SELECTED ZONE OF AN URBAN INDIAN CITY VADODARA, GUJARAT

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Anemic mothers are at greater risk of delivering premature and low-birth-weight babies who have an increased risk of dying. Prevention of anemia in non-pregnant women (preconception) could improve the health status of the pregnant women, with reduction of both maternal and perinatal mortality. Purposive selection of the western zone of an urban city of India (Vadodara, Gujarat) and its 1 Urban Health Center (UHC) was done. Anganwadi of Navawas of selected UHC was also purposively selected to get a sample size of 250 married women (NP/NL) of the reproductive age group (calculated based on 19% prevalence of undernutrition reported as per NFHS IV, with 95% CI & 5% Precision). All married women (NP/NL) of reproductive age group residing in slums, who were planning to have a child or were using temporary family planning methods & gave written consent were enrolled for the study. Hemoglobin status, mean intakes of iron rich foods in 9 food groups namely grains, white roots, tubers & plantains, pulses, fruits & vegetables, fats & oils, sugars, meat, poultry, fish & eggs, nuts & oilseeds, dairy & discretionary foods was assessed by 24 hours dietary recall method to compute the consumption of each food groups in gms/CU/day. More than half (54.7%) of the subjects were found to be anemic, with 23.4% mildly anemic (11-11.9g/dl), 26.04% moderately anemic (8-10.9g/dl) and 4.69% severely anemic. Knowledge about anemia was poor (69.6%), with 48.8% of the subjects being aware of IFA supplementation for the control of anemia. Majority (90.4%) did not consume IFA regularly, where 63.2% responded non availability of IFA tablets as the reason for irregular consumption. Counselling by ASHA on IFA intake was poor (26.4%). Deworming tablets delivery was almost absent (98%). Based on the 24 hour diet recall the mean daily iron intake from food groups was reported to be 4.925 ± 1.28. Minimum Dietary Diversity Score (MDD-W) was that majority (52%) of the women did not consume 4 food groups daily, making them vulnerable for micronutrient deficiencies. The study demonstrates that controlling anemia in reproductive age group populations has remained a neglected area, inspite of the existence of National Iron plus initiative (NIPI) which adopts a life style approach. Ensuring regular supply of IFA with greater focus on education for regular consumption of IFA and preventing its side effects are simple interventions that need to be delivered at scale to overcome the problem of nutritional anaemia. Government initiative to supply double fortified salt in nutrition supplementation programs and in PDS has the potential to overcome the problem.

FSPT: 65.

CULTIVATION OF MEDICINAL AND AROMATIC PLANTS TO IMPROVE THE INDIAN ECONOMY

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India is one of the World's leading biodiversity centres, encompassing over 400 habitats of specific species, with ~ 20% of the global species (~ 45,000 plant species). However, several species have become rare, threatened or endangered ones, owing to over-exploitation. Problems arising due to rapid genetic loss of medicinal plants have forced the need for international co-operation and co-ordination for the conservation of medicinal plants to ensure availability of adequate quantities for future generations. There is ample scope of improving the quality of the drugs by cultivation of medicinal and aromatic plants (MAPs). Presently, there is an increasing world-wide need of the plant-based products, viz., medicines, health products, pharmaceuticals, food supplements, cosmetics. The annual world market of medicinal plants is over 60 BUSD, which is growing annually at the rate of 7 %. India is one of the major exporter of crude drugs, with annual export of herbal raw materials and medicines worth ~ 100-114 MUSD. India's share of the global market is ~ 2% and hence, there is enormous scope to exploit the export market.

A cultivator of medicinal and aromatic plants wishes to be sure of his benefit. A medicinal or aromatic crop, on proper selection of varieties, often leads to an economically viable plantation. Profitable commercial cultivation of MAPs is the outcome of implementation of a number of factors, namely, location, good genetically stable planting materials, good agro-technological practices, nutrient inputs, harvesting management and implementation of suitable post-harvesting techniques to preserve the end products till the smart and effective marketing arrangements are made. Cosmetic industry and aroma therapy are two important areas where Indian herbals could contribute to economy. Names of some worth mentioning commercially important species are, Aloe spp., Rose spp., Chamomile spp., Ocimum spp., Lawsonia innermis, Mesua ferra, Calendula spp., Lavendula spp., Mentha arvensis.

Keywords: Medicinal plants, improving Indian economy, conservation of medicinal plants, world market of medicinal plants, Indian export of herbal products, economically viable medicinal plants

FSPT: 66.

FOOD SECURITY IN INDIA UNDER CLIMATE CHANGE

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Climate change is a threat to mankind. Since the end of the nineteenth century the earth's average surface temperature has increased by 0.3–0.6°C. Over the last 40 years, the rise has been 0.2–0.3°C. Recent years have been the warmest since 1860, the year when regular instrumental records became available. Recent efforts to project the effects of current national policies indicate that there is about a 40 percent chance of exceeding 4°C warming above preindustrial levels by about 2100. If present temperatures were to be maintained, the world would be devoted to around 2.3 m of sea-level rise over the next 2,000 years. On the other hand, sea levels would rise to around 3.6 m under a 2°C warming scenario and to approximately 8 m over the same period under a 4°C scenario. It is also important to note that greenhouse gas emissions and concentrations leading to a warming of 4°C by 2100. Due to these changes, there will be negative impacts on the four dimensions of food security i.e. food availability, food accessibility, food utilization and food system stability. Indian agriculture is extremely vulnerable to weather and climate. Climate change has added to the enormity of India's food-securitychallenges. While the relationship between climate change and food security is complex, in certain places it benefiting while in other way drastically threatening the food as well as nutritional security in India. Food security is a situation that exists when all people at all times have physical, social, and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an

active and healthy life. Continuously changing climate threatening the heart of the Sustainable DevelopmentGoals (SDGs) which targets to end hunger, achievefood security, and improve nutrition. For India, food security continues to be high on its list of development priorities because the country'srelatively high rates of economic growth havenot led to a reduction in hunger andundernutrition.There is an increasing concern about the economic impact of climate change on agriculture.In many parts of India, episodic droughts and cyclonic storms have become more frequent. Monsoon seasonal rainfall has decreased by 6 to 8% of the regular in eastern Madhya Pradesh, north-eastern India and several parts of Gujarat and Kerala over the past century. Storms have become more common in India, especially in West Bengal, Odisha and Gujarat. They have increased at a rate of 0.011 events per year. In addition, sea level has risen between 1.06 to 1.75 mm per year. Such varying climatic patterns will dominate India even towards the end of the 21st century. India will experience deep rainfall, leading to enormous soil erosion and landslides. The intensity of rainfall will increase by one to four mm per day. But it is seen that the intensity of rainfall will increase in rain abundant areas, leading to flooding and loss of fertile soil. Areas like Rajasthan, Madhya Pradesh, Gujarat, and Andhra Pradesh are drought prone which will receive less rainfall, resulting in severe droughts. Furthermore, India's rising surface temperatures over the years will rapidly meltdown the Himalayan glaciers. India has many reasons to be worried about climate change because a majority of the people depend on climate sensitive sector *i.e.* agriculture, forestry, and fishing for livelihood. If not addressed in time, the existing problem of food security in our country will become more severe due to change in the climate. For us, it will become more difficult to ensure food security under the changing climate where more than one-third of the population is estimated to be extremely poor and one-half of all children are malnourished in one way or another.

FSPT: 67.

ASSESSMENT OF FOOD SAFETY AND HYGIENE IN AN INDUSTRIAL UNIT

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Now a days Food safety handled and controlled by three basic essentials, control hazards related with the initial processing environment faculty systems maintain the maximum hygiene practices. This study is focus on overall food production conditions in a particular food production Centre. A cross – sectional study was done on 100 respondents (Food handlers) selected randomly residing in Jamui Sharia Modern Grow Food Preservation center of Varanasi. Self-constructed questionnaire were used for data collection. The study was analyzed by percentage. It was observed that center was monitored and checked in every 4-6 month regarding its food safety but the respondents were not aware about HACCP. Most of the respondents have knowledge about basic hygiene practices but few of the respondents implemented that.

Keywords: Quality, Food safety, HACCP, Environmental hazard.

FSPT: 68.

VALUE ADDITION OF MINOR FRUITS

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India has a wide range of climate and soils which allows cultivation of many varieties of fruit crops. The varying weather of this country provide suitable environment for growing variety if fruits. The fruits are available in abundance & also in different season. This has resulted in limited scope for expansion of other minor crops. Underutilized fruit crops are those of local or regional importance, but generally lack national recognition, although they are rich source of antioxidants and minerals. Lack of interest on underutilized crops may be due to astringency,

acidic nature of fruits like the aonla, bael, karonda etc. Value addition of this fruits can help to meet the nutrition requirement of the people & economic sustainability.

Keywords: Minor fruits, value addition, processing.

FSPT: 69.

NUTRACEUTICAL: AN ECOFRIENDLY APPROACH FOR SUSTAINABLE AND HEALTHY LIFE

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A rapidly growing global population, an industrialized food system is leading to over consumption and undernutrition. A changing climate and degrading environment are pushing the limits of what Earth can sustain. These conditions have raised the global burden of disease. Nature is one of the most important resources of human foods and medicinesNutraceuticals are basically the hybrid of 'nutrition' and pharmaceutical'. Nutraceuticals, in broad, are food or part of food playing a significant role in modifying and maintaining normal physiological function that maintains healthy human beings. Now a day every person wants to live the healthy life. Synthetic medicines are having some harmful effects on human health as well as on ecosystem. Now nutraceuticals can be used to improve health, delay the aging process, prevent chronic diseases, increase life expectancy, or support the structure or function of the body without harming our environment.

Therefore, nutraceuticals will definitely play promising and unique way of safer medicines. Rapidly increasing knowledge on nutrition, medicine, and plant has fortunately changed the concepts about food, health and, brought in a revolution on them. Nutritional therapy and phototherapy have emerged as new concepts of safer medicine. These systems have quickly and widely spread in recent years. Strong recommendations for consumption of nutraceuticals, natural plant foods, and the use of nutritional therapy have become progressively popular to improve health, and to prevent and treat diseases. Nutraceuticals used in various diseases, Alzheimer's disease, cardiovascular disease, obesity, cancer, eye cycle, diabetes. The use of the dietary fiber, omega 3 fatty acid, antioxidant, probiotic is for the better human life possible. It summarizes the progress made on nutraceuticals, nutritional therapy, health benefits, regulation and their promising approach. Thus, Nutraceuticals can help us to achieve an ecofriendly approach to maintain healthy life.

Keywords: Nutraceutical, Nutrition, Pharmaceutical, Probiotics etc

FSPT: 70.

PROSPECTS OF NUTRACEUTICAL, FUNCTIONAL FOOD FOR FUTURE USE

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The term nutraceutical is a hybrid or contraction of nutrition and pharmaceutical its definition was any substance that may be considered a food or part of a food and provides medical or health benefits, including the prevention and treatment of disease. Such products may range from isolated nutrients, dietary, supplements and diets to genetically engineered designer foods, herbal products, and processed foods such as cereals, soups, and beverages. Functional foods are foods or dietary components that may provide a health benefit beyond basic nutrition. The health promoting effects of phyto - chemicals and nutraceuticals and or functional foods likely are due to a complex mix of biochemical and cellular interactions which together promote overall health of the individual. There is growing recognition of the potential role for nutraceuticals and dietary supplements in helping to reduce health risks and

improve health quality. The present herbal nutraceuticals effective on hard curative disorders related to oxidative stress including allergy, alzheimer, cardiovascular, cancer, diabetes, immune, inflammatory and Parkinson's diseases as well as obesity. Nutraceuticals cover a wide range of products, from sports drinks available on supermarket shelves to prescription drugs for patients with serious medical conditions.Functional foods are found virtually in all food categories, however products are not homogeneously scattered over all segments of the growing market. In the global marketplace nutraceuticals and functional foods have become a multi-billion dollar industry. Nutraceutical and functional foods great demand in future as health benefit.

Keywords: Nutraceutical, functional food, pharmaceutical, disease and health benefit

FSPT: 71.

DEVELOPMENT OF CURCUMIN – STARCH NANOCOMPOSITE AND ITS COMPARISON WITH STARCH FILM

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Currently there has been a much interest in edible film made from renewable and natural polymer such as protein, polysaccharide and lipids. The use of these materials, due to their biodegradable nature, could at least solve the waste problem at some extent. Packaging is an important protection for foods, preventing contamination, and maintains conditions of hygiene. It works as a barrier against external contaminants, mainly pathogens found in the environment. Nano-food packaging materials may extend food life due to high barrier properties and improve food safety. This research work includes the curcumin nanoparticle synthesis by microfluidization process. Size of Curcumin sample was 160.100 ± 6.151 nm and after one pass, three pass and five pass of microfluidization, the size of curcumin nanoparticle became 151.800 ± 6.954 nm, 81.090 ± 1.369 nm and 80.177 ± 1.793 nm. respectively. Edible film was prepared using starch as base material. Curcumin nanoparticle was incorporated in the film and physicochemical properties of curcumin incorporated film was compared with starch film. Curcumin nanoparticle incorporated film exhibited antimicrobial properties towards *Bacillus subtilis.* Zone of inhibition was 14mm in curcumin incorporated starch film.

Keywords: Curcumin Nanocomposite, Microfluidization, Antimicrobial Packaging, Starch film

FSPT: 72.

ADVANCES IN FOOD SCIENCE AND POST HARVEST TECHNOLOGY

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The purpose of this study was to identify a number of critical issues concerning influencing food security. Embedded within the narrative is a critical concern for reducing food process and enhancing value addition. Preservation and safety of the product are important at both the house hold and market level. This has greatly improved the handling and the quality of food crop and contributed significantly to improving nutrition and national level development. Improvements have been made in many aspects of post harvest technologies and handling of perishable food. Including harvesting indices, harvesting methods, pre cooling methods and applications, storage techniques, packing and packaging, quarantine systems, transport system especially by road and sea, has been modified. The increasing demand for healthy food has spawned a lot of research in developing technologies around food processing and preservation.

The problems in developing countries are very complex in nature, and are not only due to technical reasons.

However, from the technical stand point there are diverse problems related to 'unavailability of adequate technologies', 'Unfamiliarity with available adequate technologies', 'inadequate use of or difficulties in adaptation of available proper technologies'. The use of traditional storage technology has many problems, including mould development and the failure to regulate temperature and moisture. In this regard there is a need for advanced storage facilities, such as metal silos, which efficiently reduce pathogen losses in grain. The food and agriculture organization(FAO) of the United Nations defines food security has a condition where all people have physical, social and economic access to sufficient, safe and nutritious food which meets the dietary needs and food preference for an active and healthy life at all times. This is not only a loss to the growers but a net loss of huge human nutrition and wastage of inputs involved. These losses can be minimized to a considerable surplus with timely and safe management of post harvest produce.

Keywords: Post-harvest; Food security; Food sovereignty; Value addition; Food losses.

FSPT: 73.

CONSUMER PREFERENCE AND CONSUMPTION OF ORGANIC FOOD PRODUCT

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Organic production is an overall system of farm management and food production that aims sustainable agriculture with high quality products. Organic agriculture is different from environment type of farming system as it follows the rule of sustainability by using natural inputs, environment friendly techniques e.g. intercropping, crop-rotation machine etc. the recognition of organic farming is increasing day by day and is now practiced in almost all countries of the world. This study was conducted to know the preference and consumption of organic food products. Chhittupur and Chitaipur area of Kashividyapeeth Block of Varanasi District was taken purposively for the present study. Total numbers of 100 respondents were taken with the help of systematic random sampling method. Result shows that organic food product is relatively new to consumers. However, majority of the consumers are aware and understand about organic products.

Keywords: Sustainable agriculture, Environment, Farm management, Organic production.

FSPT: 74.

DEVELOPMENT OF WATER SPINACH POWDER AND ITS NUTRITIONAL ANALYSIS

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The study was performed on Water spinach (*Ipomea aquatica*), a hidden gem with lots of nutritional attributes and medicinal properties. The plant has originated in Southeast Asia. In USA it has been declared as noxious but it has a good market in Honkong, China and Indonesia however in India it is underutilized and is used mostly by poor people. To check its feasibility in other products and to know its nutritional attributes, powder was made by drying the leaves and stems of the plant using different drying technique such as Sun drying, Lyophilize drying, Tray drying. The physico-chemical analysis of powder was done to get a comparative result in which the lyophilize dried powder has the most significant result. The physico-chemical property revealed a good amount of carbohydrates (58.15%), Ash (12.39%), protein (4.01 %) and fat (4.46 %) contents. The plant posses a high antioxidant property of 77.25% and a total phenolic content of 40µg/ ml. The ICPMS(Inductively Coupled plasma mass spectroscopy) process done revealed an iron content of 181600 ng/ g. The study concluded that the water spinach is the cheapest and abundant

source of nutrients that can be used to fight malnutrition, anemia and other diseases in our country by giving this plant a good position in green leafy vegetables and not treat it merely as weed.

Keywords: - Drying technique, lyophilize drying, ICPMS, Total phenolic conent, Tray drying

FSPT: 75.

NUTRACEUTICAL AND NUTRITION SECURITY FOR FOOD AND HEALTH

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Nutraceutical is a hybrid word of "nutrition" and "pharmaceutical," introduced by Stephen L. DeFelice in 1989. Hence "nutraceuticals" is a substance that may be considered as a food or part of food which provide medical and health benefits apart from providing basic nutrition. Nutraceuticals are various substances like functional food, functional beverage and dietry supplements like nutrient derived from food product. Examples of nutraceuticals are natural foods, including antioxidants, fortified dairy products and vitamins, minerals, herbals, milk, and cereals. Among them, "vitamin-enriched" health-promoting products and also fresh foods like vegetables, fruits, fruits and fermented foods populated with live cultures can also be considered to be functional foods with probiotic benefits. Potential nutraceutical approaches towards health and medicinal benefits while nutraceuticals become established nutraceuticals only after there are sufficient clinical use to demonstrate a benefit. Nutraceutical using frequency is approx. 50-70 % in developed country and the number is increasing rapidly because of public perception that "natural is good", consumers dissatisfied with drug cost, desired for personalised medicine and getting focus on preventing medicine. About 20-30% population consume multivitamin supplement daily which indicate high public interest in prevention of disease through approach based on nutrition.Nutraceuticals are a leading trend in healthcare medicines in the market and are at the intersection of food and pharmaceutical industries. Due to changing lifestyle and growing disposable income leading to change in the habit of dietry pattern which is likely to increase rapidly the demand for nutraceutical product.

Keywords: Neutraceuticals, nutrition, pharmaceuticals, dietry and medicine.

FSPT: 76.

SUSTAINABLE AGRICULTURAL DEVELOPMENT FOR FOOD SECURITY AND NUTRITION IN LIVESTOCK

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Agricultural development plays a major role in improving Food Security and Nutrition by increasing the quantity and diversity of food as a driver of economic transformation and because agriculture is the main source of income for a majority of the people who live in the most extreme poverty. Earning sufficient income from agriculture is key for the 1.3 billion people who work in the sector, and directly determines their food security. Livestock production is central to food systems development and is a particularly dynamic and complex agricultural subsector, with implications for animal-feed demand, for market concentration in agricultural supply chains, for the intensification of production at the farm level, for farm income, land use, and for nutrition and health. Livestock has often set the speed of change in agriculture in recent decades. While food security concerns historically focused on total calorie intake, today they encompass the so-called "triple burden" of malnutrition, hunger (deficiencies in dietary energy intake), estimated by FAO to affect some 792 million people worldwide, micronutrient deficiencies (such as iron, vitamin A, iodine and zinc), which, according WHO, affect some two billion people and increasing overnutrition that now affects more

people than hunger does. Resource efficiency in livestock production will have to be improved in order to maintain production systems within critical planetary limits, preserve the ecosystem services on which agricultural production relies, and reduce land degradation, biodiversity loss and pressure on water use and quality. According to the World Development Report, agriculture provides employment to 1.3 billion people worldwide, 97 percent of them in developing countries. Women play a vital role in the management of many livestock systems, especially poultry and pigs.

FSPT: 77.

MICROGREENS: AN ASSESSMENT OF KNOWLEDGE, AWARENESS & PRACTICES AMONG URBAN WOMEN OF VARANASI

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As the world population rising gradually and unapproachability of fresh, healthy & pesticide free vegetables for consumption is the major issues at present time. In order to feed world's rapidly growing residents it's very important to promote environmental sustainable crop production to maintain food & nutritional security. So, microgreen are came into light as new class of green leafy vegetables, harvested at immature stage between 7 to 21 days of seedling used as salad, garnishing, soup & with another dishes. It can be grown with or without soil in trays or food containers at household level. The term microgreens is not much popular in many developing countries including India though it have high nutritional density than mature counterpartss. This study was undertaken to observe the awareness of urban women about microgreens. A cross sectional study was done in susuwai area , vidyapith block of Varanasi . Total 70 women were selected randomly. Self-constructed questionnaire were administered for data collection. Result of the study shows that 91.42% respondents have not any idea about microgreens, but 82.5 % respondent were highly interested for growing microgreens. So , the study concluded that there is strong need to conduct educational intervention programme regarding growing and consumption of microgreens.

Keywords: Vegetable herbs, antioxidants , Green Salad, feed, food and nutritional security.

FSPT: 78.

IN-VITRO ANTIOXIDANT ACTIVITY IN METHANOL EXTRACTS OBTAINED FROM THE SEED KERNELS OF LOCALLY PRODUCED MANGO (*Mangifera indica* L.) IN EASTERN UTTAR PRADESH

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Now a day, bioactive compounds such as polyphenols, flavonoids, carotenoids, anthocyanin, etc., presents in fruits and vegetables are receiving much attention due to their potential antioxidant activity. Consumption of such antioxidants rich fruits and vegetables offers health benefits including protection against a number of diseases such as cardio-vascular diseases and cancer. Seed kernel of mango (*Mangifera indica* L.) is a major byproduct obtained during processing of mango. In the present study, an attempt was made to evaluate the antioxidant activity in methanol extracts obtained from seed kernels of eight varieties of *M. indica* using different *in-vitro* methods such as by 2, 2-Diphenyl-1-picrylhydrazyl (DPPH), 2, 2-Azino-bis 3-ethylbenzthiazoline-6-sulfonic acid(ABTS) and ferric-reducing antioxidant power(FRAP). The results showed that total phenolics and flavonoids contents in tested varieties of *M. indica* ranged between 114.04 mg GAE/g DW to 139.46 mg GAE/g DW and 5.72 mg QE/g DW to 8.34 mg QE/g DW, respectively with maximum in Totapuri (139.46 mg GAE/g DW) and Dashehari (8.54 mg QE/g DW), respectively. The results further showed that maximum antioxidant activity tested in terms of DPPH, ABTS and FRAP were found in Lalaram (92.33%), Mallaika (95.02%) and Sukul (24.04 µM Fe(II)/g DW), respectively. The IC_{50}

values in tested seed kernels were found to be range from a minimum of 50 µg/ml to maximum of 90 µg/ml. From the above data, the present study concludes that seed kernels of mango is a rich source of natural polyphenols as well as possesses potent antioxidant activity. Therefore, the seed kernels of tested plants may be used for extraction of nutraceuitcals and health benefits by pharmaceutical industries and local people, respectively.

Keywords: Total phenolics, Total flavonoids, Antioxidant activity, IC_{50}, *Mangifera indica*

FSPT: 79.

INTRODUCTION OF PUSA CONCENTRIC ONION STORAGE STRUCTURE IN DISTRICT KANPUR NAGAR (U.P.)

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Onions (*Allium cepa* L. cepa) are a major source of flavoring in fresh and cooked food, and are the second most important horticultural crop after tomatoes. They are used, produced and traded worldwide. Bulb onions vary in flavor from very mild to extremely pungent when tasted uncooked (Crowtherd et al., 2005). Onions are an important vegetable world-wide, ranking second among all vegetables in economic importance with an estimated value of $6 billion dollars annually. While onions contribute significant nutritional value to the human diet and have medicinal properties, they are primarily consumed for their unique flavor or for their ability to enhance the flavor of other foods. Area under onion crop is increasing day by day in district Kanpur. Farmer usually sells all the produce except leave some portion f or household use. Since Farmers use to spread it on floor, onion used to starts rotting soon. Hence, to address this issue PUSA Concentric Onion storage structure were introduced and their efficacy was tested against farmers practice. An On Farm Trial was conducted in Village Basen and Kurmikhera of District Kanpur under Home science unit of KVK Kanpur Dehat. Size of structure was kept 2. X2.5X8.5 (LXBXH). Technology proved highly efficient as weight loss under structure was 9.00 per cent with comparison to farmers practice of spreading on floor/ or keeping on bamboo basket. Average rotting occurred in 11.20 percent onion kept in structure while it was 23 percent in farmers practice. But availability/ fabrication was a big challenge in popularization of technology. It is recommended to train local artisans so that structure can be fabricated at local level.

Keywords: Onion, Rotting, Storage Structure, Perishable, Flavour, Concentic

FSPT: 80.

ADVANCES IN FOOD SCIENCE AND POST-HARVEST TECHNOLOGY

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Importance of agricultural biodiversity is realized as it ensures the production of food, fibre, fuel, fodder, etc. maintain other ecosystem services and sustain rural people's livelihoods. Advances in Post-harvest Technology of crop produce in order to increase their shelf life have a major role in sustainable agricultural development. Post-harvest treatment largely determines final quality, whether a crop is sold for fresh consumption, or used as an ingredient in a processed food product. The most important goal for post-harvest handling are keeping the product cool, to avoid the moisture loss, and slow down undesirable chemical changes, and avoiding physical damage such as bruising, to delay spoilage. There are a large number of factors that govern the keeping quality of agricultural produce, that can be classified under pre-harvest, harvest and post-harvest factors. These factors if not controlled properly, lead to post harvest losses on large scale. Minimally processed fresh produce is one of the fastest growing sectors of food industry. Different minimal processing methods can be applied at the various steps in the food distribution chain, from storage of agricultural products to packaging/processing of the ready-to-eat product. Demand for safe, minimally processed food products represents crucial challenges for the food-packaging industry with the idea to design and produce novel packaging solutions able to maintain the safety and quality of products.

Keywords: Post-harvest technology, shelf life, factors, minimally processed products, food distribution, packaging, quality

FSPT: 81.

FOOD SECURITY AND SUSTAINABILITY IN INDIA

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The problem of food security is de facto and global. While we look at the financial crisis we cannot ignore the almost forgotten food crisis. India has revolutionized its agriculture but there is the phenomenon of Food Mountains and lakes alongside poverty, malnutrition and ill-health. For an emerging economy of India food insecurity is both an immediate tragedy and a threat to long-term well-being. Eradicating hunger and ensuring higher quality foods is not going to be easy even as agriculture is affected by climate change. However, agriculture forms part of the solution to climate change also. While we expect 'more' from agriculture we also need to accept the fact that agriculture by itself is unlikely to be able to eradicate hunger completely. Alternative strategies need to be (re)searched and adopted, quickly and safely. People should be able to buy enough food, not necessarily that they become self-sufficient. Need for a new matrix of food economics is apparent. Security also means safety for the consumers and the environment, now and in the future. Questions of ecological fallout cannot be brushed aside in futuristic strategies for the country's food security. Food security has implications also for people who are producers of food both at the farm and non-farm levels. Agriprenuers and all connected with the food, nutrition and health sectors are vital actors in the field game. This paper tries to analyse the problem of food security from a multi-dimensional perspective with emphasis on the aspects of poverty and sustainability. Besides looking at the varied dimensions of food security, the paper also evaluates the present polices and possible options.

Keywords: Food, Climate Change, Agriculture

FSPT: 82.

FOOD SECURITY AND SUSTAINABLE AGRICULTURAL DEVELOPMENT IN INDIA

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Food security is the ability to provide enough food to the entire population of a particular state or country at all times. The paper discussed the concept of food security, various ways, policies and strategies to be embarked upon by the government for sustainable agricultural development to ensure adequate food security. The need for agricultural sustainability was examined. It also discussed the socio-economic implication of sustainable agriculture and its challenges. The paper recommends an improved policy execution, monitoring/ evaluation and support to agriculture by the Federal government as the measures for a sustainable agricultural development in India.Every human being needs food not just for energy giving but to sustain life in general. The issue of food security should not be over emphasized because of its necessity to life through a sustainable agricultural development. Agriculture was the major source of the country's economy and source of foreign exchange before the era of oil discovery in Nigeria. It was after the discovery of oil that the agricultural production gradually dropped and lesser attention given to it by the federal government, this led to the challenge of food insecurity, unemployment and youth restiveness at Niger Delta communities where oil is explored and agaric farm destroyed.

Keywords: Climate Change, Sustainable Agriculture, Food security.

FSPT: 83.

SUSTAINABLE AGRICULTURAL DEVELOPMENT FOR FOOD SECURITY AND NUTRITION

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Sustainable Agricultural development for food security and nutrition" requires considering the dynamics of agricultural development: what it does, the outcomes, and how it performs vis-à-vis the two key objectives of sustainability and FSN. Agricultural development has a key role to play in relation to poverty reduction, in the context of economic development and growth as a whole. Also, given the economic and social importance of agriculture, which provides a livelihood to 38.3 percent of the world total labour force (FAO, 2015a), and the importance of food as a basic human need, agricultural development is a key domain for the universally agreed human rights framework, including the progressive realization of the Right to Food. Considering the crucial importance of agricultural development to ensure FSN, to reduce poverty, and to ensure sustainable management of natural resources, SAD is central for the implementation of the 17 Sustainable Development Goals (SDG) agreed in 2015.What are the relationships between food security, sustainable food systems and sustainable agricultural development? In line with HLPE (2014), "Sustainable food systems are food systems that ensure food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition of future generations are not compromised.

Keywords: Sustainable agriculture, climate change, FSN

FSPT: 84.

IMPACT OF NANO ZNO ON GROWTH AND PHOTOSYNTHETIC EFFICIENCY OF RICE SEEDLINGS: QUALITY AND PRODUCTIVITY ASSESSMENT

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Nanotechnology opens a large scope of novel application of nanoparticles in the fields of agricultural as they have unique physicochemical properties such as high surface area, high reactivity and particle morphology. In the present study also application of nano-form of ZnO and their effects were compared with its corresponding doses of bulk form by growing *Oryza sativa* (rice) plants in hydroponic condition. The growth medium is treated with ZnO as bulk and its nano-form having different doses i.e. 50, 100, 500 and 1000 ppm. Rice seedlings treated with nano form of ZnO showed better response compared to the seedlings treated with its bulk form. Among the treatments of nanoform, maximum growth ($\sim$ 50 %) was observed at lower dose (50 ppm) with the enhancement in photosynthetic O_2 evolution compared to the control and other higher doses. Further, changes in PS II photochemistry, OJIP Chl-*a* fluorescence transients kinetics and energy flux per reaction center were also estimated. It showed that the values of PS II transient kinetics increased and values of energy fluxes decreased in rice seedlings treated with lower doses compared to the control and its bulk form. Higher dose of bulk as well as nano ZnO i.e. 500 and 1000 ppm showed detrimental effect on physiological attributes of rice seedlings, however nano form is less toxic than bulk form. Therefore, this study suggests that nano form of nutrient is more favorable than its bulk form for increasing the growth of plant in nutrient deficient conditions only up to certain level. However, an extensive study will be required to understand the mechanism behind this aspect.

FSPT: 85.

INNOVATION IN FOOD PROCESSING AND POST HARVEST TECHNOLOGY

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Food processing is the transformation of agricultural row products into food. India is the world's second largest producer of fruit and vegetable, are the main constituent of human feed. Our body gets many nutrients from these such as carbohydrates, vitamins, minerals, water & fiber. Great Variation in climate leads to higher production of the most fruits in over all India. Fruits spoiled quickly due to presence of water, which leads to fermentation by micro-organisms, using more enzymes and chemicals, changes fruit properties and taste. It is necessary to test them to avoid spoilage. Normally 20%-30% fruits are spoiled during transportation after production, before reach to consumers. Across the India 2% of fruits and vegetables are processed. Many different products can be made from the same fruit. Apart from India, in developed countries the lowest fruit processing is 50%-80%. By fruit processing, a common man can become entrepreneur and can provide employment to other people. There are 5 areas under food processing in India, in which the dairy sector, fruit and vegetable, processing of grains, meat, fish and poultry processing, consumer goods such as packaged food and beverage.

Keywords: Food, Processing, Fruits, Vegetables, India

FSPT: 86.

POST-HARVEST TECHNOLOGY PROMOTING NATIONAL DEVELOPMENT

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There is no clear definition of the term 'developing countries' (DC), which encompasses a wide range of countries with diverse challenges. Rising incomes and widespread urbanization have been the most important determinants behind the increase in food consumption, especially fresh fruits and vegetables, and have also increased the importance of postharvest handling of fresh commodities. The application of refrigeration, packing and packaging, transportation, modified (MA) and controlled atmospheres (CA) have improved significantly over the last 2 to 3 decades. However, the establishment of an adequate 'cold chain 'remains the major obstacle facing the handling of foods in general and fresh commodities in particular. More improvements in other handling techniques are also still needed. Following the trend in developed countries, consumer interest in functional foods has been increasing in some DC, and will continue to increase. The situation in DC is very different from one country to another. As food resources are limited, not only new technologies, but also conventional technologies have to be mobilized to help solve complex problems. The food industry in DC especially that of the fresh horticultural crops industry, is faced with tremendous growth and market demand, both for the local markets and for export, but there is 2minimal or no regulatory action for enforcing minimum quality standards and implementing food safety.

Keywords: Post-harvest, Agriculture, Food.

FSPT: 87.

POSTHARVEST TECHNOLOGY IN IMPROVING NUTRITION

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There have been significant advances in postharvest research over the last few decades that have led to the development of a diversity of appropriate technologies in many countries including several developing countries. This has greatly improved the handling and quality of food crops, and contributed significantly to improving nutrition and national development. Improvements have been made in many aspects of postharvest technologies and handling of perishable foods, including harvesting indices, harvesting methods, pre-cooling methods and applications, storage techniques, packing and packaging, quarantine systems, transport systems especially by road and sea, modified and controlled atmospheres, etc. However, there is a persistent problem in most of the world (especially in many developing countries), where significant quantities of perishable foods are lost every year. Although postharvest R&D in several developing countries has improved significantly, many of the postharvest technological innovations are either not used or use in adequately. The problems in developing countries are very complex in nature, and are not only due to technical reasons. However, from the technical stand-point there are diverse problems related to unavailability of adequate technologies unfamiliarity with available adequate technologies inadequate use of or difficulties in the adaptation.

Keywords: Post-harvest, Agriculture, Food.

FSPT: 88.

POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

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Harvested fruits and vegetables require adequate and advanced postharvest processing technologies for minimizing the qualitative as well as quantitative losses after harvesting. Nearly 40% fruits and vegetables are wasted every year due to improper handling, storage, packaging, and transportation. Wastage of fruits and vegetables in huge amount due to un-implementation of advance postharvest technological approaches also reduces the per capita availability of fruits and vegetables. Intensive emphasis is required to develop the advance postharvest technologies for improving the global food security by enriching the economy of agricultural produce of the world with minimal losses of consumable fruits and vegetables. The present article discusses the common yet important postharvest technologies to maintain the quality of fruits and vegetables. Total vegetable and fruit production in the world has been estimated 486 million and 392 million tons, respectively and 30-40% of total production in developed country is spoiled due to lack of postharvest handling up to consumption. India is second largest producer of fruits and vegetables with first rank in production of ginger and okra, second in bananas, papayas, angoes etc. But in the case of developing country like India, the postharvest losses noticed close to 50% of the total fruits and vegetables production which badly affects the availability of fruits and vegetables.

Keywords: Vegetables, Agriculture, Food.

FSPT: 89.

AGRICULTURAL POST-HARVEST INNOVATIVE TECHNOLOGIES

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Limited capacity for post-harvest handling and processing often undermines the profitability of farming particularly during years of bumper harvest. Notably, the perishable nature of many agricultural products limits their access to profitable markets thus dwindling income of small farmers. Hence, enhancing post-harvest technologies is the critical strategy to add value to the food crops so as to increase price and move millions of African small farmers from poverty. As part of its initiatives, FARA through its developmental approach namely Integrated Agricultural Research for Development (IAR4D) has been working with small farmers through the Sub Saharan Challenge Program (SSA CP) to link them with markets that offers a better price which will help them to reap from farming activities. The SSA CP has promoted Innovation Platforms (IP) within which all concerned stakeholders develop innovative technologies, processes, institutions for improving the efficiency of value chains. This is done among others by initiating innovative post-harvest technologies which are appropriate to the conditions of the area and crop grown. These technologies serve twin purposes: the increased shelf-life of the product and enhancing accessibility to niche markets which offers higher prices. The objective of this paper is to assess the effect of Irish potatoes post-harvest handling (cleaning, sorting, grading, and packaging) on the price basing on experience from Gataraga.

Keywords: Post-harvest, Agriculture, Food.

FSPT: 90.

EFFECT OF COOKING METHODS ON PRODUCTS PREPARED FROM BROWN RICE VARIETIES

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Brown rice is a whole grain cereal produced by removing only the hull or husk using mortar-and pestle or rubber roller (dehuller) milling machine. It is known as pinawa in Pilipino but labeled either as brown, unmilled, or unpolished rice. The bran layer that is not removed gives the grain its brown color and retains its high levels of soluble fiber, antioxidants, and other vitamins and minerals. When the bran is removed, it becomes well-milled or white rice. The experiment was conducted in the Research laboratory of Foods Nutrition and Public Health, Ethelind College of Home Science, Sam Higginbottom University of Agricultural, Technology and Sciences. Products Idli and tikki were prepared from different varieties of brown rice, T1 (Basmati brown) and T2 (Jasmine brown) by using two cooking methods (baking and steaming). Organoleptic quality and nutritive value of the prepared products were evaluated. Sensory evaluation of prepared product was done by using nine point hedonic scale based score card. The Proximate analysis of the prepared products was done by standardized methods AOAC (2005).The experiment was replicated five times and the data obtained during investigation were statistically analyzed using analysis of variance (ANOVA) and critical difference (CD) techniques. From the results, it is concluded that brown rice can be used in place of white rice in Idli in order to enhancethe nutritive value. The product was acceptable on the basis of sensory evaluation. In Tikki treatment T2 (jasmine brown) was highly acceptable in terms of flavor, taste, color and overall acceptability, where as in idli the treatment T1 (basmati brown) was more acceptable than the treatment T2 in terms of flavor, taste, colour and over all acceptability. The treatment T1 of idli was prepared by steaming method and the maximum content of energy (368 Kcal/100g), protein (12.15 g/100g) and iron(5.64mg/100g) were found in treatment T1 of the idli and the treatment T2 of tikki was prepared by baking method and the highest content of fiber (1.92g/100g), carbohydrates (57.26 g/100g), protein(8g/100g) and fat (7.56g/100g) was found in T2 of tikki.

Keywords: Pestle, Proximate analysis, hedonic scale and antioxidants

THEME 3: ENVIRONMENT, SUSTAINABILITY & CLIMATE CHANGE (ESCC)

ESCC: 1.

CLIMATE CHANGE AND AGRICULTURE: IMPACT, ADAPTATION AND MITIGATION STRATEGIES

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India is a vast country covering 3.28 million km^2, occupying only 2.4 per cent of the world's geographical area but supporting 16.2 per cent of the global human population. It is endowed with varied climate supporting rich biodiversity and highly diverse ecology. More than sixty percent of its population is dependent on climate sensitive activities such as agriculture. Climate change projections made up to 2100 for India, indicate an overall increase in temperature by 2-4°C with no substantial change in precipitation quantity. The expected changes in climate, especially rainfall, are also marked by significant regional variation, with the Western Ghats, the Central Indian and the North Eastern regions projected to receive more rainfall compared to the other parts of India. Further, an increase in intensity and frequency of extreme events such as droughts, floods, and cyclones is also projected. All these changes are likely to have adverse impacts on India's water resources, agriculture, forests and other ecosystems, coastal zones, energy and infrastructure and on human & animal health. Agricultural impacts due to climate change have received considerable attention in India as well as North Gujarat. They are closely linked to the food security and poverty status of a vast majority of population. Increase in temperature is reducing crop duration, increase crop respiration rates, alter photosynthetic partitioning to economic products, effect the survival and distribution of insect-pest and diseases and hasten nutrient mineralization in soils, decrease fertilizer use efficiencies, and increase evapo-transpiration. All these can have a tremendous impact on agricultural production and hence food security of North Gujarat region.

There are several mitigation and adaptation practices that can be effectively put to use to overcome the effects of climate change with desirable results. These methods fall into the broad categories of under crop/cropping system-based technologies, resource conservation-based technologies and socio-economic and policy interventions. To mitigate the effects of climate change on agriculture and animal production and productivity, a range of adaptive strategies need to be considered. Change in cropping calendars/sequences or pattern involving some alternative crops and late or early-maturing varieties could be the immediate option, conservation of soil moisture and efficient water-harvesting techniques are also important for North Gujarat region. The long-term strategy should utilize genetic resources to develop heat and drought tolerant varieties that could be better adapted to new climatic and atmospheric conditions including greater availability of CO_2. The strategies to address the impacts of climate change on agriculture thus, some of the issues like unbalancing in impacts of rise in temperature, atmospheric CO_2 levels and uneven distribution of rainfall are also needed urgently to be addressed.

ESCC: 2.

RESPONSES OF EARLY AND LATE SOWN WHEAT CULTIVARS UNDER ELEVATED OZONE CONCENTRATION

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Tropospheric ozone (O_3) is a long range transboundary secondary air pollutant, a major component for global climate change, causing significant damage to agricultural crops worldwide. The increasing emissions of O_3 precursorsdue to urbanization and industrialization led to progressive increase of ground level O_3. The current level of yearly O_3 concentration in India is around 55 ppb which is above the threshold level (40 ppb) for sensitive crops.