BOOK of ABSTRACTS

National Conference
on
Bioresources Management for Sustenance of Ecosystem and Livelihood

26-29th Nov., 2015

At
Uttar Banga Krishi Viswavidyalaya
PO.-Pundibari, Cooch Behar-736165. WB

Organised by

Cooch Behar Association for Cultivation of Agricultural Sciences
(COBACAS)

In collaboration with
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PROGRAMME SCHEDULE
of
National Conference
on
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West Bengal, India

Day 1 (26-11-2015)

Venue: ATIC Auditorium

10.00 hrs onward	**Registration**
13.00-14.00 hrs 13.00-13.10 hrs 13.10-13.15 hrs 13.15-13.20 hrs 13.20-13.30 hrs 13.30-13.40 hrs 13.40-13.50 hrs 13.50-13.55 hrs	**Inauguration** Receiving of Guests at dais with bouquet Welcome address by President, COBACAS Inauguration song and lighting of lamp Address by Guest of Honour, Prof. (Dr.) M. L. Madan Address by Chief Guest, Prof. (Dr.) S. K. Sanyal Address by Chairman, Vice Chancellor UBKV Vote of thanks by Organizing Secretary
14.00-14.30 hrs	**High tea**
14.30-15.10 hrs	Key Note address 1 **"Nutrient Mining in Indian Agriculture: Food Security and Soil Health Concerns"** by **Prof. (Dr.) Saroj Kumar Sanyal**, Ph.D. (Cambridge), FNAAS, FISSS, FAScT, Former Vice-Chancellor, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal; Adjunct Professor, Indian Agricultural Research Institute, New Delhi and Bihar Agricultural University, Sabour, Bhagalpur, Bihar; Chairman, Research Advisory Committee, NBSS & LUP (ICAR), Nagpur; CRIJAF (ICAR), Barrackpore, West Bengal and CSR&TI, Central Silk Board, Ministry of Textiles, GoI, Berhampore, West Bengal
15.15-15.55 hrs	Key Note address 2 **"Perspectives for nutritional security and livelihood sustainability through Livestock under climate influenced changing farming conditions"** by **Prof. (Dr.) M. L. Madan** Former Vice Chancellor, Pt Deendayal Upadhaya University of Veterinary Science, Mathura and Punjabrao Deshmukh Agricultural University, Akola; Former Deputy Director General (Animal Sciences), ICAR, New Delhi; Former Chairman, Livestock Sub-group, Haryana Farmer's Commission and President, Society of Animal Physiologists of India
18.00-19.00 hrs	**Cultural Program** ***(Venue: ATIC Auditorium)***
19.30 hrs onward	**Conference Dinner** hosted by Hon'ble Vice-Chancellor, UBKV ***(Venue: Central Farmer's Hostel)***

Day 2 (27-11-2015)

Venue: Central Farmer's Hostel

Pre-lunch Session	
9.00-09.45 hrs	**Breakfast**
11.00 hrs onward	**Concurrent Poster display session of all themes**
	COBACAS Best Thesis Award Poster Display and evaluation and short listing by the panel
10.00-13.30 hrs	**Technical Session 1: Bioresources Management for Ecosystem Sustenance** **Chairmam**- Prof. (Dr). Saroj Kumar Sanyal Former Vice-Chancellor, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur West Bengal Adjunct Professor, Indian Agricultural Research Institute, New Delhi and Bihar Agricultural University, Sabour, Bhagalpur, Bihar Chairman, Research Advisory Committee, NBSS & LUP (ICAR), Nagpur; CRIJAF (ICAR), Barrackpore, West Bengal and CSR&TI, Central Silk Board, Ministry of Textiles, GoI, Berhampore, West Bengal **Co-Chairmen**- Dr Sudarshan Dutta, Deputy Director International Plant Nutrition Institute - South Asia (East India and Bangladesh) Program **Rappoteur**- Dr Avijit Dey ICAR- Central Institute for Research on Buffaloes, Hisar
10.00-10.20 hrs	**Lead Lecture 1:** 4R Nutrient Stewardship – an initiative of IPNI for sustainable crop nutrition. **Dr Sudarshan Dutta**
10.25-10.45 hrs	**Lead Lecture 2:** Plant Phenolics: Potential benefits on Health, Methane Mitigation and Animal Performance. **Dr. Avijit Dey**
Tea break	
	Host-induced silencing of a nematode protease gene in tomato plants conferred enhanced resistance to root-knot nematodes **Tushar Kanti Dutta and Uma Rao**
	Genetic transformation of immature embryos from maize by gus marker gene with Agrobacterium **M. Guru Prasad, V. Sridevi, M. Satish Kumar and G. Vijaya Kumar**
	Plant growth promoting potentiality of native *Azotobacter* sp. and their molecular typing **Rajib Dey, Kanish Sarker, Nirmal Mandal and Subrata Dutta**
	Analysis of genetic variation in *Musa balbisiana* Colla population of Meghalaya as revealed by Single Primer Amplification Reaction approach **Animos Lamare, Indrani Baruah, Nayanmoni Borah and Satyawada Rama Rao**
	Development of Super rice in mid duration group for irrigated and shallow low land ecology **S. K. Dash, S. K. Pradhan, L. Behera, A. Anandan, P. Swain, J. Meher, K. Chattopadhyay and O. N. Singh**

	Fruit based agroforestry - an alternative land use system for crop diversification and poverty alleviation of farming community **P. K. Dhara**
	Study on crop diversification pattern under changing climate situation of Himalaya with special reference to Darjeeling hill **Dhiman Mukherjee**
	Eco-friendly use of coal fly ash as a supplement of nutrient for better productivity of Sunflower **Sabitri Nahak, Gayatri Nahak and Rajani Kanta Sahu**
	Integrated Nutrient Management of Upland Rice yield and soil nutrient status **Punabati Heisnam, Abhinash Moirangthem, Augustina Saha, Anwesh Rai, Khuraijam Priya Devi, L. Nabachandra Singh and Ashish Kumar Singha Roy**
	Indigenous Ornamental Fish Diversity in Torsa and Ghargharia: Nature's Conservation Strategy. **Arpita Dey, N. Ray and D. Sarkar**
	Effect of different seed and soil treatments on plant growth and incidence of rhizome rot and wilt disease complex of ginger **B. R. Sharma, S. Roy, S. Dutta, Sibdas Baskey and Sajeed Ali**
	Studies on the seedling blight disease incidence and severity in *Valeriana jatamansi* zones **S. Baskey, K. Roy , B. Thapa, B. Tudu, Dipak Nayak, S. Hembrom and S. Chakraborty**
	Effect of TiO_2 nano particles on seed germination and growth of tomato **Bimal Das, Rakesh Yonzone and K. K. Sarkar**
	Improving seedling health of bell pepper (*Capsicum annum* L.) by plant growth promoting microorganisms **N. Sarkar, A. Roy, P.M. Bhattacharya and A. Debnath**
	Some special characteristics of Farmers' varieties of rice (*Oryza sativa* L.) for testing of distinctiveness **Bidhan Roy and Dinesh Tulsiram Surje**
13.30-14.30 hrs	**Lunch**
14.00-15.00 hrs	**Poster evaluation by the panel**
Post-lunch Session	
15.00-18.00 hrs	**COBACAS best thesis award power point presentation**
19.00 hrs	**Dinner**

Day 3 (28-11-2015)

Venue: Central Farmer's Hostel

Pre-lunch Session	
9.00-10.00 hrs	**Breakfast**
10.00-13.30 hrs	**Technical Session 2: Ecosystem Management and Livelihood Improvement** **Chairman**- Dr. L. C. De, Principal Scientist ICAR-NRC for Orchids, Sikkim **Rappoteur**- Dr. Soumen Maitra, Head Department of Floriculture, Medicinal and Aromatic Plants Uttar Banga Krishi Viswavidyalaya, Pundibari
10.00-10.20 hrs	**Lead Lecture 1:** Characterization of Commercial Orchids through DUS Test Guidelines **Dr. L. C. De**
10.25-10.45 hrs	**Lead Lecture 2:** Essential oils: a value-addition for improvisation of commercial floriculture in India **Dr. Soumen Maitra**
Tea break	
10.50-13.30 hrs	Physical strain of work up with manual weeder **Gayatri Mohanty and S. K. Mohanty**
	Application of GIS in forest resource management **Sunita Pati, Trupti Barai, P. J. Mishra and B. B. Behera**
	Influence of organic and inorganic nutrient management practices on growth and yield of sunflower hybrid **S. Boja Raj, K. Srinivasan, E. Somasundaram and R. Shanmugasundaram**
	Process development of therapeutic RTS beverage from blend of Aloe vera and Pineapple **R. Sasikumar, K. Vivek**
	Minor fruits: food and nutritional security in West Bengal **Arju Ali Khan, Anwesha Das, Susanta Kumar Sarkar**
	Rainwater harvesting in hilly tract of west Bengal and Northeast region **Rodrick Lepcha and Pemba H. Bhutia**
	Symptom expression in Turcicum Leaf Blight disease of maize **Sajeed Ali, A. K. Chowdhury and B. R. Sharma**
	Effect of macronutrients (Zinc and Boron) on quality improvement in Kinnow Mandarin **P. Baraily, M. K. Gurjar, R. A. Kaushik**
	Guar gum- an alternative for sustainability in rainfed condition **Augustina Saha, Shirshendu Samanta, Punabati Heisnam, Mumtak Lego, Abhinash Moirangthem, and V. M. Bhale**
	Nutritional indices of *Cricula trifenestrata* Helfer (Lepidoptera: Saturnidae) **N. Chaudhuri and Gharde. S. Krushna**
	Rapid monitoring of soil arsenic pollution via diffuse reflectance spectroscopy **Somsubhra Chakraborty and Shovik Deb**
	A comparison on glycemic index values of different rice varieties

	Lakshmi Hijam and K. K. Sarkar
13.30-14.15 hrs	**Lunch**
Post-lunch session	
14.15-17.45 hrs	**Technical Session 3: Education, training, law, policy, strategies and participation** **Chairmam**- Prof. (Dr.) A. K. Chowdhury Department of Plant Pathology Uttar Banga Krishi Viswavidyalaya, Pundibari **Co-Chairman**- Dr. P. K. Pal Head, Department of Agricultural Extension Uttar Banga Krishi Viswavidyalaya, Pundibari **Rappoteur**- Dr. T. N. Roy Associate Professor Uttar Banga Krishi Viswavidyalaya, Pundibari
14.15-14.35 hrs	**Lead Lecture 1:** Conservation agriculture packages and subsistence farming system of eastern India. **Prof. (Dr.) A. K. Chowdhury**
14.40-15.00 hrs	**Lead Lecture 2:** Preparedness of rural women towards disaster management in the era of climate change. **Dr. P. K. Pal**
15.05-15.25 hrs	**Lead Lecture 3:** An Enquiry into the Small farmers' Perceptions and Practices to Mitigate Adverse Effects of Climate Change in West Bengal **Dr. T. N. Roy**
Tea break	
15.30-17.45 hrs	Re-examining the status and role of women self help group in empowering the rural women **K. Pradhan, Rema Das, Avishek Saha, Victor Sarkar, Bablu Ganguly, Yanglem Lakshimai Devi and Saiman Manger**
	Grading of Workload of Male and Female Agricultural Workers **Dr S K Mohanty**
	Conservation management strategies for Sacred Natural Sites of Uttarakhand, India **Yogesh Gokhale and Nazir A. Pala**
	Development of Ergonomically Designed Weeder for Increasing Productivity **Prerana Priydarsini Jena, S. K. Mohanty and J. N. Mishra**
	Reviewing the performance of poverty alleviation and livelihood security programme **Khumukcham Stina, A. Sarkar, R. Josmee and Ram Singh**
	Integrated Pest Management of rice – its impact and adoption by the farmers of Darjeeling Himalaya **Sajeed Ali, B. R. Sharma, M. W. Moktan, A.D. Thapa and B. D. Kharga**
	Potential threats of rice straw burning and its alternative uses **Rakesh Yonzone, M. Soniya Devi, Surajit Kundu, Prerna Baraily, Bimal Das, Chiranjit Mazumder and Kavita Mondal**
	A prospective perception of forest dependent stakeholders from Indian Himalayas

	Aatif Hussain, Kaiser Iqbal, and Nazir A. Pala
	Climate Change perception of Forest Dependent Communities in a Humid Tropical Foothill Forest of Indian Eastern Himalayas **Tanusri Dey, Gopal Shukla, Nazir A. Pala, P. K. Pal and Sumit Chakravarty**
18.00-19.30 hrs	**Valedictory session**
19.30 hrs onward	**Conference Dinner hosted by Hon'ble VC, UBKV**

Day 4 (29-11-2015)

Venue: Central Farmer's Hostel

11.00 hrs onward	Farmers-Scientist interaction and training
9.00 hrs onward	Post conference tour to Indo-Bhutan border by delegates

KEY NOTE
AND
LEAD LECTURES

Keynote-1: NUTRIENT MINING IN INDIAN AGRICULTURE: FOOD SECURITY AND SOIL HEALTH CONCERNS

Saroj Kumar Sanyal[1] and Kaushik Majumdar[2]

[1] Formerly at Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741 252, District-Nadia, West Bengal
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The necessity of increasing food production to meet the demand of the ever-increasing population in India is self-evident. The total area under cultivation has remained more or less constant over the past several decades, and the agricultural lands are also gradually being diverted to non-agricultural uses. It is unlikely that sizable additional area will be brought in under cultivation in the foreseeable future. Therefore, there is no other viable option than increasing the crop production per unit area (productivity) for meeting the future production goals.

Maintenance of native soil fertility in the intensively cultivated regions of the country is one of the preconditions of maintaining and improving the current crop yield levels. Intensive cropping systems remove substantial quantities of plant nutrients from soil during continued agricultural production round the year. The basic principle of maintaining the fertility status of a soil under high intensity crop production systems is to annually replenish those nutrients that are removed from the field. The removal of crop residues from agricultural fields renders this a more difficult task (Sanyal *et al*., 2014). The term "*Nutrient Mining*" refers to a situation when the quantity of soil nutrients removed by a crop from an agricultural field exceeds the amount that is recycled back and/or replenished to the field. This causes a decline in the native soil fertility and may seriously jeopardize the future food security of the country.

A continuous mismatch between nutrient removal and replenishment, even at the recommended levels of fertilizer application, was evident in the long-term studies on various cropping systems. The long-term rice-wheat experiments in the Indo-Gangetic Plain (IGP) under the All India Coordinated Research Project on Integrated Farming Systems reveal that additions of N and P in different locations were greater than their removal by the crops. On the other hand, negative K balances were noted in all the treatments at all the locations. However, the effect of negative K balance may not be visible on the plant available K content of soil owing to the relatively high K supplying capacity from the respective non-exchangeable K (NEK) pools of the illitic minerals-dominated soils of the IGP. Indeed, the assessment of the plant-available K in soils does *not* measure the NEK pool,or its *depletion*. However, continued (unnoticed) excessive depletion of NEK from the interlayer space of the illitic clays may lead to an irreversible structural collapse of these minerals, thereby severely restricting the release of K from such micaceous minerals (Sarkar *et al*. 2013). This would impair the long-term soil fertility in respect of K, and its restoration may require much higher and thoroughly unwarranted investment in future.Further, the estimates of apparent N balance, which was positive at all the locations, may not also mean a sustainable input-output relation either. In rice soils, the inclusion of N losses from rhizosphere by leaching, volatilization and denitrification in the nutrient balance calculation may render the N balances negative at all the locations. Thus, the current practices of nutrient management in cropping systems are exhaustive in terms of N and K withdrawals, leading to depletion of these nutrients from the native soil reserves.

The nutrient output: input ratio (nutrient depletion factor) provides a measure of the extent of nutrient uptake exceeding the additions and provides gross estimates of possible depletion. Site-specific studies conducted across the rice-wheat growing regions of India indicates that crop uptake of P exceeds its input at 6 out of 10 locations, whereas the output: input ratio for K and S were more than 1.0 at all the locations (**Table 1**), indicating a stress on soil K and S supplies. These results become more revealing when nutrient uptake of P, K and S was furnished from the soil native reserves in the absence of their external input. Results show the largestnutrient removal accompanying the highest productivity level.

It is apparent that well-documented soil-crop management practices are yet to address adequately the issue of nutrient mining from soil by the crops and cropping sequences, and the effect thereof on the long-term native soil fertility. There is thus a need for appropriate environmental auditing, concomitant with soil-crop management practices.

Table 1. Nutrient depletion factor and nutrient uptake from soil reserve under rice-wheat system with best management practices correcting all the existing nutrient deficiencies except that of the indicated nutrients

Location	Rice-wheat System yield (t ha^{-1})	Nutrient depletion factor (Output: Input Ratio)			Depletion of soil nutrients from soil reserve (kg ha^{-1})		
		P_2O_5	K_2O	S	P_2O_5	K_2O	S
Sabour	13.8	1.74	1.86	1.20	88	261	42
Ranchi	10.4	0.73	1.09	2.04	63	205	41
Ludhiana	16.1	1.36	2.29	2.07	126	354	58
Palampur	9.8	1.70	1.83	1.35	74	226	36
R.S.Pura	13.2	0.67	1.71	1.48	94	301	45
Faizabad	12.3	0.97	1.52	1.48	80	252	39
Kanpur	14.6	1.03	1.48	2.27	66	247	43
Modipuam	16.7	1.98	1.63	3.50	100	294	58
Varansi	12.1	1.35	1.50	1.60	65	221	38
Pantnagar	12.4	0.77	1.45	2.02	67	220	42

Source: Source: Tiwari *et al*. (2006)

Indeed, Buresh *et al*. (2010) illustrates the nutrient balance methodology, based on the QUEFTS (*Quantitative Evaluation of the Fertility of Tropical Soils*) model, for estimating the K balances in agricultural fields for single crop and cropping systems involving cereals. The essential components of such K balance calculations included contributions (input) from the retained crop residues, irrigation water and added organic matter, as well as the loss (output) of K from the system through leaching and export through the grain of the crops. These authors (2010) examined two options for rice to calculate the fertilizer K rates based on partial maintenance of soil K level with gradual drawdown or depletion of such native soil K. In one option with partial maintenance, fertilizer K requirement was calculated as a fraction of the full maintenance. The other option with partial maintenance allowedK depletion from the soil reserves up to a threshold limit, which is treated as an input in the nutrient balance. In such approach, the indigenous soil K supply to support the targeted crop yield was obtained from the corresponding omission plot data. However, Singh *et al*.(2014) (cited in Sanyal *et al*., 2014) examined such nutrient balance in rice-wheat systems by replacing the omission plot data with the indigenous nutrient supply calculations of nutrient (N, P and K) contributions from the soil available pool (soil test data) and the appropriate nutrient use efficiency factors.

For addressing these issues, thenutrient input from irrigation water and losses through leaching would feature prominently in the nutrient balance equations that help estimate fertilizer requirement to achieve a targeted crop yield. A portion of the K and other basic cations added to the field through irrigation water, for instance, may also be lost *via* leaching from the highly permeable soils with adequate drainage and low CEC. Further, there are several researchable issues pertaining tothe assessment of equitable distribution of crop residues among different competitive uses, such as between animal feed requirement and nutrient recycling in fields, thereby providing options forfarmers to retain at least a part of the residues in the field. Critical estimation of the rate of mineralization of crop residues with different (C: N) ratios under varying agro-climatic conditions and management scenarios would also be required for assessing the nutrient availability from crop residues in the nutrient balance and nutrient mining calculations. The availability of organic resources, having several competitive usages, for agricultural uses, along with their nutrient loading needs to be ascertained for reliable nutrient balance computations in the context of the integrated nutrient management options.

A national portal for soil data repository is a critical requirement for assessing nutrient mining from soil. Such a national-level initiative to develop and maintain a soil data repository will allow tracking of soil fertility changes in

intensive cropping regions over time. At this point, such databases are fragmented and maintained by several organizations, which are unavailable in the public domain. Integrating the former into one national portal will help the overall assessment of the national soil resources and developing other knowledge resources, such as fertility maps for different soil nutrients at a finer scale. Once developed, such a database could be periodically updated with contribution from different organizations.However, the data querying from several disparate sources may cause concern for the appropriate reconciliation of the soil test data. Creating a national committee to oversee the data input, with particular reference to data sources and data quality could minimize such concerns. Developing a national portal of soil data will strongly fit into the current initiative of generating the "Soil Health Card" for millions of geo-referenced farm field soils. Thiswould be a logical starting point for a "national soil data repository" for the posterity, and will be an extremely valuable resource to facilitate research, planning and implementation of the improved agricultural practices at the local, regional and country scale. Such a repository will also help reorient fertilizer management practices, based on agro-climate, soil type and management practices to minimize soil nutrient mining while sustaining the soil fertility levels.

It is but obvious that the nutrient mining in agriculture cannot be avoided altogether. Indeed, different soils, under similar cropping systems and comparable management practices, will differ considerably in their inherent buffer powers to withstand the stress arising from "*nutrient mining*". In other words, the degree of soil vulnerability varies (Sanyal*et al*., 2014). Multiple cropping systems and management practices adopted by farmers on numerous soil types in the country further complicate the nutrient mining scenario. Therefore, the allowable range of nutrient mining under variable climate-soil-crop-management domain needs to be assessed, at least at the regional scale. The current article discussed several research and application mechanisms that may provide some guidance to alleviate large-scale nutrient mining in the country. However, a larger objective of this article is probably to bring the nutrient mining issue in our collective consciousness as a threat to the quality of our soil resources and our food security. A national effort to address the nutrient mining may go a long way to maintain the quality of our soils for the posterity and to ensure the food security of the future generations.

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Keynote-2: PERSPECTIVES FOR NUTRITIONAL SECURITY AND LIVELIHOOD SUSTAINABILITY THROUGH LIVESTOCK UNDER CLIMATE INFLUENCED CHANGING FARMING CONDITIONS

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Although food availability has increased along with the growing human population over the last 30 years, there are still millions suffering from malnutrition. This problem is not only the result of insufficient food production and inadequate distribution, but also due to poverty, compounding the issues of security and livelihood sustainability.

Livestock (LS) production constitutes a very important component answering these issues and its contributions go beyond direct food production (milk, meat and eggs)to include their multipurpose uses, such as draught, skins, fibre, fertilizer and fuel, as well as capital accumulation. Furthermore, LS is closely linked to the social and cultural lives of several million resource-poor farmers and landless animal owners for whom animal ownership ensures varying degrees of sustainable livelihood and economic stability. The contribution of animals to both agricultural and overall economic development is grossly underestimated and improved efficiency of animal agriculture, with its various commodities and service products, is crucial to achieving sustainable agricultural development and food security

Malnutrition and hunger is endemic among the rural landless poor who only live through livestock. Hence programs that directly address the livestock will in fact be the only option of removing the nutrient hunger. Rural and urban anemic mothers and malnutritioned children need rich protein supplementation that effectively does come from only milk or meat or eggs. The production and the productivity status of pulses, the other contributor to the nation's protein basket, in spite of efforts, has been even negative over the past decade . On the other hand animal protein production and consumption in terms of milk, meat, and eggs has recorded an annual growth of 3.5, 6.3 and 11.7 percent respectively during these years. Demand and growth forecasts therefore pitch Animal agriculture as the viable means for nutritional security for the country.

Total Factor Productivity growth study shows that changing farming conditions and technologies supported and demand driven Livestock sector has proved as an engine for growth to ensure nutritional security and livelihood of landless rural poor below the poverty line. Poverty is minimum in states in India where the LS contribution to agricultural GDP(Punjab and Haryana) is above 40% and maximum among states (Bihar and Orissa) where this contribution is very low. This demands a paradigm change in agricultural production and research concepts.

The growth, consumption and demand of the animal agriculture products have catapulted livestock into a driver seat to lead the nation to a path of nutritional security.Livestock can make a major contribution to the efficient use of available natural resources in mixed-farming systems and can increase the productivity of crops in a more profitable and sustainable manner. The farmers can mitigate risks by producing a multitude of commodities like cereal, oilseeds, horticulture, floriculture and pisci culture etc by providing critical input support born out of livestock rearing. , The ***integrated farming systems*** approach envisages a judicious mix of crop production and other enterprises like dairy, poultry, piggery, fishery, sericulture, etc. suited to the given agro-climatic conditions and socio-economic status of the farmers. Crop-livestock, crop-fish, agro-forestry and other forms of integrated farming systems can help to provide additional channels of household income and opportunities for value addition. Thus, it has a whole farm approach to reduce risk and increase production and profit with better utilization of wastes and residues.

The livestock production system is sensitive to climate change and at the same time itself a contributor to the phenomenon. Climate induced changing farming condition are confronting the sector with great challenges. Increased ambient temperatures lead to depressed voluntary feed intake, reduced weight gains, and lower milk

production. Animals are somewhat able to adapt to higher temperatures with prolonged exposure but production losses will occur in response to higher temperature events. Increased temperature will hold advantage to animals in cold regions. In India, climate change has the potential to be an increasingly formidable challenge to the development of the livestock sector. It provides employment to 18 million people and has a GDP share of 33 per cent and is quickly increasing. India possesses the largest number of cattle and buffalo (world share 16.1% and 56.7%), having high genetic diversity and different production potential. With the change in the climate and its associated effect on animal production, the climate change has questioned the food security concerns further. Poor breeding strategies along with poor mitigation strategies have been closely associated with reduced animal production as well as altered animal health. As a contributor to climate change, when emissions from land use are factored in, the livestock sector accounts for 9 percent of all carbon dioxide emissions derived from human-related activities, as well as 37 percent of methane emissions—primarily gas from the digestive system of cattle and other domesticated ruminants—and 65 percent of nitrous oxide gases, mostly from manure. In this scenario, urgent and necessary steps are required to protect animal health as well increase the animal production on one hand and address the mitigation issue as well.

Very rapid changes in farming and livestock production systems across India require greater efforts to understand changes and their implications for health, trade, livelihoods and the environment for all stakeholders, both resource rich and resource poor. We also need to look at inter- relationships along the equity, efficiency and sustainability dimensions and farming related policies and interventions.

Animal Agriculture can serve as an engine for the national agriculture and GDP growth, for the nutritional security, poverty alleviation and sustainable development particularly among the marginal and landless rural poor. Even among small holders practicing intensive agriculture, agriculture is only profitable and sustainable preposition when practiced in integrated production system mode. In the concepts of development and sustainability, it is, therefore, essential that livestock be considered the real estate around which the future agricultural and rural development should be based particularly under changing farming condition and resource input use.

Lead-1: ONION IN INDIA: PRODUCTION, CONSTRAINTS AND FUTURE THRUST

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Onion is an important horticultural commodity grown worldwide for culinary purposes and medicinal values. An Indian culinary preparation is incomplete without onion. Though India produces a significant quantity of onions it is not regular and sufficient enough to meet the demands for both domestic requirement and exports. In India, however, its significance is defined not only by its essential role in the diets of millions of Indians, rich and poor, but also the resulting political significance. Sometimes it goes out of the reach of the poor because of its high retail price which can be as high as Rs. 80- 100/kg as was observed in recent years. A standard explanation for the inflation in onion prices over the last few years has been that the demand for this vegetable has far exceeded its supply. There may be several reasons for this, but low productivity of the crop in India is one of the major reasons. The production and productivity of onion in India are very low compared to many countries. Unawareness of the farmers about suitable seasons, varieties for different seasons, climate, soil and improved cultivation techniques, as well as diseases and pests damaging the crop and their control measures and post harvest management are though main reasons, unawareness of characteristics of varieties, seasonality and proper post harvest practices by marketing agencies are also reasons responsible for limiting the production and productivity of onion indirectly.

To achieve the goal of self sufficiency, these identified constraints are to be taken care of and necessary efforts are required for ensuring onion availability round the year by increasing production and minimizing post-harvest losses for meeting increasing demand both in domestic as well as export markets. The present paper focuses on the present scenario of onion production in India with its potentiality, constraints and future thrust.

Lead-2: CHARACTERIZATION OF COMMERCIAL ORCHIDS THROUGH DUS TEST GUIDELINES

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According to UPOV Convention 1961, Distinctiveness, Uniformity and Stability (DUS) testing is essential to provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants and for the benefit of society. It provides rights for breeders to exploit or develop new plant varieties, to allow access to foreign varieties with widen gene pool, to promote intensive breeding activities and to prevent unauthorized varieties exploitations. In the present investigation, 41 hybrids of *Cymbidium*, 14 hybrids of *Dendrobium,* 9 hybrids of *Vanda*, 9 hybrids of *Cattleya*, 50 hybrids of *Phalaenopsis*, 40 hybrids of *Oncidium*and 10 genotypes of *Paphiopedilum*were studied for development of DUS test guidelines using common descriptors. In *Cymbidium*, out of 66 characteristics, pseudobulb size, inflorescence length, number of flowers, flower width, flower duration, flower predominant color, lip ornamentation, blooming time; in *Dendrobium*, out of 60 characteristics, plant height, internode length and number, inflorescence length, flower width, lip colour, and ornamentation and flowering

time and in *Vanda*, out of 66 characteristics, plant type, internode length, leaf type, spike length, flower number, inflorescence colour, sepal and petal ornamentation, lip shape, colour and ornamentation, spur length and flowering time were used for grouping of hybrids. In *Cattleya*, out of 53 common descriptors developed, plant height, leaf number/ pseudobulb, flower width in front view, petal predominant colour, lip predominant colour and lip colour pattern and in *Phalaenopsis*, out of 58 common descriptors developed, plant size, flower width in front view, petal predominant colour and colour pattern, predominant colour and colour pattern of apical lobe of lip whereas in *Oncidium* out of 60 common descriptors, plant type, leaf number per basal leaves /pseudobulb, flower width in front view, petal main colour, petal colour pattern, lip main colour and lip colour pattern and in *Paphiopedilum*, out of 77 common descriptors floral bract shape, flower width, dorsal sepal colour pattern, synsepal width and main colour, petal orientation, lip colour pattern and petal staminode size were used for grouping of hybrids.In Mokara(*Arachnis* x *Ascocentrum*x *Vanda*), 61 morphological descriptors have been developed. Amongst eight commercial orchid genera, DUS Test Guidelines of *Cymbidium, Dendrobium, Vanda, Phalaenopsis, Cattleya,Oncidium* and *Paphiopedilum*have been published in '*Plant Variety Journal of India'* and notified for registration under PPV & FRA, NASC Complex. New Delhi.

Lead-3: 4R NUTRIENT STEWARDSHIP – AN INITIATIVE OF IPNI FOR SUSTAINABLE CROP NUTRITION

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Exponential trend of the increasing population has set forth a large challenge to food security, especially for South Asian countries. Increase in productivity is the only option as the horizontal expansion of the cultivable land is very limited. Along with varietal improvement, crop management is another important aspect for productivity enhancement. Nutrient management is one of the most critical and essential components for crop productivity enhancement. However, the imbalanced application of plant nutrients increases the production cost as well as environmental footprint. Therefore, appropriate nutrient management strategies based on rigorous scientific principles are necessary for sustainable agriculture. Nutrient management strategies should be science-based but simple enough so that both farmers as well as extension professionals could implement that in a timely fashion. Data from different sources highlight imbalanced use of nitrogen fertilizers over phosphate and potash is reducing the crop nutrient use efficiencies, while leading towards mining of some essential elements such as potash and other micronutrients. At one end, inappropriate fertilizer application creates environmental pollution while on the other hand under use causes soil nutrient mining. This demands a serious insight into the present nutrient management approaches prevalent in India and adopted by farmers. The 4R Nutrient Stewardship concept provides nutrient recommendation to the farmers by guiding to choose right source of fertilizer and advice what will be the right rate, time and place or method of application to protect the environment and increase farm profitability. Nutrient Expert® (NE®) fertilizer decision support tool is one among several tools and strategies available for on-farm implementation of the 4R Nutrient Stewardship. On-farm evidences highlight the capacity of the NE® tool to improve productivity as well as economic benefit for rice, wheat and maize farmers in an environmentally sustainable manner. The ease of developing 4R Nutrient Stewardship compliant fertilizer recommendation for individual cereal farmer makes NE® an attractive option for farmers and their advisors. Providing nutrient management decision support to millions of cereal farmers in India will go a long way in addressing future food security concerns without leaving large environmental footprint of agricultural nutrient use.

Key words: Environmental concern, Fertilizer Use, Food Production, 4R Nutrient Stewardship.

Lead-4: PLANT PHENOLICS: POTENTIAL BENEFITS ON HEALTH, METHANE MITIGATION AND ANIMAL PERFORMANCE

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Phenolics are ubiquitous in all plant organs and integral part of animal and human foods. Phenolic acids, flavanoids and tannins are the most common phenolic compounds. Fruits and vegetables are rich source of polyphenols for humans. Whereas, tree leaves in tropical countries are potential sources phenolic compounds for animals. Researchers have become more interested in polyphenols due to their potent antioxidant properties and credible effects in the prevention of cardiovascular, neurodegenerative diseases and cancer. Condensed tannins (CT) and flavanoids have the ability to modify the rumen fermentation towards reduced methanogenesis by altering rumen microbial community and their supplementation reduces nitrogen excretion in ruminants by improving its utilization efficiency. Improvement in feed intake, growth rate, wool production, reproduction and milk production in ruminants fed CT containing diets were observed in a dose dependent manner. In ruminants, most proteins are rapidly solubilised and release 56- 65% N in the rumen during mastication; consequently large losses of N (25-35%) occur as ammonia absorbed from rumen. CT from tree leaves could be used as organic protectant of proteins to improve protein utilization by ruminants and reduce environmental pollution by minimising N losses through urine. Supplementation of CT through leaves of *Artocarpus heterophyllus, Ficus infectoria, Ficus bengalensis and Ficus glomerata* at 1.5- 2.0% levels was observed to reduce the rumen degradability of groundnut cake to 60-75 per cent from the normal value of 92 per cent. Controlling gastro-intestinal parasites by supplementation of CT through *F. infectoria, Psidium guajava* and *Ficus bengalensis* was effective to ameliorate drug resistance. Feeding study to lambs and crossbred cows with supplementation of CT (1.5%) either through *F. Infectoria* and *F. bengalensis* leaves was found to increase feed efficiency, growth rate, milk yield, fat yield, antioxidant status and immunity of animals. Flavanoids and tannin-rich feeds could reduce or inhibit rumen biohydrogenation of vaccenic acid to stearic acid, resulting in the accumulation of conjugated linoleic acids (CLA) in milk and meat which has hypolipidaemic and anti carcinogenic effects in humans. Judicious application of plant phenolics could improve overall health and production performance of animals.

Key Words: Polyphenols, Animal health, Antioxidants, Methane mitigation, Livestock production

Lead-5: BREEDING AND INHERITANCE OF PARTHENOCARPIC GYNOECIOUS CUCUMBER AND GHERKIN FOR PROTECTED CULTIVATION

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Parthenocarpic gynoecious cucumber and gherkin varieties are suitable for polyhouse cultivation as these varieties develop fruits automatically without any pollination. Now a days many of the private seed companies are selling varieties/ F_1 hybrid of parthenocarpic cucumber and gherkin at a very high price as their seeds are being sold on per seed basis. Keeping in view these facts, programme on development of parthenocarpic gynoecious varieties for protected cultivation was undertaken during 2010 at Division of Vegetable Science IARI, New Delhi. The initial material was an exotic collection which was broken by using silver thio-sulphate (3Mm) for induction of male flowers and individual plant selection was carried out and generations were advanced during spring summer and *kharif* season respectively, under insect proof net house. In winter season of 2014-15, seventeen breeding lines which were advanced to F_8 and showing true gynoecious and parthenocarpic behaviour were evaluated under low cost

polyhouse. The line DPaC-6 was observed as most promising as it expressed 27.6% and 26.9% higher yield than check Pant Parthenocarpic Cucumber – 2 and Asma, respectively. Its yield (147.4 t/ha) was statistically at par with the best check F_1 hybrid Kion (145.8 t/ha). The yield obtained by DPaC–6 (147.4 t/ha) can be considered as quite high since it was obtained during off-season (winter season) under low cost polyhouse without using any energy. The inheritance studies of fruit skin colour and parthenocarpy was also conducted by crossing DPaC-6 and monoecious cucumber variety Pusa Uday. The F_1 progeny showed intermediate colour between dark green DPaC-6 and light green Pusa Uday. The F_1 progeny showed true gynoecious parthenocarpic behaviour as its fruits were seedless and developed without pollination which suggested that gynoecious parthenocarpic trait is governed by single dominant gene. The F_1 progenies were advanced to F_2 and also simultaneously backcrossed with parthenocarpic line DPaC-6 to confirm the monogenic dominant nature of parthenocarpy. Molecular markers have been identified which can distinguish the F_1 hybrid from the parthenocarpic gynoecious parents PPC-2 and monoecious parent Pusa Uday. In gherkin, parthenocarpic gynoecious line DG-8 was found to be the best as it yielded 86.6 t/ha which was 12.95% higher than the commercial check hybrid Annaxo (76.67 t/ha). The results highlighted the importance of parthenocarpic gynoecious cucumber line DPaC-6 and DG-8 gherkin line for their commercial production under low cost polyhouse during winter season (off-season).

Lead-6: BIOTECHNOLOGY AND BIOINFORMATICS AS A MITIGATION TOOL UNDER CLIMATE INFLUENCED CHANGES OF FARMING CONDITIONS

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Climate is the average weather of a place at a given point and time of the year, over a long period spanning over decades.While the weather can change in just a few hours, we expect the climate to remain relatively constant.If the climate doesn't remain constant, it will lad to climate change, which is one of the crucial issues for debate in today's modern world. It is substantially altering the pattern of life on the planet earth, causing widespread species extinction, migration and behavioral changes.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 changes in average temperatures, rainfall and types of pests and diseases leading to adoption of changes in farming patterns.These changes in turn impact crop as well as plant diversity in terms of growth, survival and productivity.In view of this, it is imperative to use modern biotechnological tools to identify, isolate and integrate genotypes that are capable of adapting and withstanding the biotic and abiotic impact arising out of climate change. Such genotypes may be found in wild or need to be synthesized anew. For instance, wild genotypes of *Citrus, Vigna*and *Musa*, known to harbor important genetic traits such as disease resistant and cold resistant may be found. Such genotypes can be extensively analyzed using DNA-based molecular markers, (eg. random amplified polymorphic DNA, inter simple sequence repeats and directed amplification of minisatellites DNA), nuclear ribosomal DNA and chloroplast DNAgenes to assess their genetic relatedness with those of the cultivated genotypes. The ultimate goal of such analysis will be to identify those cytotypes/ genotypes which possess useful genesthat can offer better productivity even under the influence of climate changes on farming conditions.

Lead-7: IMPACT ASSESSMENT OF BIOPRIMING INTERVENTIONS FOR NUTRIENT USE EFFICIENCY-INDIAN STORY

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Since environmental stress negatively affects crop growth and productivity throughout the world and the energy crisis threatens the **sustainability** of both irrigated and rainfed system, it is becoming increasingly evident that priming techniques can enhance and improve the performance of crops without deteriorating the natural resource base. Among the available options, on-farm seed priming is a simple, proven technology that has been an age old practice, tested, and refined in laboratories, in experimental plots, and by farmers themselves in their fields. It's easy to use with a wide range of crops in many different farming conditions. Farmers in the indo-gangetic plains of Uttar Pradesh, India prime rice, wheat, maize and pulse seed before sowing. This simple method is now spreading to other parts of the country as well. Although priming with water or tiny amounts of phosphorus, boron and zinc is common but use of microbes can make a huge difference. Biopriming is becoming a potentially prominent technique to induce profound changes in plant characteristics and to encourage desired attributes in plants growth associated with fungi and bacteria coatings. Biological factors such as fungi and bacteria are used in biopriming which includes: fungi and antagonist bacteria and the most important of all are *Trichoderma, Pesodomonas, Glomus, Bacillus, Agrobacterium* and *Gliocladium.* Therefore, seed priming in combination with low dosage of biocontrol agents has been used to improve the plant performance, stabilize the efficacy of biological agents in the present set up of agriculture and reducing dependency on chemical inputs.

Lead-8: ESSENTIAL OILS: A VALUE-ADDITION FOR IMPROVISATION OF COMMERCIAL FLORICULTURE IN INDIA

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Essential oil industry is now considered as a lucrative enterprise. There are several classes of essential oils for which plant sources are also available. Various techniques are also employed for extraction of essential oils from aromatic plant parts. Some ornamentals are already in the list of prominent essential oil bearing plants like Roses, Jasmines and Tuberoses etc. Many an ornamental plant species produce fragrant flowers which are the non-conventional sources of essential oils may include - Lily Tree, Pagoda Tree, Iron Wood Tree, Golden Champa, Cape Jasmine, Night Jasmine, Screw Pine, Pot Marigold, French Marigold, Garland Flower, Freesia, Sweet Sultan, Sweet Pea, Carnation, Mignonette etc. India is a biodiversity rich country which contains about 1500 different aromatic plants species. The present research needs to focus on the identification of newer sources of fragrant ornamentals from native habitats, standardization of specific extraction technique for particular plant species, isolation of newer compounds and proper packaging technique for storage and marketing. Market intelligence is also an integral part to support this system as well as to promote commercial cultivation of those ornamentals in India.

Key words: Essential oil, ornamental plant, floriculture

Lead-9: CONSERVATION AGRICULTURE PACKAGES AND SUBSISTENCE FARMING SYSTEM OF EASTERN INDIA

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In eastern India dependency on monsoon for planting and crop production, small holdings (90 % less than 1ha), poor infrastructure for irrigation and ground water development, severely affect agriculture resulting in low crop yields and even crop failures. Further, nearly 40 % of summer rice area (3 Mha) in Bihar and West Bengal remains fallow during the winter season forming a rice fallow system. Planting a second crop after rice in this region depends on availability of residual moisture in the soil. Intensification and diversification of the rice-fallow system using no till wheat and food legumes provide an opportunity to strengthen food as well as nutrition security in the region. Conservation agriculture (CA) based technologies can meet dual aims of reducing production costs and improving productivity and profitability.

Keeping this view, a study on CA-based rice-wheat cropping system was undertaken in 2007-08 in the experimental field of the University. The tailoring of rice and wheat varieties, incidence of weeds and their management, incidence of diseases and assessment of soil health have been studied after six years continuous practice of CA.

Tailoring of rice varieties under direct seeded conditions with brown manuring:

Hybrids: NK Sahadri (6.4t/ha), NK 3325(6.0t/ha), Arize 6444(6.3t/ha), PHB 71(5.6t/ha); HYVs: Swarna sub 1(4.7t/ha), IET 15847(4.2t/ha), Nilanjana(4.1t/ha)

Tailoring of wheat varieties under no-till conditions:

Timely sown conditions: HD 2733(4.3t/ha), PBW 343(4.1t/ha), DBW39(4.2t/ha); Late sown conditions: NW 2036(3.6t/ha), Francolin(3.7t/ha)

Disease dynamics in no-till rice and wheat

Rice: The severity of sheath blight (*Rhizoctonia solani*) disease indicates that the DSR plots had higher (9 to 38%) Percent Disease Index than puddled transplanted plots in the initial years but the differences have been narrowed down (0.8 to 6% Percent Disease Index) after five years continuous practice of no till.

Wheat: No tilled wheat had more disease severity (138 to 342 higher Area Under Disease Progress Curve,AUDPC) than conventional tillage irrespective of the varieties, however, after five years continous practice of no- till, the differences in disease severity was reduced and recorded less (-37 to 120) AUDPC .

Weed management in DSR

Integrated weed management practices that encompasses Glyphosate @ 1.5 kg/ha as pre-plant desiccators+ butachlor @ 1.5 kg/ha as pre-plant surface application + brown manuring (*Sesbania*rice co-culture) + 2,4-D @ 0.50 kg/ha at 35 days after sowing (DAS) was found to be effective in controlling weeds in DSR during rainy season. Bispyribac sodium @ 25 g/ha applied at 20 DAS was found to be effective in controlling grasses.

Weed management in no- till wheat

Considerable reduction of growth of dominant weed flora *Polygonum persicaria* L., *P pensylvanicum*L.and *P orientale* L. was recorded in no till wheat, however, growth of other broadleaved weeds *Stellaria media* Cyrill*, S.aquatic* Cyrill*, Oldenlandia diffusa* L.*, Vicia sativa*L.and*V.hirsuta*L.and grasses *Cynodondactylon*(L) Pers., *Setaria glauca*(L.) Beauv and *Digitaria sanguinalis*(Retz.)Koel was increased considerably in succeeding years.

Application of glyphosate (1.50 kg ha^{-1}) at 5 days before sowing followed by pre-emergence application of metribuzin (0.20 kg ha^{-1}) and post-emergence application of carfentrazone-ethyl (25 g ha^{-1}) at 32 days after sowing (DAS) was effective for controlling weeds in no till wheat for profit maximization and controlling 2,4-D tolerant weeds (Mukherjee *et al*, 2011).

Measurement of soil health parameters in no-till fields:

After five years of consecutive use of CA, no-till plots with bio-fertilizers have significantly higher soil enzyme activity (Dehydrogenase and Acid Phosphatase), microbial biomass carbon and oxidizable organic carbon than conventional fields than Conventional tillage plots.

Lead-10: PREPAREDNESS OF RURAL WOMEN TOWARDS DISASTER MANAGEMENT IN THE ERA OF CLIMATE CHANGE

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Rural women play important role in different household management activities; disaster management may not be the exception of it too. A disaster refers to a catastrophe, mishap, calamity or grave occurrence from natural or man-made causes, which is beyond the coping capacity of the affected community. In the era of climate change, the negative impact of such calamities is being manifold day by day. Awareness and preparedness may be the most important mechanism to cope with these catastrophes and reduce the extent of damage. Unfortunately, our communities are not well prepared to deal with such disasters when they come as a result of inadequate knowledge, low level of preparedness or inability to mitigate and respond to the disaster in due time. The Disaster Management Act, 2005 envisaged that comprehensive disaster management and emergency preparedness should be based on the concept of active young people as well as women participation in all phases of the disaster cycle. Household and community level disaster management plan must recognize the value of including women in different phases of it. With this backdrop, the present study was undertaken in Jalpaiguri district of West Bengal to assess the benchmark situation of rural women to assess their awareness and preparedness towards disaster management.

From the study it is seen that disaster preparedness of the women are very low and it is influenced by the awareness level on disaster management as well as by the socio economic and personal characters like cosmopoliteness, asset possession, family education status, information seeking behavior, housing and sanitation index, training and organizational participation and awareness regarding disaster management. Govt. should intervene on increasing knowledge of disaster management and should also stress on women participation in disaster assessment, preparedness and prevention in the household and community level.

Key word: Disaster management; Women; Disaster preparedness

Lead-11: AN ENQUIRY INTO THE SMALL FARMERS' PERCEPTIONS AND PRACTICES TO MITIGATE ADVERSE EFFECTS OF CLIMATE CHANGE IN WEST BENGAL

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This study analyzes smallholders' perceived views on climate change along with their adopted specific farm practices as the measures to mitigate the unforeseen effects of climate change in West Bengal with a unique set of primary data selected of purposively from 125 farmers during 2013 and 2014. Findings reveal that the farmers strongly feel various aspects of climate change at their own situations (mainly in terms of high temperature and irregular rainfall). Some of their common practices like diversification, adjustment in planting time, *IFS inter alia* are found good options to tackle adverse effect of climate change. In non-irrigated farms, change of planting date in case of irregular (delay) rainfall becomes effective to reduce risk by12.54% of yield loss and also ensures better return through recovery by 16%. Non-adopters of special irrigation practices during the delay in rainfall are found to foregone excess benefits over costs. Values of estimated *Herphindal Index* (around 0.6 to 0.7) indicate that farm diversification should be promoted more. Estimates of *Adaptation Strategy Index* (ASI) and *Problem Confrontation Index* (PCI) indicate that *inter alia* irrigation facility is the main economic issue of adaptation and also the main constraints. To continue agriculture further in this situation, the resource-poor farmers expect more information and institutional supports. Various feasible aspects at farm level as well as for institutional level have also been advocated to manage the effects of climate change in future.

Keywords: ***Climate change, farmers' views, cropping pattern, diversification index, adaptation & constraints Index***

ORAL PRESENTATIONS

FRUIT BASED AGROFORESTRY - AN ALTERNATIVE LAND USE SYSTEM FOR CROP DIVERSIFICATION AND POVERTY ALLEVIATION OF FARMING COMMUNITY

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Natural resources are vital to meet the food, livelihood and environmental security. In view of the future prospects of the said items it is now widely accepted that attention has to be paid on conservation, sustainable development and management of natural resources. Even after utilizing the full potential of irrigation, a major part of the farming areas will remain rainfed. Fruit-based agroforestry offers affordable alternative for resource conservation and sustainable production. West Bengal is an agricultural intensive state where food security is mainly ensured through rice-rice cropping system. The productivity of this system has stagnated or even decline in certain areas due to depletion of native nutrient reserves and lowering of underground water table along with over increasing population and decline in per caput availability of land. Practically there is no scope for horizontal expansion of land for agriculture; only vertical expansion is possible by integrating with the adoption improved farming technologies to produce crop per drop of water and per plot of land. Fruit-based agroforestry system is an alternative land use system that integrates the cultivation of arable crops, fruit trees and silvi component which provide higher economic returns to the farmers, improve the soil health and fill the gap of national forest cover (33%). Field experiments at Regional Research Station under Red and Laterite zone and on-farm trials were conducted involving Mango/Guava/Ber sapling at a spacing of 10m × 10m or 8m × 8m and Silvi species (Gamhar /*Acacia auriculiformis* /*Eucalyptus tereticornis*/ Kadam / *Dysoxylum binectariferum)* within the two fruit plants / boundary plantation with different crops like cereals, pulses, oilseeds and vegetables crops. On-farm trials were carried out according to the choice of crops by the farmers. In this system fruit production started after one year or two years of plantation thereby giving additional income to the farmers. Experimental results indicate that the maximum gross income ha/year more when vegetables included as intercrops followed by cereals crops. Studies on soil fertility reveal that available N, P and K as well as organic carbon percentages were higher under pulse crops with lucrative return through harvesting of trees.

Key words: Fruit-based Agroforestry system, Intercrop, Soil fertility.

MINOR FRUITS: FOOD & NUTRITIONAL SECURITY IN WEST BENGAL

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The minor fruits are grown to a limited extent only and commercially farming of these crop is still a far cry. These lesser known fruits are under-utilized & less exploited; their cultivation is limited; consumption and organized trade is not up to the mark; their season specificity, availability in small pockets- especially where dense/ patch forests exists, long gestation period, mode of storage and ripening and absense of processing period, mode of storage, ripening and absence of processing information etc. Due to rapid urbanization lots of wild fruit crop species are on verge of extinction. Using of undescriptive land resources to conserve those fruit plants will be a ray of hope for fragile health situation of poor mass in Bengal. The concept of food security has started growing last 50 years. The present paper delineats the composition of minor crops available in southern bengal, their exploitation, conservation and role in assuring food and nutritional security. Food security exists when every people, in every nook and corner of the country, at all times have physical and economic access to sufficient safe nutritious food to meet

their dietary requirement. Food and nutrition security is not only an ethical and moral topic but more importantly is right based issue which deals with the relation of the natural-cultural ecology with food and nutrition in different dimensions. Exploiting locally available gene resources of minor fruits which are not only delightful in organoleptic properties but also are rich source of phytonutrients. As we know North Tarai Dooars & North Eastern hilly region is rich source of different wild and minor fruit crop, which can be utilized for farming purposes. A large number of diversity in other tropical and subtropical fruits belonging to the genera Garcinia, Artocarpus, Phyllanthus, Annona, Averrhoa, Persia, Aegle, Passiflora and Tamarindus etc. are reported from the region. These crops have the potentiality to alleviate the poverty, food and nutritional insecurity through processing and value addition. Most of these minor fruits are rich source of essential nutrients, bioactive molecules, vitamins, minerals which are suitable for medicinal, aromatic and processing industry. So therefore it is very important to maintain and conserve those valuable gene resource for our better future.

INFLUENCE OF ORGANIC AND INORGANIC NUTRIENT MANAGEMENT PRACTICES ON GROWTH AND YIELD OF SUNFLOWER HYBRID

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Field experiment was carried out at Tamil Nadu Agricultural University, Coimbatore, during *kharif*, 2011 to find out the Influence of organic and inorganic nutrient management practices for maximizing the productivity of sunflower hybrid TNAU SFH CO 2. The experiment was laid out in a split plot design with three replications. The main plot consisted of two treatments *viz.,* control (no organics) and FYM @ 12.5 t ha^{-1}. The subplots comprised of nine combinations of spacing and fertilizer levels *viz.,* 60 x 30 cm with 75% RDF, 60 x 30 cm with 100% RDF, 60 x 30 cm with 125% RDF, 60 x 45 cm with 75% RDF, 60 x 45 cm with 100% RDF, 60 x 45 cm with 125% RDF, 60 x 22.5 cm with 75% RDF, 60 x 100 cm with 75% RDF and 60 x 22.5 cm with 125% RDF. The soil of the experimental field was of sandy loam type and with low in available nitrogen, medium in available phosphorus and high available potassium. Among the different combinations of spacings and fertilizer levels, a spacing of 60 x 22.5 cm with 125 % RDF (75: 105: 75 NPK hg ha^{-1}) registered higher plant height. The dry matter production, stem girth, root length and root volume were higher at 60 x 30 cm with the application of 125 % RDF which was on par with 60 x 30 cm with 100 % RDF (60: 90: 60 NPK hg ha^{-1}). Yield parameter was higher at the spacing of 60 x 30 cm with 100 % RDF. Highest grain yield of 2275 kg ha^{-1} was recorded at the spacing of 60 x 30 cm with 125 % RDF which was comparable with 60 x 30 cm and application of 100 % RDF (2190 kg ha^{-1}). The yield increase under these two treatments was 42.3 % and 40.1 % higher than 60 x 22.5 cm spacing with the application of 75 % RDF. It is concluded that application of FYM at 12.5 t ha^{-1} and adopting a spacing of 60 x 30 cm with 100 % RDF is optimum for maximizing the productivity of sunflower hybrid.

REEXAMINING THE STATUS AND ROLE OF WOMEN SELF HELP GROUP IN EMPOWERING THE RURAL WOMEN

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In the changing social niche, the Government of India and State authorities alike have increasingly realized the importance of devoting attention to the economic betterment and development of rural women in India. Indian constitution guarantees that there shall be no discrimination on the grounds of gender. In the ground reality, however, rural women have harder lives and are often discriminated against with regard to property rights and in access to different rural social services as well as amenities. Women undertake the more onerous tasks involved in day to day running of households including collection of fuel wood , involvement in agricultural activities, fetching of drinking water, taking care of nutritional and health status of the family members etc. Women's empowerment has long been a central feature and limelighted issue in Indian context. Key instruments for supporting women's empowerment are Self Help Groups wherein 10-20 rural women from the same village, mostly poor women come together to contribute to weekly or monthly dues as savings and provide group loans to their members. The promotion of self help groups and mainstreaming the poor women in remote areas of India are two major challenges for supporting the women development. Apart from weak market linkages in the context of income generating activities, there are also few other issues relation to generation of women self help groups. Capacity building of Self Help Groups which are in need of support in financial management and organizational development. With these backdrops the present paper envisages to assess the empowerment of women after joining the self help group. The present study was conducted in coochbehar II block of coochbehar district to analyze the provision of women empowerment through self help group formation and management. The purposive, multistage and random sampling procedures are followed to select 100 women Self help group members as respondent for the study. The data were collected with the help of structured interview schedule through personal interview method. The data were processed into several inferential statistics namely correlation, regression analyzer etc. The study had identified the improvement of women empowerment indicators which were categorized into five definite domains namely psychological, cultural, social, economic and political empowerment.

Key words: ***Women empowerment, Self Help Group, self confidence, social security, bank linkage.***

STUDY ON CROP DIVERSIFICATION PATTERN UNDER CHANGING CLIMATE SITUATION OF HIMALAYA WITH SPECIAL REFERENCE TO DARJEELING HILL

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Current knowledge suggests that climate change will affect both biotic (pest, pathogens) and abiotic (solar radiation, water, temperature) factors in crop systems, threatening crop sustainability and production under hill agro-

ecological niche. More diverse agro-ecosystems with a broader range of traits and functions will be better able to perform under changing environmental conditions, which is important given the expected changes to biotic and abiotic conditions. Together with increasing temperatures, climate change also leads to increasingly unpredictable and variable rainfall (both in amount and timing), changing seasonal patterns and an increasing frequency of extreme weather events, floods, droughts and fire. These can result in decreasing productivity, changing agro-ecological conditions, increasing or altered patterns of pest activity and accelerating rates of water depletion and soil erosion. The changes, and the responses of communities to them, are many and varied in both nature and extent, depending on situation, culture, environment (mountains, drylands, forests, wetlands,), agro-ecosystem, environment and opportunities. In order to understand and analyse the information an appropriate conceptual framework of suitable cropping system is to be needed. Present investigation was carried out during 2011-12, under the aegis of Uttar Banga Krishi Viswavidayalaya, Kalimpong, with the objective to study various cropping system and possible crop diversification under changing climate situation of hills. A variety of research has shown that high plant diversity within agricultural plots can yield higher production levels than systems with low plant diversity. Recognition that climate change under high altitude could have negative consequences for crop production has generated a desire to build resilience into cropping systems. One rational and cost-effective method may be the implementation of increased agricultural crop diversification. Maize would be the most important food crop in the hills and most of the cropping system is maize based. This can very much convenient under changing climate situation as farmers grow it in high altitude also. Earlier maize cultivation was restricted to low to mid altitude zone, but due to increase in temperature and less rainfall this can easily grow in high altitude particularly in Sikkim and Darjeeling hill. In Eastern Himalaya, a variety of crops are planted ranging from maize, vegetables like cabbages, potatoes, squash, coriander and chillies. With regard to agriculture, climate change was found to be a mixed blessing. For negative impacts, the most common responses included overall lower productivity in agriculture, growth of new crop diseases and inability to grow winter vegetables. On the positive side, respondents talked about the ability to grow new crops viz. Potato and wheat. Few regions farmers, the locals were now able to grow potatoes and coriander in winter which was not possible earlier. Rhododendrons and magnolia are flowering earlier by almost one month in Rishav and Lolegao (Kalimpong block II) region. Cultivation of high altitude medicinal plants viz. *Swertia chirayita*, *Podophyllum hexandrium*, *Sausaria lappa* etc. become severely affected with reduction of snow fall and increase in day temperature. Cultivation of aromatic medicine, and exotic plants and orchids has been a source of income in the regional economy, however its cultivation become restricted to few pockets only due to erratic rainfall pattern. Promoting bamboo plantation as a coping mechanism to climate change. Bamboo can be used as construction material, props, fodder etc to reduce dependence on trees and conventional materials, it can also be effectively used for carbon sequestration.

"GUAR GUM" – AN ALTERNATIVE FOR SUSTAINABILITY IN RAINFED CONDITION

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Guar gum is a drought tolerant crop with water requirement of about 250 mm suitable under rainfed condition. Being a leguminous crop it has the capacity to improve the soil fertility. With limited requirement of water, nutrition, short duration and soil conditioner, guar gum can suitably grow on marginal land with limited resources. In view of this, present investigation has been undertaken entitled "Guar gum an alternative for sustainability in rainfed condition". Yield attributing characters viz., number of pods plant^{-1}(14.56), number of seeds pod^{-1}(7.26), number of cluster plant^{-1}(4.66) were significantly higher with opening of furrow in each row which was at par with opening of

furrow in alternate rows. Opening of furrow in each row and alternate rows resulted in increased yield (270.17 kgha^{-1}) compared to flatbed configuration. The protein content (27.65%) and gum content (27.05%), increased marginally with land configuration of opening of furrow in each or alternate rows. Soil moisture content (38.80%) was maximum in opening of furrow in each row which was comparable with opening of furrow in alternate rows and increased significantly than flat bed configuration. Yield attributing characters viz., number of pods (14.28), number of seeds pod^{-1}(7.42) and number of cluster plant^{-1}(4.95) were higher with Vermicompost-2.0 t ha^{-1} than FYM-2.5 t ha^{-1}, Soybean compost-2.0 t ha^{-1} and control. Higher yield (281.71 kg ha^{-1}) was found due to Vermicompost-2.0 t ha^{-1} followed by other organic sources. Protein content (27.95 %) and gum content (27.58 %) was observed significant due to Vermicompost-2.0 t ha^{-1} than control. Soil moisture content (38.54%) was slightly improved with Vermicompost-2.0 t ha^{-1} followed by FYM-2.5 t ha^{-1} and Soybean compost-2.0 t ha^{-1}. Thus on the basis of performance opening of furrow in each row or alternate rows is beneficial to conserve soil moisture along with vermicompost as nutrient source.

Keywords: ***Fym, Organic, Soybean compost, Vermicompost.***

PHYSICAL STRAIN OF WORK UP WITH MANUAL WEEDER

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Physical strain of four types of manual weeders like Khurpi , Trench hoe, Wheel hoe and Wheel finger weeder were ergonomically evaluated with respect to their physiological parameters and physical strain noticed during weeding operation.. The performance in respect of the physiological as well as mechanical parameters were like Working heart rate (WHR), Oxygen consumption rate (OCR), Energy expenditure rate (EER), Relative cost of work load (RCWL) were measured with twelve (12) subjects in the age group of 18-45 years. The mechanical parameters like actual field capacity (FC), highest performance index (PI) were also measured. The physiological and anthropometric parameters of selected subjects were also measured in the laboratory .Four weeders like Khurpi , Trench, Wheel hoe and Wheel finger weeders were evaluated with male and female workers. The mean value of working heart rate was observed to be minimum 85.6 beats/min in case of Khurpi and maximum 130.8 beats / min in case of Wheel hoe. Wheel hoe and Wheel finger weeder recorded maximum physiological parameters during weeding operations as these tools are operated in standing posture in push-pull mode. The actual field capacity was recorded maximum 0.0311 ha/h in case of Wheel finger weeder followed by 0.0149 ha/ h in Wheel hoe and lowest 0.0038 ha/ h(38 square meter) in case of Khurpi.

Key Words: Strain, Weeder, Working heart rate , Oxygen consumption rate , Actual field capacity

INTEGRATED NUTRIENT MANAGEMENT OF UPLAND RICE YIELD AND SOIL NUTRIENT STATUS

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In India, national food security system largely depends on the productivity of rice ecosystem. Management of organic waste in environment friendly manner is becoming difficult due to rapid increase in population and urbanization. The continuous accumulation of these materials is becoming a potential source of land, water and air pollution. Composting is one of the biological processes for recycling of organic waste. It not only reduces the dependence on chemical fertilizers but also improves the bio-physico-chemical properties i.e. encourages the growth and activity of mychorrhizae and increase fertilizer use efficiency, sustain higher productivity and improved soil health. It is very likely that the use of composted organic materials along with chemical fertilizers may be an effective alternate approach for further improving levels of the crop yields without deteriorating soil health. Some researcher reported that 75% Recommended Dose Nitrogen through inorganic fertilizer and 25% nitrogen through carpet waste + cow dung Slurry + *Pleurotus sajor* + *Azotobacter* + PSB + *Trichoderma* + enrichment with S and Zn was the most appropriate organic nutrient Management system for higher productivity with better soil health on long term basis. Furthermore, other Researchers also reported that Combined use of 50% recommended dose of fertilizers, Gliricidia @ 2.5 t/ ha and bio-fertilizers with highest grain yield, net returns and Cost benefit Ratio was the best Integrated Nutrient Management option. Therefore Keeping in view of this, the review is to obtain high yields of rice plant and to improve the soil fertility by combining organic and inorganic fertilizers in a sustainable way.

Keywords: Integrate, Nutrient, bio-fertilizer, Chemical, Rice, Management, Sustainable.

PROCESS DEVELOPMENT OF THERAPEUTIC RTS BEVERAGE FROM BLEND OF ALOE VERA AND PINE APPLE

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Aloes have been used therapeutically for their medicinal and nutraceutical value. Pine apple (*Ananas comosus*) juice contains the high vitamin C (47.8 mg/100 ml). Hence Aloe vera juice was blended with pineapple juice for increasing the therapeutic, nutritional and functional value of ready-to-serve (RTS) beverages. Aloe vera gel and pineapple juice were utilized at various combinations with sugar and artificial sweeteners (aspartame, saccharine and neotame) for preparation of therapeutic RTS beverages and evaluated for physicochemical and sensory attributes during storage. The study revealed that the low calorie therapeutic RTS beverages prepared by blending of aloe vera and pineapple juices with neotame has scored maximum for almost all sensorial quality attributes such as appearance, colour, flavour, taste and overall acceptability and also found ascorbic acid content (45.8 mg/100 g). A reducing trend was observed in ascorbic acid and increasing trend was observed in acidity content during the storage of beverages at room temperature over a period of 60 days. The beverage changed significantly with respect to TSS content along the storage period.

Keywords*: Aloe vera, Pine apple, Therapeutic beverages, Ready-to-serve (RTS), Storage studies, Sensory Quality and Artificial sweeteners*

ECO-FRIENDLY USE OF COAL FLY ASH AS A SUPPLEMENT OF NUTRIENT FOR BETTER PRODUCTIVITY OF SUNFLOWER

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To assess possible impacts of fly ash on edible crop, this investigation examined the changes in growth, biochemistry, heavy metal content of *Helianthus annus*. Results of field experiments reveal that fly ash applied to soil at the rate of 5 T/H to 80 T/H increased germination, shoot height, Leaf number, Root number, Root length, peroxidase Activity and etc. The observed beneficial effects of fly ash on crop growth & its yield performance may be attributed to its contents of plant nutrients especially the trace elements in poor or marginally deficient soil. Because of the presence of heavy metals in the edible parts, it may be concluded that fly ash can be used in agriculture as soil amendment with caution.

Key words: Fly ash, *Helianthus annus,* Growth, Biochemistry, Cytology, Soil and Heavy metals.

RAINWATER HARVESTING IN HILLY TRACT OF WEST BENGAL AND NORTHEAST REGION

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Water is essential for all life and used in many different ways, it is also a part of the larger ecosystem in which the reproduction of the bio diversity depends. Development of human societies is heavily dependent upon the availability of freshwater in adequate quantities and with suitable qualities. Water harvesting term was first used by Geddes, University of Sydney. He defined as the collection and storage of any form of water either runoff or creek flow for irrigation use. The absence of alternative sources like wells or dug wells which are common in the plains. Water harvesting was practiced more than 1000 years back in South India, by way of construction of irrigation tank, ooranis, temple tanks, farm ponds etc. Rainwater harvesting is a technology used for collecting and storing rainwater from rooftops, the land surface or rock catchments using simple techniques such as jars and pots as well as more complex techniques such as underground check dams. The main principal components for Rain water harvesting viz., catchment area, collection device, and conveyance or utilization system. The hilly states like Assam, Nagaland, Manipur, Mizoram, Meghalaya and Tripura in the Indian boundary which followed the traditional artificial recharge practiced like Zabo, Cheo-oziihi and Bamboo-drip Irrigation. Rainwater harvesting appears to be one of the most promising alternatives for supplying fresh water in the face of increasing water scarcity and escalating demand. Rain water harvesting can serve as an important role in hilly areas where poor quality of fresh water are limited causing its scarcity and areas with limited rainfall. Water scarcity is a major issue in the hilly areas like Darjeeling and some major areas of North East India a proper and quality research alone with knowledge distribution to the people about rain water harvesting is a need of hour.

Keywords: Rain water harvesting, utilization, hilly regions.

REVIEWING THE PERFORMANCE OF POVERTY ALLEVIATION AND LIVELIHOOD SECURITY PROGRAMME

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According to the Government of India Millennium Development Goal Report 2009, the Poverty Headcount Ratio was estimated to reach 18.6 percent by 2015 to suggest that the country will still remain short by about 3.5 percentage points from the set target. Ever since the inception of planning in India, the policies and the programmes have been designed and redesigned to formulate specific poverty alleviation programmes to usher better livelihood of people for greater social transformation. An important one is Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) came into being to mandatorily provide at least 100 days of guaranteed wage employment in a financial year on demand. MGNREGA is a powerful instrument for ensuring inclusive growth in rural India through enhancing income which inturns lead to better access with food in a sustainable manner and livelihood security of the rural poor. Now, contextual to such large public expenditure for alleviation of poverty, the present research take a stock as to how this flagship programme have been able to comply with the promises made during their introduction in respect to enhancement of the quality of life amongst the poverty stricken rural gentry of Manipur with critical examination of the performance of the programme. The study is based on secondary data as it intends to examine the functioning of MGNREGA in the state as a whole. Thus, data has been collected from the official website of MGNREGA (www.nrega.nic.in) and annual report for MGNREGA, published by Department of Rural Development and Panchayati Raj, Govt. of Manipur. Data used in the study relate to the years 2008-09 to 2014-15. Official data furnished reveals a comparative picture of seven years physical achievement in issuance of job cards, employment demanded and provided and person days generated from 2008-09 to 2014-15 in Manipur. The data shows a consistent increase in issuance of job cards in almost every year. And it also reported that in overall during the seven financial years under taken for the study scheduled tribes holds the highest in job cards issuance. MGNREGA as we all know, is a demand driven employment guarantee Act, accordingly the execution of MGNREGA was also evaluated in terms of job demanded and provided and it was found that most of the financial years attained equal number of households provided employment with respect to households demanded employment, which was indicative of positive performance of the programme leading to a quality change in the life of the people. Thus, from the findings, we can conclude that MGNREGA acts as strong strategies of food and livelihood security of the vulnerable people.

INDIGENOUS ORNAMENTAL FISH DIVERSITY IN TORSA AND GHARGHARIA : NATURE'S CONSERVATION STRATEGY

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A rapid survey conducted during pre monsoon, post monsoon and winter season of three consecutive years (2011-2013) from selected sampling sites and landing centres of Torsa and its offshoot, Ghargharia river of Coochbehar District revealed 24 and 26 indigenous ornamental fish species belonging to 8 and 9 orders and 19 and 21 genera respectively. Cypriniformes was recorded to be the largest representing Order in both Torsa and Ghargharia bearing 10 and 12 species respectively. Study on availability of seven selected threatened indigenous ornamental fish as experimental species under order Cypriniformes (3), Cyprinodontiformes (2) and Perciformes (2), elsewhere known as very rare in other river system of West Bengal, revealed their frequent availability in torsa and ghargharia. In Ghargharia, most of the experimental fish species was recorded plenty in numbers. *Chanda nama* was

absent in torsa but it was present in moderate number in Ghargharia (15). Endangered species, *Esomus danricus* was found in good quantity in Torsa (34) which was recorded highest in Ghargharia (63) being 1.85 times higher than Torsa. *Amblypharyngodon mola* and *Colisa fasciatus* were found double of the quantity found in Torsa. *Puntius ticto*, the vulnerable one was found 1.5 times higher in Ghargharia. Most significantly, *Colisa lalia* was recorded 7.00 times higher in Ghargharia showing better citation than Torsa . Only exception is *Chanda ranga* showing higher quantity in Torsa. Present observation clearly indicated a relationship between course and area covered by the river and biodiversity richness. Torsa, being the main river course facing much anthropogenic exploitation demonstrated a declining trend of fish diversity whereas Ghargharia, the offshoot having lesser anthropogenic activities were observed to be more rich in respect to its fish species diversity which enlightens us to think about the Nature's inherent conservation strategy adopted by an offshoot like Ghargharia.

Keywords: conservation, ornamental fish biodiversity, torsa, ghargharia

HOST-INDUCED SILENCING OF A NEMATODE PROTEASE GENE IN TOMATO PLANTS CONFERRED ENHANCED RESISTANCE TO ROOT-KNOT NEMATODES

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Plant-parasitic, root-knot nematodes (*Meloidogyne* spp.) are arguably the most damaging genus of biotrophic pests of vascular plants, and thus have a major impact on global agricultural production. Due to the Changing climate and agricultural practices RKNs are becoming a menace in newer crops and geographical localities. Currently available management practices have failed to contain the problem; hence, there is a critical need to develop environmentally-friendly and smart approaches tailor-made to reduce the nematode disease burden in Indian agriculture. Utility of host-delivered RNAi has been demonstrated in several plants (Arabidopsis, tobacco and soybean) that exhibited resistance against root-knot and cyst nematodes. In the present study, a *M. incognita*-specific protease gene, cathepsin L cysteine proteinase (*Mi-cpl-1*), was targeted to generate tomato transgenic lines to evaluate the genetically modified nematode resistance. *In vitro* knockdown of *Mi-cpl-1* gene led to the reduced attraction and penetration of *M. incognita* in tomato, suggesting the involvement of *Mi-cpl-1* in nematode parasitism. Transgenic expression of the dsRNA of *Mi-cpl-1* gene resulted in 60-80% reduction in infection and multiplication of *M. incognita* in tomato. Evidence for *in vitro* and *in planta* silencing of *Mi-cpl-1* was confirmed by expression analysis using quantitative RT-PCR. Our study demonstrates that *Mi-cpl-1* plays crucial role during plant-nematode interaction and plant-mediated downregulation of this gene elicits detrimental effect on *M. incognita* development, reinforcing the potential of RNAi technology for management of phytonematodes in crop plants. The findings of the present study lead to the better understanding of the mechanism of nematode parasitism which ultimately helps in designing smarter nematode management options.

GENETIC TRANSFORMATION OF IMMATURE EMBRYOS FROM MAIZE BY GUS MARKER GENE WITH AGROBACTERIUM

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An efficient Agrobacterium-mediated transformation system, from which transgenic tropical maize plants were directly generated without previous crosses with laboratory or temperate lines, was established. Experimental evaluations were focused on two main issues: i) Establishment of appropriate tissue culture conditions, which induced somatic embryogenesis from the immature embryos cells, and ii)The delivery of T-DNA toward these cells. High rates of embryogenic calli, mainly generated from the immature embryo, were obtained when 2-4-D were included into the MS based induction medium; rates up to 19 plants per gram were regenerated from these induced calli. Regarding the Agrobacterium strains evaluated for their transformation capability on the tropical maize lines NJ-2092 used here, best results were obtained from the strain when applied at OD 550_{nm}= 0.5-1.0. Physical micro-wounds before the Agro-infection proved to be an excellent way to promoting both the T-DNA transferring toward the immature embryo and the increasing of rates of transient GUS expression. The highest frequencies of transient GUS expression corresponding to the embryos as well as the regeneration of whole transgenic plants emerged from them, were obtained using immature embryos wounded by bombarding at 80 lb/in^2 followed for vacuum infiltration before and during the Agro-infection, respectively. Analysis of the progenies confirmed the sexual transmission of the introduced genes and their stable expression.

Keywords: Agro-infection, Immature embryos, Somatic-embryogenesis, 2-4 Dichlorophenoxy acetic acid, 6-Benzylamino purine, Indole acetic acid, Naphthelyene acetic acid.

PERCEPTION ON EFFECT OF CLIMATE CHANGE ON FOREST AND ADAPTATION STRATEGIES OF FOREST DEPENDENT COMMUNITIES IN A HUMID TROPICAL FOOTHILL FOREST OF INDIAN EASTERN HIMALAYAS

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The present study documented perception of forest dependent community inhabiting in and around fringe villages of Chilapata Reserve Forest on climate change with its associated risk and coping strategies adopted. A total of 100 respondents not below the age of 40 through random sampling were selected for personal in-depth interview through close ended questionnaire schedule. The results show that forest dependent community of Chilapata Reserve Forest have considerable awareness and consistence on climate change and its effects on the weather, ecosystems, biodiversity and agriculture. They perceived climate change and believed it as worldwide phenomena. Majority of them perceived increase in temperature as increase in day and night temperature, mildness in winter and warming of winds. Similarly they believed that monsoon is becoming unpredictable day by day with changed intensity and pattern but generally arriving late and withdrawing early over the past few decades along with decrease in cloudy and rainy days. Majority of these people also perceived negative impact of climate change on forest biotic and abiotic environment along with risk on their livelihood through increased misery, decreased income, increase susceptibility to

serious diseases and decreased availability of food and water. Having perceived climate change the community is adopting knowledge-based adaptive measures to cope with it but with medium adaptive capacity. A total of 17 coping options were identified. Pre-monsoon dry-seeding, agroforestry, crop rotation, short duration crop varieties and use of organic products are popular. The study also revealed a need for scientists, government and non-government agents and other stakeholders to support efforts by farmers to adapt to effects of climate change through technological, policy and financial interventions with an aim of improving livelihoods and food security.

***Keywords*: Climate change, adaptation, mitigation, biotic, abiotic, dry-seeding etc.**

GRADING OF WORKLOAD OF MALE AND FEMALE AGRICULTURAL WORKERS

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Grading of workload during Agricultural activities in paddy cultivation system has been chalked out on the basis of the physiological parameters of male and female workers in Odisha in the age group of 18-45 years. For this purpose ergonomical parameters like working heart rate (WHR), oxygen consumption rate (OCR), energy expenditure rate (EER), relative cost of workload (RCWL) (% of VO_2 max) of both male and female agricultural workers performing forty (40) different operation in paddy cultivation system were measured. Six male and six female workers were selected for this study and their physiological parameters were recorded. VO_2, max varied in the range of 1.82 to 2.12 l min^{-1} for male and 1.56 to 1.81 l min^{-1} for female workers. The highest cardiac cost in term of working heart rate was observed to be maximum in case of grain threshing by beating of paddy bundler on stone/wooden surface followed by (142.3 beats min^{-1}) operating with pre-germinated paddy seeder (138.2 beats min^{-1}). For the case of female worker the highest cardiac cost was recorded highest in bund thinning with spade (138.4 beats min^{-1}) followed by operating with 6 row pre germinated paddy seeder (136.3 beats min^{-1}) and lowest in case of winnowing with power winnower (98.2 beats min^{-1}). The oxygen consumption rate and energy expenditure rate followed the same trend. The grading of workload was generally based on the physiological parameters like heart rate, oxygen consumption rate and relative cost of workload.Many researchers have categorized this grading of workload rate broadly into six types like very light, light, moderate heavy, heavy, very heavy and extremely heavy. But during the participatory discussion with these agricultural workers it was noticed that the workers generally categories it into three major types of grading i.e light, medium and heavy type of agriculture operation. Keeping the WHR, OCR and RCWL (% of VO_2 max) into consideration the agricultural activities can be categorized for the agricultural operation can be named as “light” type of operation when the working heart rate, oxygen consumption rate and relative cost of work load are below 100 beats min^{-1}, 0.6 $lmin^{-1}$, and 35% where as for “medium” type of operation the WHR, OCR and RCWL (% of VO_2 max) may in the range of 100-125 beats min^{-1}, 0.6 – 1.01 $lmin^{-1}$ and 35-50% . For “heavy” type of operation the WHR may be considered (> 125 beats min^{-1}), oxygen consumption rate (> 1.01 $lmin^{-1}$) and relative cost of work load (> 50%). Keeping all these three grading of work load into consideration laddering, paddy broadcasting, power transplanting, birds scaring, spraying with hand compressor spraying are categorized as light type of operation. Whereas bund thinning, manual transplanting, weeding, high treadle pump, harvesting with sickle, reaper, grain threshing can be graded as medium type of operation. Ploughing with Mould Board Plough, Bullock puddling, using four row paddy transplanter and 6 / 8 row paddy seeder, water lifting with local Tenda, transporting unthreshed paddy on head and yoke etc. may be categories as heavy type of operation.

***Keywords*: Grading, Work load, Paddy cultivation, Working Heart Rate, Oxygen consumption Rate.**

DEVELOPMENT OF ERGONOMICALLY DESIGNED WEEDER FOR INCREASING PRODUCTIVITY

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As natural postures and movements are necessary for an efficient work, the tools, equipment and work places need to be designed to suit the body size of the workers (Grandjean, 1982). It is not possible to make designs to suit everybody i.e. from the biggest to the smallest workers, from male to female agricultural workers. Keeping this in view, design recommendations was made for modifying the existing wheel hoe and wheel finger weeder, those are generally of dry land weeders operated in push-pull mode. Different anthropometric parameters like stature, accromial height, elbow height, olecranon height, elbow rest height, elbow-elbow breadth, hand length at metacarpal-III were taken into consideration. The ergonomically designed weeders were evaluated with male and female workers with respect to their physiological and mechanical parameters.

Key words: Ergonomics, weeders, anthropometric, weeding index.

CONSERVATION MANAGEMENT STRATEGIES FOR SACRED NATURAL SITES OF UTTARAKHAND, INDIA

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The scientific studies carried out all over India suggest the ecological importance of SNS in India with Uttarakhand becoming no exception. For documentation purpose a semi-structured questionnaire was prepared which covered aspects such as Village profile, Features of sacred elements including area of SNS, Management system, conservation options and perceptions for future management of these SNS. The management options followed by the local communities documented in the present study for 132 SNS from nine districts are of different opinions across different study sites. Out of various management options followed, three options are mainly dominant as seen from the documentation namely Social fencing, Boundary demarcation and customary rights. The faith of the local people in the deity is the most obvious aspect of the SNS and which gets reflected from the social fencing as the dominant management option followed by the local communities. There have been three major suggestions which dominate the out of total eight suggestions for conservation management of the SNS in Uttarakhand. The most important suggestion (26%) is awareness and education for not only to the younger generation but also to the practitioners and the government departments such as the State Forest Department. The National Guidelines on Selection and Management of the Biodiversity Heritage Sites have been issued by the National Biodiversity Authority (NBA). The present study of 132 SNS provides a very good basis to understand the applicability of these guidelines in the context of Uttarakhand.

Key words: Sacred, Perception; Management; suggestion; Heritage

A PROSPECTIVE PERCEPTION OF FOREST DEPENDENT STAKEHOLDERS FROM INDIAN HIMALAYA

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The State of Uttarakhand occupies a special place in participatory management of common natural forest resources because of its Van Panchayat system. This article indicates that the rules and regulations devised by the Van Panchayat Village Committee for the management of forests are unique from one Van Panchayat to another. The study also examines the perceptions and attitude of the village communities on the use, conservation and management of Van Panchayats. In this paper, in-depth interview and questionnaire data about general description of villages and perceptions were examined from both qualitative and quantitative information. Respondents have expressed their perception about their problems, attachments, committee selection, youth and women's participation, local development needs, work towards dispute settlement and positive or negative attitudes towards Van Panchayats. Despite, most of the respondents supporting the management of Van Panchayats, some respondents especially educated youths have negative attitude towards management. The study illustrates and suggests a number of suggestions for the management of Van Panchayats.

Key words: Management, Communities, stockholders, perception

PLANT GROWTH PROMOTING POTENTIALITY OF NATIVE *AZOTOBACTER* SP. AND THEIR MOLECULAR TYPING

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Azotobacter is a free-living nitrogen-fixing bacterium, which is used as a biofertilizer in the cultivation of most crops. Present day *Azotobacter* sp. is used as plant growth promoting rhizobacteria (PGPR) for improvement of soil and plant health. In the present study, 22 rhizobacterial isolates, from different crop rhizospheres of Terai and Gangetic agro-ecological regions of West Bengal, were isolated and screened for PGPR activities. Among these, 10 were found to be potential PGPR and selected for further study. The *Azotobacter* isolates were morphologically identified, and characterization was performed through different biochemical assays and also through molecular by Nif H-g1 primer pairs. The *Azotobacter* isolates were studied for *in vitro* antagonistic potentiality against soil borne pathogen *Rhizoctonia solani*. The antagonistic potentialities of *Azotobacter* were assayed based on quantitative estimation of indole acetic acid (IAA), hydrogen cyanide (HCN) and siderophore.

The *Azotobacter* population was ranged from 7.5 x 10^3 to 9.8 x 10^4 Cfu g^{-1} soil from wheat crop rhizosphere. The highest population was found in soil sample, collected from Domkal, Murshidabad and the lowest was found in Jalpaiguri soil sample. All the isolates showed a positive 250bp DNA fragment by primer pair *Nif H-g1* ensuring their genus *Azotobacter*. Among the isolates, AZT8 was recorded the best plant growth promoting potentialities showing chili vigor index 1105.44 and producing IAA, 118.08 µg/ml. Isolate AZT3 was found to be the most antagonistic against *R. solani* , exhibiting percent inhibition at 72.2%. Calculating Pearson correlation it has been found that

antagonistic activity is positively correlated with siderophore production, whereas, vigor index is positively correlated with IAA production. Through ERIC-PCR fingerprinting analysis it has been found that there are four clusters and eight distinct genotypes at 31% similarity level and by BOX-PCR fingerprinting analysis it has been observed that there are five clusters and ten distinct genotypic patterns at 37% similarity level. High degree of genetic diversity was observed among the native *Azotobacter* isolates. BOX-PCR was found to be more effective in determining genetic diversity among the *Azotobacter* isolates. And finally, due to the innate potentiality of producing an array of antifungal metabolites and plant growth promoting substances, a consortium of isolates AZT3 and AZT8 can be exploited for bio-intensive disease suppression in sustainable agriculture.

Keywords: *Azotobacter,* biofertilizer, plant growth promoting rhizobacteria, antagonistic potentiality

SOME SPECIAL CHARACTERISTICS OF FARMERS' VARIETIES OF RICE (*ORYZA SATIVA* L.) FOR TESTING OF DISTINCTIVENESS

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Distinctiveness of a genotype is compulsory for registration under PPV&FR Act (2001). Some of the special characters of rice have been already included in the *Table of Characteristics* in the "Guidelines for Conduct of Test for Distinctiveness, Uniformity and Stability on Rice (*Oryza sativa* L.)" published by PPV and FR Authority, Government of India for Rice, however some other characters which may be included in the descriptor and/or some existing trait in the descriptor may be modified. In this communication we have found that multiple kernel character (reference variety- *Jugal*) has not been included in the above mentioned descriptor and this character may be included. Occurrence of single, double and triple kernels per spikelet was 53.9, 42.2 and 3.9%, respectively. Only the colour of the sterile lemma has been included in the existing descriptor, whereas the length of the sterile lemma may also be included. The average length of the sterile lemma in *Rami Gelee* was 9.09 mm, whereas the length of fertile lemma was 8.67 mm. Apart from these two characters, in this communication we have elaborated three more characters, namely clustered panicle, coloured kernel and dark purple coloured rice plant.

Key Words: Famers' varieties, Rice, Clustered panicle, Many kernel, Black kernel, Long sterile lemma, Purple plant

APPLICATION OF GIS IN FOREST RESOURCE MANAGEMENT

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To meet the requirements of natural resources, it needs a better management of spatial data and information. Recent trends which have been used to tackle problems of management now a day include remote sensing and GIS. Manual and conventional approaches for management have become outdated as these are tiresome which calls for a need to apply remote sensing /GIS tools in better management of natural resources. GIS applications can be effectively used in urban planning, natural resource management, query of species on the verge

of extinction, selection of suitable species for afforestation, wood supply simulation, fire control management, monitoring fire, forest decline, forest road designing, tourism development and other land uses.

EFFECT OF TiO_2 NANO PARTICLES ON SEED GERMINATION AND GROWTH OF TOMATO

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Nanotechnology, the process to generate, manipulate, and deploy nanomaterials, represents an area holding significant promise for the agricultural scenario. The present experimental investigation demonstrates the effect of nano Anatase -TiO2 (<100nm size) particles on the seed germination and growth of Tomato (*Solanum lycopersicum*) seedling using local variety Patharkuchi. Tomato seeds were treated with different concentrations of nanoscale TiO2 (10, 20, 30, 40, 50 mg L^{-1}) and the effect of this treatment was studied on seed germination and seedling growth characteristics. The experiment was conducted at laboratory and arranged on base on completely randomized design (CRD) with 3 replications including 20 seeds in each replicates. The study was carried out in a glass plate and pot for 20 days of seedling growth. Application of nTiO2 significantly enhanced the characteristics of seed germination and seedling growth for most of the treatment as compared from the control. Based on biomass assay, it was found that the seedlings displayed good growth over control, demonstrating a positive effect of the nanoparticle treatment. Different concentration of nano particles showed good germination of seeds and had no toxic effect on growth. Best performance was observed for germination percentage in concentration 10 mg/lit and maximum roots and shoots growth in 20 mg/lit TiO2 concentration. Application of TiO2 stimulated a significant impact on the seed germination potential and growth but it was found that the accumulation and uptake of nanoparticles was dependent on the exposure concentrations. In particular, the exposure of plants to nano materials and the impacts of such an exposure on plant systems could open a new direction research on nanotechnology.

Keywords: **TiO2, nano particles, tomato**

ANALYSIS OF GENETIC VARIATION IN *Musa balbisiana* COLLA POPULATION OF MEGHALAYA AS REVEALED BYSINGLE PRIMER AMPLIFICATION REACTION APPROACH

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The Indian subcontinent is considered to be the majorcenter of hybridization of the wild *Musa* progenies, as it forms the center of secondaryorigin of the taxa and therefore expected to exhibit a highdegree of diversity.*Musa balbisiana* Colla is known to be one of the wild progenitors of cultivated bananas and plantains. Knowledge of genetic variability is very important for contemplating any conservation and management programmes. Single Primer Amplification Reaction (SPAR) methods i.e.,a combination of random amplified polymorphic DNA (RAPD), inter simple sequence repeats (ISSR) and directed amplification of minisatellites DNA (DAMD)markers function as important tools for analyzing genetic variation in plants. They collectively provide a comprehensive description of the

nature and the extent of existing natural genetic diversity,as the primers target different regions of the genome. A total 47SPAR primers (RAPD-25, ISSR-12 and DAMD-10) with high reproducibility were used for intraspecific genetic variation analysis of the 12 genotypes of *M. balbisiana*, which yielded 331 polymorphic bands (87.10 %).The RAPD, ISSR and DAMD markers revealed 82.63 %, 90.36 % and 84.72 % of polymorphic bands, respectively.The polymorphic information content (PIC) values were almost identical for each marker system while the resolving power (Rp) was found to be highest in DAMD (4.10).The dendrogram obtained showed the presence of two main clusters in three analyses with some genotypes (MB10-MB11 and MB5-MB7) always maintaining and manifesting their strong genetic relationship by clustering together.Combinations of such markers can thus be considered as more effective and promising for assessing genetic variation in other*Musa*species as well.

A COMPARISON ON GLYCEMIC INDEX VALUES OF DIFFERENT RICE VARIETIES

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Rice is a staple carbohydrate source for a large part of humanity. Rice grains from different parts of the world differ genetically. In cultures that consume a lot of rice, it is also a contributor to excess carbohydrate in the diet causing our modern day health woes, of obesity and decision associated with ageing. The glycemic index (GI) is a tool to measure a food's effect on blood sugar. Generally food with GI of 55 or less are considered low (good), while values of 56 to 69 are medium and those 70 or higher (bad). Low GI rice could help to "keep diabetes at bay" by slow digestion and absorption rates in the body, causing a gradual and sustained release of sugar in the blood. Investigators from the International Rice Research Institute (IRRI) and Australia 's Commonwealth Scientific and Industrial research Organization (CSIRO) Food Future Flagship evaluated 235 varieties of rice and discovered that the glycemic index values ranged from 48 to 92 which indicate people with diabetic have healthful options when it comes to choosing rice as part of their diet. It was also found that the main gene associated with glycemic index in all the varieties is the waxy gene. This information will allow rice breeders to develop more varieties of rice with low GI values and thus expand the options for people with type 2 diabetes. India's most widely grown rice variety Swarna have low GI and varieties like Doongara from Australia and Basmati have medium GI.

Key words: Rice, Glycemic index

EFFECT OF DIFFERENT SEED AND SOIL TREATMENTS ON PLANT GROWTH AND INCIDENCE OF RHIZOME ROT AND WILT DISEASE COMPLEX OF GINGER

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Ginger cultivation in Darjeeling hills of West Bengal has suffered badly due to occurrence of rhizome rot and wilt disease complex. In the present study attempts have been made to manage this complex problem by seed and soil treatment with different chemicals and biotic agents. The synergistic effect on plant growth promotion of ginger was recorded when rhizomes were treated with bio-agent consortia i.e. both *Pseudomonas fluorescens* and *Trichoderma viride* Pundibari isolate. Nearly 51-80% reduction in disease incidence was observed when hot water and bio-agent consortium treated seed rhizome was planted in soil where neem cake was applied. Seed rhizome treatment with bio-agent consortium had a synergistic effect both on plant health and disease management.

Keywords: Ginger, Zingiber officinale Rosc, Rot and wilt disease complex, Management

IMPROVING SEEDLING HEALTH OF BELL PEPPER (C*apsicum annum* L.) BY PLANT GROWTH PROMOTING MICROORGANISMS

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Organic vegetable cultivation is a present day need not only to meet the demand of export oriented produce and to reduce cost of cultivation but also to protect the environment and crop ecosystem from inevitable continuous hazards due to indiscriminate use of chemical fertilizers and pesticides. Soil microorganisms perform key role in maintain soil fertility. Significant activities have been observed in biological control of the plant pathogens as well. Use of these plant growth promoting microorganisms (PGPMs) is gaining tremendous importance in the field of research and the farming community in particular. However, the performance depends upon the potentiality of the isolates and in most cases appropriate consortia of microorganisms with different modes of action proved to be better than application of individual. In the present investigation four widely studied PGPMs viz., *Azotobacter* sp. (UBAZ-1), phosphate solubilising bacteria (UBPS-9), *Trichoderma* sp. (UBT-18) and *Pseudomonas fluorescens* (VPf-1) were evaluated for their ability either individually or in consortia to induce the physical and biochemical fitness of the bell pepper (*Capsicum annum*) transplants. Bio-inoculant consortia irrespective of combination increased the germination, chlorophyll, shoot and root length, shoot and root biomass as compared to non-inoculated seedlings of bell pepper. UBT-18, UBPS-9 and UBAZ-1 in integration were found to significantly increase the physical parameters like chlorophyll, shoot length; fresh and dry shoot weight. Germination was significantly higher in UBT-18 and VPf-1 inoculation. Vigour index as the indicator of seedling health was significantly higher with consorted inoculation of UBT-18, UBPS-9 and UBAZ-1. Biochemical attributes like total protein, phenol and poly phenol oxiadase activity were also found to be strongly correlated with the better health of the seedlings which could further be endorsed by higher microbial activity in the rhizosphere. Protein and phenol content were maximum in transplants raised with consorted inoculation of UBT-18, UBPS-9 and UBAZ-1. Poly phenol oxidase activity was found to be significantly high in the seedlings raised by using combination of UBT-18, UBPS-9, VPf-1 and UBAZ-1. The highest dehydrogenase activity of the nursery mixes at transplanting stage was measured in consorted inoculation of UBT-

18, UBPS-9 and UBAZ-1. Uptake of nitrogen and phosporus in mature plants and available nitrogen in the soil at harvesting stage were also found significantly higher when grown with microbial consortia.

RAPID MONITORING OF SOIL ARSENIC POLLUTION VIA DIFFUSE REFLECTANCE SPECTROSCOPY

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This pilot study investigates the viability of applying diffuse reflectance spectroscopy (DRS) approach using the visible near infrared (VisNIR), mid infrared (MIR) and combined VisNIR + MIR spectra for identifying soil As pollution. The raw soil reflectance spectra were preprocessed using three spectral transformations for predicting soil As contamination using three multivariate algorithms. In general, better accuracy was achieved by VisNIR spectra via elastic net-first derivative model (R^2=0.97, residual prediction deviation=6.32, RPIQ=7.33, RMSE=0.24 mg kg^{-1}). The predictive mechanism for estimating soil As was governed via close association between soil As and spectrally active soil components.Moreover, the VisNIR-predicted As results were incorporated into ordinary kriging and indicator kriging to identify spatial patterns of soil As contamination and pollution risk hotspots. Summarily, this study suggested that the combined use of VisNIR prediction and geostatistics has the potential to identify the spatial patterns of As contamination in soil quickly on site, reducing the need for expensive laboratory analyses.

Keywords: elastic net; diffuse reflectance spectroscopy; landfill; mid infrared; soil arsenic; visible near infrared.

NUTRITIONAL INDICES OF *Cricula trifenestrata* Helfer (Lepidoptera: Saturnidae)

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The nutritional indices of *Cricula trifenestrata* Helfer (Lepidoptera: Saturnidae) was studied on four food plants all over the year. The proportional food intake during different larval instars revealed that about 3-4.7% of the total intake of dry matter was ingested in first three instars, 69-72% by last, about 90-92% during the last two instars and about 95-97% during last three instars of *C. trifenestrata*. On the basis of both RCR and RGR the crucial stage of development of *Cricula trifenestrata* larva was the 3rd instar. Higher ECI and ECD of the 3rd stage larvae also suggested that the 3rd stage larva was physiologically quite different to the other instars. Based on higher RCR, RGR, ECI and ECD and lower larval duration, RR and AD values the suitable foods and the seasons for the development of the insect are som followed by cashew, mango and cinnamon and May-October followed by October-January, January-March and March-May in terai region of West Bengal.

STUDIES ON THE SEEDLING BLIGHT DISEASE INCIDENCE AND SEVERITY IN V*aleriana jatamansi* Jones

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Indian valerian *(Valeriana jatamansi* jones*)*, is an endangered, high value, medicinal plant. The plant has distinct dimorphism in the floral biology and gynodioecious character and perennial in nature. Plant height at maturity stage has the range between 10.5 cm. – 22.3 cm. The plants were found to have flowering period in between January to April. Indiscriminate collection of rhizomes from the plants made potential threat of its existence in some previously found localities in Darjeeling district, West Bengal, India. It is enlisted in the endangered category by IUCN and as an endangered species in the national medicinal plant board, New Delhi. The cultivation of Indian Valerian is getting popular due to its tremendous medical potential for treating diseases in human beings and as well as increasing demand of aroma and ayurved industry. It has sesquiterpenoids, valerianan oids, forty chemical constituents, constituents of essential oils and eleven jatamanins. It has also been used in Ayurvedic system of medicines for preventing epilepsy, snake and scorpion bite, cholera, dementia, nerve diseases of human beings. Valerian, the commercially produced alkaloid is found to be present in Valerian roots which is effectively used as sedative in Germany having the trade name 'Valmane' besides other diseases. The valepotriates of the plant has cyto- tonic and anticancer activity which was clinically proved, found in the leaves and rhizomes of the plant. Recently, Seedling blight has been emerged as alarming threat to the cultivation of Indian Valerian. Fixed plot surveys were conducted at 15 days interval to get an idea about the nature of disease incidence and severity at different altitude. The plant is affected by fungal pathogen *Rhizoctonia solani* in the entire three experiment plot Kalimpong (3250 ft msl), Algarah (5600ft msl) and Lava (6800ft msl) of Darjeeling district, West Bengal. The symptomatology of seedling blight disease incidence, severity and distribution in the study area was examined during 2011–2015 to know the nature of disease and influence of weather parameters were also recorded to find out the correlation. The results of the study indicated that seedling blight incidence is greatly influenced by weather parameters and *Rhizoctonia solani* caused highest seedling blight disease in the month of August (23.12%) and lowest disease incidence was recorded in the month of June (9.60%).

Key words: Indian Valerian, *Valeriana jatamansi* , *Rhizoctonia solani*,, Severity and seedling blight.

DEVELOPMENT OF SUPER RICE IN MID DURATION GROUP FOR IRRIGATED AND SHALLOW LOW LAND ECOLOGY

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Breaking the yield ceiling of irrigated rice would be the key for meeting the global as well Indian rice requirement. There is by and large stagnant yield potential of semi-dwarf *indica* inbreeds observed since release of

IR-8. New plant type (NPT) is one of the potential approaches for raising yield ceiling in irrigated ecology initiated by International rice research Institute in late nineties, but was not resulted with much success in *indica* rice. In this context, *Tropical japonicas (Javanicas)* and aromatic rice were supposed to be the potential donors, because of their diversity in terms of genetic distance. However, there has to be a combination of few prospective traits, viz., erect and broad top three leaf, panicle heaviness and architecture, high culm strength to support heavy panicles, high grain number, higher grain fertility, heavy panicles and optimum tiller number etc. In this context, 250 *Tropical japonicas* (TJ), TJ derivatives, aromatic derivatives were tested and 8-10 were found with suitable for some or other traits for their morpho-physiological traits and their combining ability. These genotypes were hybridized with second generation NPTs to harness the genetic broadness of NPTs along with *tropical japonica* ancestry. Biparental and multiparental crosses were made and the pedigree method of selection was practiced. In F8, 47 genotypes were selected with above said parameters along with higher biomass and heavy panicles (highest panicle size ranged from 4.5 g to 15.5g). However, biomass was attributed mostly due to top three leaves, rather than more plant height. Yield evaluation was done in Advanced Yield Trial during *Kharif* and *rabi* seasons and two genotypes were emerged with highest grain yield of 8.01 and 7.94 t/ha (53.94% and 53.6% higher grain yield in comparison to checks), respectively during dry season 2014. The plant type obtained was as per prediction, however, shy tillering (around 160 tillers/m2 with single seedling planting) increased the tendency of somewhat less grain yield. This indicated that there is further scope of increment in grain yield through genetic as well as agronomic manipulation for breaking yield ceiling in irrigated and shallow lowland.

EFFECT OF MACRONUTRIENTS (ZINC AND BORON) ON QUALITY IMPROVEMENT IN KINNOW MANDARIN

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Kinnow a mandarin hybrid (*C. nobilis* Lour. × *C. deliciosa* Tenora) is one of the most important and finest varieties of mandarin grown especially in North India. The production of quality kinnow depends upon many factors among which micronutrients such as zinc (Zn) and boron (B) plays a vital role due to its wide spread deficiencies mostly in the citrus cultivated areas of India. Therefore the present investigation was undertaken with a view to determine the Quality improvement in Kinnow mandarin through foliar application of zinc and boron. Results revealed that combined application of 0.2 per cent boric acid + 0.5 per cent zinc sulphate at fruit set and peach size stage of fruit through foliar spray exerted great influence on physio-chemical characteristics and leaf nutrients content of kinnow mandarin. Maximum TSS (12.18 ^{o}B), juice content (41.43%), reducing sugar (3.87%), TSS/Acid ratio (16.66) and total sugar (7.22 %) were recorded with foliar application of 0.2 per cent boric acid + 0.5 per cent zinc sulphate at fruit set and peach size stage of fruit (T_9) as compared to other treatments. Among the treatments maximum ascorbic acid content (25.23 mg/100 g) was recorded in treatment T_8 (0.2% B + 0.4% Zn) closely followed by treatment T_9 (25.16 mg/100 g), whereas minimum rind thickness (2.79 mm) was recorded in treatment T_8 and T_9 (2.79 mm) as compared to other treatments.

Key Words: Boric acid, Zinc sulphate, Foliar, Micronutrients, Yield.

POTENTIAL THREATS OF RICE STRAW BURNING AND ITS ALTERNATIVE USES

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Rice is a widely grown crop and burning of its straw has been practiced in every parts of the country as it is found to be reliable, inexpensive, less demand of labor and equipments at the time of harvesting and limiting the carryover of many diseases of rice. Burning of rice straw has got many negative impacts. It not only causes change in atmospheric compositions by releasing air pollutants but also causes many problems on public health. Moreover the burning practice causes gradual decline in crop production by affecting soil condition. Even though rice straw helps in supplying nutrients, organic amendments to the soil and also having immense uses as in cattle feed, mushroom cultivation, compost, mulching etc farmers mostly opt for burning causing adverse impact on crop production. Therefore after rice harvesting, environmental and economic benefits associated to alternative rice straw management should be considered against traditional burning practices in future.

Keywords: rice straw, burning, air pollutants, nutrients, economic benefits.

EFFECT OF DATES OF SOWING AND CULTIVARS ON GROWTH AND YIELD OF SUMMER SESAME (*Sesamum indicum* L.)

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Sesame (*Sesamum indicum L.*) is an important third major oil seed crop after groundnut and rapeseed mustard in India. In order to study the effect of dates of sowing and cultivars on growth and yield of summer sesame (*sesamum indicum* L.), field experiment was carried out at Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, West Bengal during 2013 and 2014. Studies with five different dates of sowing (i.e., 10th February, 20th February, 2nd March, 12th March and 22nd March)in the main plots and three cultivars of sesame (i.e., Rama, Savitri and Tillotama) in the sub plots, in a split plot design was conducted on sesame.Higher amount of dry matter was recorded in cultivar Rama when sown on 2nd March. LAI recorded at 75 DAS found to be highest when the crop was sown on 2nd March. Among the cultivars, Rama recorded the highest LAI at 75 DAS.The crop sown on 2nd March, during late summer season, yielded the highest amount of seed yield which was 55.99 cent^{-1} and 40.85 cent^{-1} (during 2013 and 2014, respectively) higher than the crops sown on 22nd March. The date of sowing significantly affected the number of branches plant^{-1}, number of capsules plant^{-1}, number of grains capsule^{-1} and test weight of grain and the crop sown on 12thMarch recorded the higher value of yield which was at par with the yield of crop sown on 2nd March .During the summer season, Rama recorded highest seed yield and it was 17.70cent^{-1} and 12.06 cent^{-1} (during 2013 and 2014, respectively) higher than the cultivars Tillotama. The number of capsules plant^{-1}, number of seeds capsule^{-1} and test weight in cultivars Rama was also recorded to be highest. Based on the result obtained from the present investigation, cultivar Rama can be adopted in *terai* zone of West Bengal during summer season, because of its highest seed yield ability. The results indicated that sowing of sesame within 2nd March to 12th March is the optimum sowing dates of sesame to have optimum seed yield if grown as late summer crop.

POSTER PRESENTATIONS

PUMPKIN SEED PROFILING OF 52 GENOTYPES: CHARACTERIZATION AND VARIATION TO ADVANCE THE PRODUCTION IN TERAI ZONE OF WEST BENGAL

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Pumpkin (*Cucurbita moschata* Duch.) is one of the most nutritive and profitable cucurbit crop capable of growing throughout the India. Along with several research and private bodies, farmers, even the growers of kitchen garden in Northeast India hold conservatory cultivation of wide range pumpkin. Among this, emphasis was given to heap up the collection of diverse genotypes as they are prized for economically significant traits. Hence, 52 pumpkin genotypes were collected from eastern Himalayan region as well as other parts of India for characterization and documentation to establish a primitive pace for pumpkin improvement in the terai zone of West Bengal. The collected seed was studied at Uttar Banga Krishi Viswavidyala, Pundibari during 2014-15 for the variation in physical, appearance and growth characters. Distinctive variation was exhibited in terms of seed length, width, thickness, shape, brightness, test weight, germination percentage, days to germination, germination percentage, germination speed, germination rate, seedling vigour index, establishment capacity of seed, and mortality percentage of seedlings. In conclusion, the variation in pumpkin seed collection can be a treasure house to broaden the gene pool available for future breeding program emphasizing for terai zone of West Bengal.

Keywords: Diversity, Germination, Pumpkin, Seed profile and Seedling vigour

SEASONAL INCIDENCE OF BROAD MITE, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) ON JATROPHA AND ITS HOST RANGE UNDER GANGETIC PLAINS OF WEST BENGAL

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Jatropha curcas L., is considered as one of the most important perennial oil yielding plants which is cultivated for producing bio-diesel to minimize environmental pollution. It is widely used for bio-fencing of small and marginal farm land especially by vegetable growers under Gangetic Basin of West Bengal. Jatropha is infested by many insect and non insect pests where the broad mite, *Polyphagotarsonemus latus* (Banks) attacks in a severe form causing enormous yield loss. The mite sustained throughout the year on it and was observed to attain maximum population (25, 50 and 52 post embryonic stages of mites per square centimeter of leaf area) during July to September respectively with a minimum population observed during winter months when the plants drop down all the leaves leaving behind young apical coppery leaves at the tip which provide shelter to the broad mite during adverse period of the year during the month of December and January. The peak population of the mite was also observed to coincide with the initiation of the reproductive stage of the *Jatropha* plant. Severe infestation of the mite makes the apical leaves deformed, leathery, bronzed, curled and dropping down of the flower buds result in poor fruit yield. A positive and significant relationship was found between mite population and temperature and relative humidity. Apart from *Jatropha*, several other host plants of broad mite were recorded along with the damage symptoms in the Gangetic Basin of West Bengal. Downward curling of the leaf edges, silver shiny and later turning to bronzed infested apical leaves, shedding of flower buds, distorted flowers and shoots were observed in chili, jute, potato, marigold, hibiscus, gerbera, brinjal, bhindi, mungbean, cowpea, sesame, peppers, cucumber, cotton, tobacco and amaranthus. Egg laying inflicting damage to young leaf of *S.nigrum* and *Coccinia sp* was noted. The dominated weed hosts of this

area like *Solanum nigrum, S. torvum, Ludwijia parviflora, Micania micranthum, Datura stramonium, Physalis minima* and *Odoratum* sp were observed to be infested by yellow mite and in most cases the whitefly (*Bemisia tabaci)* was further found to transmit the mites from *Jatropha* fence to commercially cultivated crops.

NEW RECORD OF PIGEON PEA AS A ROOSTING CROP FOR *BACTROCERA CUCURBITAE* (DIPTERA: TEPHRITIDAE): IMPLICATIONS FOR AN ATTRACT-AND-KILL APPROACH

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The melon fly, *Bactrocera cucurbitae* is an economic pest of cucurbits and has a wide distribution in many tropical and subtropical countries of the world. It is difficult to manage under field conditions and causes significant economic damage to the cucurbits crops. Integrated pest management approach with male annihilation and bait application techniques (MAT and BAT) are the most widely used techniques for management of the melon fly. In the present study, pigeon pea was recorded as a roosting crop for the melon fly and could be used as a trap crop for its management. The maximum adult fly activity was found during evening time on pigeon pea and varied from 16.66 to 18.04 adult fly/ plant from 8 AM to 5 PM, respectively. Pigeon pea as trap crop for the melon fly could help in the improvement of bait application techniques and reduce the load of insecticides on main crop i.e. cucurbits. Whereas, pigeon pea as a bordering crop will also help in the enhancement of soil fertility and nutritional security of poor and marginal farmers who cultivated cucurbits for their daily livelihood.

Keywords: Melon fly; *Cajanus cajan*; fruit fly; trap crop; roosting vegetation

YIELD ATTRIBUTES AND FRUIT QUALITY RESPONSE OF CAPSICUM (*Capsicum annuum* L.) TO VARIED LEVELS OF NPK UNDER SHADE NET HOUSE

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Capsicum known as shimla mirch or bell pepper is one of the most highly demand crop and occupies a place of pride among vegetable. Capsicum cultivation can contribute in raising the country economy pattern. Yield attribute traits and fruit quality response of capsicum (*Capsicum annuum* L) to varied levels of NPK under shade net house was evaluated. The experiment was laid in randomized block design with three replications. Among the treatments combination, application of N:P:K @150:120:60 kg/ha proved better to improve the yield attributes traits than other treatment combinations by revealing maximum number of fruits /plant (9.40), fruit length (9.23 cm), fruit diameter (5.92 cm), yield / ha (29.41 t/ha). This treatment was also found to be associated with highest shelf life (5.37 days) and lowest average physiological weight loss (14.81%). Application of N: P: K @ 150:75:120 kg/ha was superior over other treatment by revealing maximum juice percentage (75.20%), Total soluble solid (T.S.S) content

(6.74 Brix) and Ascorbic acid content (92.30 mg/100g). Cultivation of capsicum under sub-tropical condition with an application of N: P: K @ 150:120:60 kg/ha revealed maximum B: C ratio of 4.70:1.

EFFECT OF NAPHTHALENE ACETIC ACID ON YIELD OF CHILLI (*Capsicum annum* L.)

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An On Farm Trial was conducted to study the efficacy of naphthalene acetic acid in reducing flower drop and increase in fruit set of chilli cv. Pusa Jwala. The trial was carried out at farmers' field of Ratua 1 block of Malda district of West Bengal under rain fed medium to upland sandy loam soil situation. There were three treatments which included a farmers practice T_1, in which plants were not sprayed with naphthalene acetic acid; technology option 1 (T_2), which included spaying of plants with naphthalene acetic acid @ 20 ppm and technology option 2 (T_3), which included spraying of plants with naphthalene acetic acid @ 50 ppm. The spraying of naphthalene acetic acid was started after the opening of first flower to last phase of flowering. The result showed a positive effect of naphthalene acetic acid on the productivity of chilli as compared to farmers practice (T_1) irrespective of dose levels, however, higher dose (T_3) was found more effective. The third treatment (T_3) resulted in the highest yield of chilli (14.37q/ha) as compared to T_2 (12.32 q/ha) and T_1 (9.87 q/ha). Therefore, it may be concluded that naphthalene acetic acid @ 50 ppm could be beneficial in increasing the yield of chilli and net profit of farmers.

Key words: Chilli, *Capsicum annum*, Naphthalene acetic acid, Growth Regulator, Productivity.

FOLIAR DISEASES OF TWO MEDICINAL PLANTS IN GANGETIC ALLUVIAL ZONE IN WEST BENGAL

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Abstract

Medicinal plants play an important role in supporting healthcare system for the majority of the population in India and are a critical source of income for rural population. West Bengal exhibits a varied range of topography and agro climatic conditions, which enormously contribute on the cultivation, adaptation and area expansion of vast array of medicinal plants. An experiment was conducted on two medicinal plants – Mesta (*Hibiscus sabdariffa* L.) and sweet flag / bach (*Acorus calamus* L) to study the disease spectrums, their isolations, identifications as well as to record their intensities. Leaf blight disease in mesta and rust disease in bach were recorded. In mesta, leaf blight disease caused by *Phoma sp.* was recorded and isolated; its pathogenecity was also been established; micrometric observations on pycnidium (95.0 µm in diameter) and pycnidiospores (10.3 x 2.9 µm) were made. Appearance of rust disease, caused by *Uromyces sp.,* in severe form (PDI -70- 85%) on bach. Micrometric observations on spores and spore bearing structures were recorded for both the diseases.

Keywords: Disease, Medicinal plant, *Phoma, Uromyces*, *Hibiscus sabdariffa*, *Acorus calamus.*

EFFECT OF DIFFERENT COMBINATIONS OF ORGANIC MANURES AND SUPPLEMENTATION OF BIOFERTILIZERS ON NUTRIENT (N, P & K) STATUS OF SOIL AFTER HARVEST OF ONION (*Allium cepa* L.)

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Onion (*Allium cepa L.*) is one of the most important commercial vegetable crops cultivated extensively in India. It is an indispensable item in every kitchen used as vegetable and condiment. Onion is liked for its flavour and pungency which is due to the presence of a volatile oil 'allyl propyl disulphide'. The organic manures positively influenced the available NPK contents of soil after the crop harvest. The increase in available NPK may be due to added supply of nutrients and proliferous root system developed under balanced nutrient application resulting in better absorption of water and nutrient uptake along with improved physical properties of the soil. The present experiment was conducted at College of Horticulture, Dr. Y.S.R. Horticultural University, Rajendranagar, Hyderabad, Andhra Pradesh during *rabi,* 2013-14 in randomized block design with 9 treatments replicated thrice. The highest nutrient (N, P & K) status of the soil (282.12, 36.51 & 332.99 kg ha^{-1}) was recorded with poultry manure (50%) + vermicompost (50%). Where as, recommended dose of fertilizers @ 150:60:60 kg NPK ha^{-1} recorded 205.33, 25.15 and 256.68 kg ha^{-1} available nitrogen, phosphorus and potassium, respectively. As conclusion, increase in the available NPK indicated that the NPK present in the manure was available to the crop and application of vermicompost, poultry manure, would have increased the available NPK content in soil.

Key words : Onion, organic manures, nutrient status, recommended dose of fertilizers.

POST HARVEST PROCESSING AND MARKETING OF LARGE CARDAMOM IN SIKKIM AND DARJEELING DISTRICT OF WEST BENGAL

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Large cardamom (*Amomum subulatum* Roxb.) locally known as 'allainchi' in Sikkim and Darjeeling, is a member of the Zingiberaceae family. Large cardamom is an important cash crop in Sikkim and Darjeeling hills. It grows best at an altitude of 600–2,400 m above msl and in areas with annual rainfall of 2,000–4,000 mm and ambient air temperature of 10–22ºC. Average annual temperature for most of Sikkim and Darjeeling is around 18°C to 25°C. At present Large cardamom is cultivated at an area of 31.59 thousand hectare with an annual production of 9.41 MT. Sikkim is the largest producer of large cardamom in India contributing 88% of total production. Large cardamom is grown as an under-storey crop in association with nitrogen fixing Himalayan alder popularly known as 'utis' (*Alnus nepalensis*) and other forest tree species that provide shade. Seeds of Large Cardamom possess medicinal properties like carminative, stomachic, diuretic, cardiac stimulant, anthelmintic etc. Local genotypes such as Ramsey, Sawney, Ramla, Golsai, Seremna, Bharlang, etc are suitable for growing at different altitudes of Sikkim and Darjeeling. Production of large cardamom is currently declining, and the main reason being viral diseases like chirkey and phurkey, lack of proper post harvest management and marketing facilities. Productivity of dry capsules among different plantations varies from a low of 100 kg ha^{-1} to a high of 450 kg ha^{-1}, the average being 150 kg ha^{-1}.

Fresh cardamom capsules generally contain 80-85% (wet basis) moisture which has to be brought down to less than 10% by curing for safe storage. Curing of fresh capsules is accomplished in a traditional bhatti which often results in poor quality. Now-a-days advanced curing methods are being followed such as flue pipe curing house, gasifier-based system, solar dryers, etc. The capsule tail (calyx) is removed manually using scissors, which is a laborious and time-consuming process. Polypropylene and ethylene terepthalate/polyethylene are used to pack dried capsule. Siliguri in North Bengal is the main trade junction for Indian large cardamom from where it is distributed to other collection centers, such as Guwahati, Kolkata, Delhi, and Amritsar. From these centers the dried capsules are exported to Pakistan, UAE, UK, USA, Canada and other countries. The need of the hour is to adopt proper postharvest techniques and better marketing strategies so as to fetch better prices by reducing post harvest losses, adding value to the produce thereby making large cardamom farming an attractive and profitable livelihood.

EFFECT OF ANTAGONISTIC BIO-AGENTS AND FUNGICIDES ON INCIDENCE OF WEB BLIGHT DISEASE OF URDBEAN(*Vignamungo L.*)

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*Trichoderma*has gained maximum attention as bio control agent due to the fact that it is effective against a large number of soil-borne plant pathogenic fungi. Tri Pun2 was found to be the most effective after Bavistin for management of web blight disease of Urd Bean. On the basis of microscopic observation and growth characteristics native Tri-Pun and Tri-Pun2 isolates were tentatively identified as *T. virens* and *T. harzianum*, respectively. The efficacy of native *Trichoderma* isolate in reducing web blight infection of urdbean was statistically at per with application of carbendazim @ 0.1 %. Web blight disease of urdbean can be minimized by alternative use of native *Trichoderma* isolate (Tri Pun2) thus reducing our dependency on chemical pesticides to some extent and consequent hazards to our ecosystem, which need further exploration.

EFFECT OF DIFFERENT CURING METHODS ON PHYSICAL PROPERTIES OF ONION BULB AT AMBIENT STORAGE

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Among fresh vegetables, onion is a delight item to exports. The major problem encountered in the onion trade is the huge losses during storage because of low storage ability. The principal factors leading to post harvest losses in onion are sprouting, rotting and physiological weight loss. Post harvest curing is one of the most important practices to store bulbs for longer time. Keeping that in view present study was investigated at the main garden of Department of Horticulture, Dr. P.D.K.V., Akola (M.S.) during the Rabi season of 2013-14 by using the cv. Akola Safed. Nine treatments (T) were used for this study, T_1comprised, field cured bulbs were kept under 50 % shade for

12 days and tops removed immediately after harvesting. In T_2, T_3, T_4 and T_5, field cured bulbs were kept under 50% shade for 15 days with topping at 3, 5, 10, 15 days after harvesting, respectively. In T_6 bulbs were kept under 100% shades for 15 days and tops were cut down 15 days after harvest. In T_7 and T_8 field cured bulbs were kept on tarpaulin under 50% and 100% shade for 15 days, respectively and topping on 7th day of harvest. T_9 is control (Farmer method). Results indicated that curing methods significantly influenced all the physical traits. The minimum physiological weight loss, sprouting, rotting, incidence of mould and moisture recorded with the curing treatment T_5 closely followed by T_6 over Control. Also, the maximum percent of dry matter, marketable bulbs and colour of bulb found with the curing treatment T_5 closely followed by T_6 over Control. Among all the curing treatments, T_5 was found superior over others in enhancing storage life and quality of onion bulb.

Key words- Onion, curing methods, physical traits

OLEORESIN YIELD OF CHILLI GENOTYPES IN BLACK SOIL UNDER VIDHARBHA REGION OF MAHARASHTRA

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Chilli, is one of the most important commercial crop. Different varieties are cultivated around the world for varied uses like vegetables, pickles, spice and condiments. Oleoresin is a viscous liquid, possessing aroma and flavor, is also extracted from finely ground chilli green powder. Oleoresin extracted from red chilli fruits is preferred against ground chillies in view of its natural anti-oxidant, long shelf life under ideal conditions and less storage space. In food and beverage industries, chillies have acquired great importance in the form of oleoresins which permit uniform distribution of colour to foodstuffs and characteristic flavor. In the pursuit of promising oleoresin yield, a field experiment was conducted in Black soil of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Kharif*-2013-14 with the consideration of twenty chilli genotypes as twenty treatments in randomized block design. All the treatments were fertilized with common recommended dose of fertilizer (150:50:50 NPK kg ha^{-1}) and package of practices. Agnirekha recorded significantly highest oleoresin content 13.95 and 19.34 % in green and red chilli fruits respectively. Nonetheless Surya, a genotype from private sector recorded highest oleoresin yield 133.69 kg ha^{-1} and 323.72 kg ha^{-1} in green and red chilli respectively. Furthermore, after harvest mean fertility status of soil (N 0.030 %, P 16.58 kg ha^{-1} and K 229.86 kg ha^{-1}) was decline over initial status (N 0.031 %, P 17.27 kg ha^{-1} and K 288.85 kg ha^{-1}) to meet out its nutritional requirement. As conclusion, the oleoresin in chilli fruits was increased with maturity of the fruits and almost double oleoresin was extracted from ripen red chilli fruits as compared to green chilli fruits.

Keywords: Chilli, Oleoresin, Residual fertility status of soil.

INSECT PESTS, BIOAGENTS AND THEIR PERVASIVENESS IN SUGARCANE UNDER PUNJAB CONDITIONS

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Sugarcane (Saccharum Spp. Complex) a member of Poaceae family is an economically important cash crop of the country grown in the tropics and sub-tropical areas. It is cultivated in an area of 5.3 m ha with an average productivity of 70.8t/ha in country while the corresponding figures for Punjab state is 96.0 thousand hectares and 70.0t/ha, respectively that represents sub-tropical ecology. Of the various constraints identified for low production and low sugar recovery in the region, increasing incidence of insect pests is of major concern. In sugarcane, the important pests are early shoot borer, (Chilo infuscatellus Snellen), top borer (Scirpophaga excerptalis Walker) and stalk borer (Chilo auricilius Dudgeon) which cause heavy losses to crop and thereby decreasing productivity in subtropical areas because the environment is more conducive for pest build up. Sugarcane being a crop of long duration (12-14 months), overlapping generations and concealed habitat of borers and simultaneous heavy incidence of sucking pests makes the chemical control difficult, ineffective and highly expensive. Though, a large number of native natural enemies remain active in sugarcane ecosystem that provide an opportunity to scientists working in this crop to explore the possibility of their potential to suppress the incidence of above said pests. Therefore, present study was conducted to monitor /observe the incidence of major insect pests and their natural enemies in sugarcane fields grown at Regional Research Station, Kapurthala during spring season 2014-15. An experiment was conducted in 1 acre area sown under commercial sugarcane variety CoJ 88 without any application of insecticide and consequently, incidence of sugarcane insect pests and natural enemies were recorded periodically. The early shoot borer incidence appeared in 2nd week of April and reached its highest level of 9.8 per cent in 2nd week of June. However, the activity of its predator Cheilomenes sexmaculata (1-2 predator/clump) was observed in 2nd week of May to July. The initial top borer incidence was observed from month of June and that reached to its maximum level of 8.5 per cent in 2nd week of August. The bio-agents viz., Rhaconotus sp., Isotima javensis and Stenobracon sp. were recorded as 2.3, 3.1 and 2.0 per cent in the month of August, respectively and 1.6, 1.2 and 1.0 per cent in the month of September, respectively. The stalk borer incidence started from second week of August and reached 9.4 per cent in the month of October. The parasitization potential of its bio-agents viz., Sturmiopsis inference and Cotesia flavipes was recorded 3.3 and 2.2 percent in the month of September, respectively, while for Sturmiopsis inference and Cotesia flavipes parasitization was observed 1.6 and 1.1 percent in the month of November. The activity of pyrilla on sugarcane noticed from second week of August and that continued up to last week of October. The activity of its bio-agent viz., Epiricania melanoleuca observed maximum (>70%) that parasitize on this pest and keep its population below economic injury level in the month of August and September. Keeping Epiricania melanoleuca aside, it was observed that the prevalence of other bioagents in natural population was less to effectively manage the incidence of important borer complex. Therefore, integration of bio-control tactics with promising insecticides (quick knock down effect, less persistence and safe to the natural enemies) can be devised for more effective management of sugarcane pests in eco-friendly manner.

OFF-SEASON FRENCH BEAN (*Phaseolus vulgaris* L.) CULTIVATION INSIDE AGRO SHADE NET: INFLUENCE OF PLANTING DATES AND NUTRIENT SOURCES

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French bean cultivation during summer months inside shade net provides assured better returns to the farmers in terms of higher yield, quality of produce and off season availability of fresh pods. But lack of standard planting time and indiscriminate chemical fertilizers results in fluctuating yield and poor return. The present work was formulated to identify the optimum planting time and proper nutrient sources of summer season french bean to make the production system economically viable and remunerative. Treatments consisted of four different planting dates and four nutrient sources laid out in two factor factorial RBD with three replications inside a UV stabilized HDPE naturally ventilated shade net house during summer month of 2012 at Uttar Banga Krishi Viswavidyalaya. The results revealed that planting dates and nutrient sources have significant effect on growth and yield attributes of off-season french bean and 14th May planting was found best considering the earliness and pod attributes. Again vermicompost (5 t ha^{-1}) in combination with 75% recommended inorganic fertilizers and biofertilizer seed inoculation emerged as best nutrient sources. The finding established that 14th May planting coupled with use of vermicompost (5 t ha^{-1}) in combination with 75% recommended inorganic fertilizers and biofertilizer seed inoculation will bring desirable growth and yield attributes and will help to augment nutrient efficiency for off-season season french bean cultivation under agro shade net.

Key words: Biofertilizer, Nutrient Source, Off-season French Bean, Planting Dates, Vermicompost

DIVERSITY AND BEHAVIOUR OF INSECT POLLINATORS IN BRINJAL ECOSYSTEM IN SOUTHERN BENGAL

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About 70% of plant species in the world are dependent upon insect pollinators for their fruit and seed development. They are also responsible for improved production and quality of the produce and also help in maintaining the hybrid vigour, variation and sustaining the gene flow in nature. West Bengal is a leading producer of brinjal in India and many landraces are available here. The present investigation was carried out at the AB Seed farm of BCKV, Kalyani, Nadia during the spring-summer season of 2015 with 24 genotypes of brinjal to assess the pollinator profile in brinjal. The main pollinators observed on brinjal were carpenter bees (*Xylocopa* sp.), honey bees (*Apis mellifera* and *Apis florea*). Besides, some grasshopper (*Atractomorpha crenulata*) skippers, moths, butterflies, beetle (Scarabaeidae), coccinellids (Grubs), syrphid fly, damsel and dragon fly and spiders were also found to visit brinjal flowers, but their role in pollination is not understood clearly. It has been observed that most of the pollinators visit the brinjal field after anthesis. *Apis florea* species of honey bee is trace pollinator. The population abundance studies when measured at 6.30-8.30 A.M. indicated that honey bees (*Apis mellifera*) were more in number (80.24%) followed by carpenter bees (11.76%) and others were only 8.00%. Higher population of *Apis mellifera* has been recorded from 6.30 a.m. to 10.30 am (3.2 bees/ m^2/ 5 min) and the carpenter bee activity was observed higher in

between 7.00 a.m. to 10.30 a.m. (1.60 bees/ m^2/ 5 min) during March-July. After 11.30 a.m., the population of both carpenter bee and honey bee got declining and no bees observed between 4.30-6.00 PM. Each carpenter bee visited, on an average 8.25 flowers/minute while the number of flowers visited by each *Apis mellifera* was 6.4/ minute. Efficiency of Carpenter bee (7.75plants/minute) is more than *Apis mellifera* (4.6plants/minute). The foraging rate of carpenter bee and *Apis mellifera* were 3.8 and 5.9 seconds respectively. The carpenter bees (1.6 flowers/plant) visited less number of flowers on a plant as compared to the *Apis mellifera* (3.6 flowers/plant). The percentage of increase in fruit set due to pollinators was observed among 10 genotypes of brinjal by counting the number of set fruits per plant in open condition as well as pollinator free net-cage condition. The pollinator free condition was obtained by covering the plants with insect proof net before flowering to final harvesting. The percentage of increase in fruit set due to pollinators was high in BCB-14 (73.2%) followed by BCB-15 (71.9%) and lowest in BCB-5 (42.6%) with an average of 55.4%.

Floriculture Development by biotechnological methods

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Biotechnology is the modern and potential technology for the sustainable development of agriculture, animal husbandry and for overall rural development. The classical definition hinges around the application of molecular genetics, biochemistry and microbiology and process technology on micro-organism, cells or tissues to provide goods and services for man. Most of the developing countries are having larger rural population as compared countries and their economics depend upon agriculture to search a greater extend. Biotechnology offers such potential for significant advances made in the improvement of ornamental crops. Large numbers of ornamental plant are being commercially propagated through tissue culture. These techniques are probably the most commonly utilized biotechnological to both for basic research and for apply commercial expects. The power of tissue culture as a propagation tools becomes especially apparent when the goal is to generate a large number of propagules of an ornamental that is either rare or has some unusual feature, making clonal multiplication highly desirable. Improvement of crop characteristics and in turn improvement of plant production has been a major impact on floriculture business. The dream of multiplying disease free plants in the required quantity on the specified time schedule in an industrial way has come true through micropropagation. Finally there is a need for a partnership between industry, government and academia if the promises of this technology are to be realised. In the last several years, basic scientific research has provided an excellent foundation for better understanding of plant regeneration.

Keywords: Floriculture, Biotechnology, Tissue culture, Micro-organism, Propagated, Propagules, Clonal, Government

AGRONOMIC PRACTICES FOR HIGHER PRODUCTIVITY IN WINTER MAIZE

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Maize is one of the most important versatile cereal crops grown in tropical and temperate regions of the world. Unlike *kharif* season, maize can also be grown in winter season the risk of damage to the crop from excessive rains, stagnant water, insect pests, etc. during winter season is far less. Very often the sowing of maize in winter season is delayed due to late harvest of preceding crops like paddy, *kharif* maize, potato, *etc*. The delayed sowing of maize results in low germination and delayed emergence due to low temperature resulting in reduction in grain yield. Under such conditions, sowing of maize on Southern side of the ridges laid in East-West direction resulted in early emergence, vigorous growth and significantly higher yield over the crop raised on flat beds. Similarly, manipulation of plant population i.e. closer planting at 40 cm x 20cm or 50 cm x 16 cm gave higher yield. Potentiality of maize crop for its growth and development can be fully exploited by adopting suitable agronomic practices such as optimum spacing, fertilizers and growing season. The major plant nutrients N, P and K limit the normal plant growth. Increasing the productivity per unit area through agronomic management is one of the important strategies to enhance the productivity of maize. Keeping this in view an attempt was made to review the work done on the effect of plant population and fertilizer level on yield and economics of maize.

Keywords: Kharif, closer planting , fertilizer, winter, maize, economic, productivity.

SCHEDULING OF IRRIGATION IN TIMELY AND LATE SOWN RAYA (*Brassica juncea L.*) CULTIVARS

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A field experiment was conducted at Research Farm, Punjab Agricultural University, during *rabi* season 2011- 12 in split plot design, keeping combinations of three dates of sowing (October 30, November 15 and November 30) and two cultivars (RLC -1 and RLM - 619) in main plots and four irrigation schedules (40, 60, 80 CPE and recommended 2 irrigations) in sub – plots with three replications. Raya sown on October 30 recorded significantly higher plant height, leaf area index, dry – matter accumulation, primary and secondary branches than November 15 and November 30 sown crop. The yield attributes, seed and oil yield were also significantly higher in October 30 sown crop than November 15 and November 30. Similar trends were observed for water use and water use efficiency (WUE). Both cultivars (RLC -1 and RLM - 619) did not differ significantly for growth characters, yield attributes and seed yield. However, Cultivar RLM – 619 recorded higher oil content and oil yield than cultivar RLC – 1. Water used was numerically higher in RLC – 1 but WUE was more in RLM – 619. Crop raised with irrigation schedule of 40 CPE produced significantly taller plant, recorded higher leaf area index and dry matter accumulation at all the growth stages than with 80 CPE and recommended irrigations but statistically at par with 60 CPE. Similarly, yield attributes, seed and oil yield were also higher with irrigation scheduling at 40 CPE, which were at par with 60 CPE but significantly higher than 80 CPE and recommended. Maximum water use was recorded with irrigation schedule at 40 CPE and it decreased with increase in CPE, while reverse was true for WUE.

Keywords: Irrigation, Schedule, Raya, CPE, WUE, water use.

MORPHOLOGICAL CHARACTERIZATION OF BREAD WHEAT (*Triticum aestivum* L.) BASED ON DISTINCTNESS, UNIFORMITY AND STABILITY (DUS) TEST

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The morphological characteristics are a feature of a plant. For effective utilization of germplasm in crop improvement programmes substantial knowledge of full genetic potential of the germplasm is essentially needed. Along with this, protection & registration of new variety of plant is possible if it conforms to the criteria of novelty, distinctness, uniformity and stability (DUS) guidelines according to the "Protection of Plant Varieties and Farmers' Rights (PPV &FR)" Act, 2001.Sixty seven advance genotypes of bread wheat were characterized according to different morphological traits. Genotypes were evaluated for twenty one traits, *viz*. Coleoptile: anthocyanin colouration, plant growth habit, foliage colour, flag leaf anthocyanin colouration of auricles, flag leaf: hairs on auricles, flag leaf: attitude, time of ear emergence, days to maturity, flag leaf: waxiness of sheath, flag leaf: waxiness of blade, ear: waxiness, culm: waxiness of neck, plant length (excluding awns/scurs), ear: shape in profile, ear: length (excluding awns/scurs), ear: density, presence of awns/scurs, awns: length, awn: attitude, seed: size (weight of 1000 grains), no of grains/ spike. All the visually assessed morphological traits were found uniform and stable. Therefore, these genotypes can be register and protect according to the PPV&FR Act, 2001 if required.

Key Words: DUS testing, PPV&FR Act, Bread wheat

STUDIES OF RELATIONSHIPS AMONG QUALITATIVE AND QUANTITATIVE TRAITS IN WALNUT (*Juglans regia* L.) GENOTYPES

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The experiment was conducted to determine the relationships among morphological, leaf, rachis, nut, shell and kernel characters using 4 genotypes of walnut selected from various walnut growing areas of Ladakh, Jammu and Kashmir, India (G_1 from Skara, G_2 from Nurla, G_3 from Temisgam and G_4 from Dhomkhar). Twenty eight traits *viz.,* tree vigour, growth habit, branching habit, leaf length, leaf width, number of leaflets, leaflet length, leaflet width, leaf and rachis pubescence, nut shape, nut diameter, nut length, shell texture, shell colour, shell seal, shell strength, shell thickness, inshell nut weight, kernel weight, kernel percentage, kernel flavor, kernel fill, ease of removal of kernel halves, kernel colour, phenol content, protein, carbohydrate content and total oil content were evaluated for correlation studies. It was evident that a positive correlation was observed between tree vigour with leaf width, shell texture, inshell nut weight and kernel weight, growth habit with leaf length and kernel colour, branching habit with leaflet lenth, Leaf width with number of leaflets, leaflet length, inshell nut weight and kernel weight. Additionally, number of leaflets is also correlated with leaf and rachis pubescence, nut diameter, nut length, shell seal, shell strength, and ease of removal of kernel halves. Positive correlation was also found among nut diameter with nut length, shell seal, shell strength, inshell nut weight and carbohydrate content of kernel, nut length with shell texture, shell colour with kernel colour and protein content, shell seal with ease of removal of kernel halves which is also correlated with shell strength, Inshell nut weight with kernel weight, kernel flavour with kernel colour, kernel fill with total oil content of kernel. Phenol content with carbohydrate content of kernel. Besides, negative correlations was

also observed among the various parameters. Between the various parameters, tree vigour, number of leaflets, shell texture, nut diameter, nut length, inshell nut weight, protein and carbohydrate content of the kernel were highly correlated with various parameters and can be used as selection criterion in breeding programmes.

Key words: Correlation, genotypes, Ladakh, walnut.

SEASONAL VARIATIONS OF MICRONUTRIENTS LEAF NUTRIENT (Fe, Mn AND Zn) STATUS OF CASHEW PLANTATIONS IN COASTAL DISTRICTS OF ANDHRA PRADESH

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The investigation was carried out during 2006 and 2007 in different cashew plantations of 12 mandals of coastal districts of Andhra Pradesh to study the seasonal fluctuation in nutrient uptake pattern during its growth phases in both fruiting and non-fruiting terminals of the cashew plants. The leaf nutrient contents Fe, Mn and Zn ranged from 107.43 to 245.28 ppm (low to high range), 71 to 220 ppm (low to high) and 9.12 to 26.32 ppm (deficient to high range) respectively. The mean leaf iron content was found to be increasing from July to January thereafter showed a declining tread indicating depletion of nutrients due to consequent mobility of Fe to the flower buds for differentiation, synthesis of chlorophyll besides, nitrate reductase and for the flavo enzymes. With respect to the trend of mean leaf Mn content in between the leaves of the terminal shoots, the non-fruiting recorded comparatively higher values in November and January. However, both fruiting and non-fruiting terminals showed a declining after fruiting. A similar result was reported by Sharma and Mahajan (1990). It is also noted that the mean leaf Zn content both fruiting and non-fruiting terminals showed increasing trend from July to November followed by a gradual fall from January to May. It explains that the greater nutrient concentration in both fruiting terminals and non-fruiting terminals during the period of November to January might have been coinciding with the flower bud initiation, and translocation of nutrient to the sink of developing cashew nut fruits under coastal districts of Andhra Pradesh conditions. Non fruiting terminals showed highest nutrient contents than fruiting terminals of all the months of study.

Key words: Cashew, Micro Leaf nutrients.

EFFECT OF PLANT GROWTH REGULATORS ON GROWTH, DEVELOPMENT AND FLOWERING OF CARNATION (*Dianthus caryophyllus* L.) cv. CHABAUD SUPER MIX

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Three different levels (50 ppm, 75 ppm and 100 ppm) of each of BA, GA_3 NAA and Ethrel were applied to Carnation (*Dianthus caryophyllus* L.) cv. Chabaud Super Mix plants and the effect was compared to control plants.

The effect of plant growth regulators on leaf length, leaf width and flower bud diameter of Carnation were found statistically non-significant. Growth regulators had a profound effect on the plant height of carnation and the longest plants were recorded as a result of application of GA_3 @ 75 ppm (75.28 cm) whereas the shortests were from untreated plants (59.78 cm). GA_3 @ 100 ppm resulted highest number of side- shoots/plant (11.94). NAA at higher concentration (100 ppm) produced the highest number of leaves/shoot (25.34). Growth regulators delayed flowering. Control plants reached the Flower Bud Initiation (FBI) stage earliest (69.17 days). The earliest time period from FBI to Colour Showing stage was recorded with the application of GA_3 at 75 ppm (25.67 days). The longest time period from Colour Showing stage to full bloom stage (5.50 days) and greater diameter of flowers (5.20 cm) were recorded with GA_3 @ 50 ppm treated plants. Control plants reached the full bloom stage earliest (4.33 days). Ethrel @ 100 ppm treated plants showed higher floriferousness (41.50 flowers/plant) and produced longest flowers (4.72 cm) with longest stalks (40.26 cm). Longest flower buds were obtained from control plants (2.88 cm). Plants treated with 100 ppm BA showed higher fresh weight (262.43 g/100 flowers) and *in-situ* longevity (6.83 days) of flowers. Higher post-harvest longevity (5 days) of flowers was recorded with Ethrel @ 50 ppm treated plants. The effect of diverse plant growth regulators is different on various qualitative characters of the Carnation plants and flowers. So the plant growth regulators may be selected according to the objective of the producer.

Keywords: Carnation, *Dianthus caryophyllus* (L.), Plant growth regulators, Benzyl Adenine, Ethrel, Gibberellic Acid, NAA

STUDY THE EFFECT OF ETHYL METHANE SULPHONATE (EMS) ON WIDELY DIVERGENT CULTIVARS OF TOMATO

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The present investigation was designed to identify the most effective concentration of ethyl methane sulphonate (EMS) to bring the variation within the population of tomato cultivar and its deviation in performance with the genotypic difference in tomato. For this purpose, two widely divergent lines of tomato namely, Patharkutchi, a widely locally adoptable cultivar of West Bengal and Berka, an introduced cultivar of Europe were treated with 0.05 to 0.50 % (V/V) EMS solutions. Results showed that in M_1 all the biological damages (lethality, injury and sterility) increased with the increasing concentration of EMS solution. The LD_{50} dose for Patharkutchi and Berika was 0.40% and 0.32% EMS solution, respectively. The effect of mutagen widely deviate along with the genotypic differences. Berika showed more susceptibility to the mutagenic treatments than Patharkutchi. EMS solution having the concentration 0.05% to 0.15% proved to be most efficient and effective for inducing wide array of variations.

Key words- EMS, mutation frequency, mutagenic efficiency, mutagenic effectiveness.

STUDIES ON THE VARIETAL PERFORMANCE OF COWPEA UNDER ZERO TILLAGE CONDITIONS IN RICE-WHEAT CROPPING SYSTEM.

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To study the performance of cowpea genotypes under rice-wheat based zero tillage conditions an experiments was conducted with eighteen (18) cowpea varieties at the Experimental Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari during pre-*kharif* seasons of 2013 and 2014 after harvesting of wheat and before sowing

of rice. The experiment was laid out in Randomized Block Design with three replications. The pooled results revealed that all the growth and yield parameters varied significantly with respect to different varieties of cowpea. Among the different varieties, maximum fresh pod yield was recorded in Kashi Kanchan (18.51 tonnes/ha) followed Triguna (17.07 tonnes/ ha), Kanak (16.69 tonnes/ha), Lafa Sohini-7 (15.59 tonnes/ha), Lafa Sundaribangla (13.76 tonnes/ha) and Bidhan Barbati-2 (13.84 tonnes/ha). Significantly highest beta carotene content in green pod was recorded in Lafa Sundaribangla (1037 IU/100g fresh pod) and lowest in Bidhan Barbati -1(888.51 IU/100g fresh pod). Maximum ascorbic acid content (20.17 mg/100g fresh pod) was recorded by Lafa Sundaribangla followed by Girija Deshi Lafa (18.69 mg/100g fresh pod). The highest protein content was recorded in Lafa Sundaribangla (4.69 %) which was followed by Girija Deshi Lafa (4.59 %) and Lafa Sohini-7 (4.34 %) and lowest protein content was recorded in VU-5 (3.20 %). On the basis of yield and quality parameters, cowpea variety, Kashi Kanchan, Triguna and Kanak may be recommended for commercial cultivation of cowpea in rice-wheat cropping system under terai zone of West Bengal.

Key Words : Cowpea, varieties, quality, yield, zero tillage.

POPULATION DYNAMICS, CROP LOSS ASSESSMENT AND ACARICIDAL MANAGEMENT OF YELLOW MITE, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) INFESTING MUNGBEAN UNDER GANGETIC BASIN OF WEST BENGAL

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Mungbean (*Vigna radiata* (L.) Wilczek), also known as green gram, is one of the important pulse crops grown in West Bengal. Besides, being an excellent source of high (25%) quality protein it is also used as green manuring crop. Though, the crop is grown both at pre-kharif and post-kharif seasons during the month of Mar- Apr to May- June and August-September to November -December under Gangetic basin of West Bengal, it is mostly grown during pre-kharif season. Mungbean is affected by various insect and non-insect pests, among which the yellow mite, *Polyphagotarsonemus latus* (Banks) plays an important role amounting huge crop loss. The pre-kharif crop is more vulnerable to yellow mite infestation than post kharif crop and their maximum population observed during end of March to mid – April. The peak population of the mite (23.2 mites/sq.cm leaf area) encountered during the initial budding stage of the crop and declined thereafter at the end of flowering stage. A tune of 50 – 80 % crop loss was estimated due to infestation of yellow mite. Among seven acaricides tested, Dicofol, Diafenthiouron and Spiromesifen showed higher efficacy against the mite than the other acaricides used. The yellow mite is a regular and major pest of mungbean which appeared in a severe form in the farmer field especially during pre-kharif season which can be manage successfully by application of two successive round of acaricides like diafenthiouron or dicofol at 10 days interval during early reproductive stage of the crop that ensure the flowering and fruit setting of the crop giving satisfactory yield.

SOIL METAGENOMICS: A NEW WINDOW OF RESEARCH IN SOIL BIOLOGY

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Soil is probably the most exigent of all avenues for microbiologists, with respect to the size and diversity of microbial community. More than 90% of the planet's genetic biodiversity is resident in soils. The biosphere though dominated by microorganisms, a majority of them has not been studied. In fact, it is now proven that only 0.1 to 1% are culturable while the rest are reluctant to grow on laboratory media. So till date, the entire potential of soil microbial diversity remains untapped. An emerging new field *i.e.* metagenomics offers a powerful lens to view the microbial world that has the potential to revolutionize the understanding of the entire living world. It gives the scientists, access to millions of microbes that have previously not been studied. Studying microbial communities can lead to advances in agriculture, earth science and global change, environmental remediation, energy science and natural product discovery (enzymes, antibiotics, etc.). Although considerable progress has been made in the characterization of microbial communities by random sequencing, new approaches for efficient screening of large soil libraries will further accelerate the speed of discovery and the diversity of the recovered biomolecules.

Keywords: Metagenomics, Microbial diversity, Sequencing, Heterogeneity.

STUDIES ON THE BIOLOGY OF PULSE BEETLE (*Callosobruchus chinensis* Linn.) INFESTING COWPEA

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Pulses (grain legumes) are the second most important group of crops worldwide. Globally, 840 million people are under nourished mainly on account of inadequate intake of proteins, vitamins and minerals in their diets. Under stored conditions , pulses suffer maximum grain loss due to dreaded stored grain bruchid pests. Studies on the biology of pulse beetle *Callosobruchus chinensis* (Linn) (Coleoptera: Bruchidae) on the stored cowpea revealed that the insect completed six generations from April to October. The total developmental period of bruchid was 33 days during July- August while it was 37.3 days during April- May. On average duration of incubation period was 7.13±0.34 and 6.04±0.78 while larval + pupal period was 28.51± 2.06 and 28.12±2.08days in two successive generations. The adult life span for male was 4.76±0.64 days and 6.01±0.13 where as for female 8.36±0.12 and 9.13±0.09 days . The total life span of male and female was 34.24±2.16 days in average. The pre- oviposition, oviposition and post- oviposition periods were 6.36±0.36 hours, 4.21±0.16 days and 4.15±0.42 days , respectively in first generation while these parameters recorded as 5.36±0.16 hours, 5.75±0.64 days and 4.69±0.57 days , respectively in second generation. The average eggs laid by female was 96.4 and 102 while hatchability of eggs recorded as 92% and 95.5% and sex ratio of male and female was 1: 1.04 and 1:1.12 in two successive generations.

Keywords: Pulse beetle, cowpea, *Callosobruchus*, biology, temperature, relative humidity.

EFFECT OF MICRONUTRIENTS ON GROWTH AND PRODUCTIVITY OF HYBRID RICE UNDER BORO CULTIVATION

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Rice is the world's most important staple food crop, which not only provided food but also influence traditions, religions, culture and life style since vedic period. 'Rice is life' for human beings especially in ancient sub continent, where 90 % of world's rice is grown and consumed with 60 % of population and where about two thirds of world's poor live. India ranks second after China with an annual production of 53.5 million tonnes of paddy, which is about 20.7 % the total world production. Balanced fertilization with major nutrients is an appropriate practice of fertilizers application for increasing crop yield and greater economic returns. Considering the fact, in addition with major nutrients like N, P, and K, micronutrients like zinc, molybdenum and boron has a major role to play. Zinc deficiency is recognized as the third most important factor after nitrogen and phosphorus limiting growth and yield of rice. Application of molybdenum stimulates the effect of nitrogen on almost all the yield attributes and boron is essential for development of reproductive organs of rice which help in improved grain yield. Therefore the present investigation was carried out to study the effect of micronutrient on growth and productivity of hybrid rice under boro cultivation. The results revealed from the experiment conducted showed that the treatment NPK (40/120 : 60 : 60) + ZnSo4 + Ammonium molybdate + Di-sodium-tetrahydrate octaborate as foliar application at active tillering stage and panicle initiation stage respectively of hybrid rice crop growth have profound influence on plant height(106.50 cm), no. of tiller per m^2 (346.66) and dry matter production (692.80 g). The yield parameters such as grain yield (6.54 t/ha), straw yield (6.79 t/ha), biological yield (13.33 t/ha), and harvest index (49.07) were also high as compared to other treatments. The yield response of combine influence at foliar application of molybdenum at active tillering stage and boron at panicle initiation stage with appropriate time of crop growth was most worthy of experiment and most effective in increasing hybrid rice yield.

Keywords: ***Hybrid rice, Micronutrients, Panicle initiation stage, Foliar application.***

FLOWERING, POLLINATION, FRUITING AND YIELD IN SOME UNDERUTILIZED FRUITS-A REVIEW

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The flowering, pollination, fruit maturity and yield of some underutilized fruits were reviewed. The flowering period and yield of ker (*Caparis deciduas* Forsk.), pilu (*Salvadora oleoides* Decne), Khejri (*Prosopis cineraria* L.), Khirni (*Manilkara hexandra*Roxb), rose apple (*Syzygiums amarangense* Merr. & Perry) and kokhum (*Garcinia indica*) are February-March and 10-20 kg per tree, January-March and 5-10 kg per tree, February-March and 20-25 kg pods per tree, spring season and 1-2 quintal per tree, October and November and 700 fruits per tree, October-November and 30-50 kg per tree, respectively. The fruit type in ker and khirnee are berry where as the fruit type in khejri is pod. The duration of fruit set to maturity in ker and khejri is 34-36 days and 140-160 days, respectively. The peak fruit setting in ker is in the month of March. The mode of pollination in ker is open pollination (18-20% fruit set) and self

pollination (8% fruit set) whereas in kokhum only cross pollination is followed. Therefore, there is a need to study about those aspects with sufficient knowledge to undertake the cultivation of those underutilized fruits.

Keywords:Flowering, Pollination, fruiting and yield in some underutilized fruits

DELINEATING THE DETERMINANTS RELATED TO ADOPTION BEHAVIOUR OF WOMEN STAKEHOLDERS TOWARDS AZOLLA CULTIVATION

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Adoption behaviour may be considered as the predisposition of the behaviour of an individual during the adoption process of any innovation. Here, in the present study, the respondents were the women stakeholders selected through Farm and Home visit and attempt has been made to analyse their adoption behaviour towards azolla cultivation because The scientific azolla cultivation has been taken up as the innovation in terms of which the adoption percentage reflected behaviour was calculated for the present study. The study was conducted in five villages of Coochbehar-II block of Coochbehar district in West Bengal. Purposive as well as multistage and random sampling procedures were followed in the present study. The adoption percentage was considered as the dependent variable and the other attributes of women stakeholders were considered as the independent variables for the study. The data were collected with the help of structured schedule through personal interview method. The statistical methods used for the analysis of the data were co-efficient of correlation and multiple regression. In the present study, it was found that the attribute namely education of the women stakeholders is positively and significantly associated with the dependent variable and the attribute farm size is significantly but negatively associated with the dependent variable, adoption percentage of the women stakeholders for azolla cultivation. It is also revealed that the variable education is contributing positively and significantly in case of characterizing the adoption percentage of the women stakeholders. The R^2 value being 0.663, it is to infer that the sixteen predictor variables put together have explained 66.30% variation embedded with the predicted variable, adoption percentage.

Key words: Adoption behaviour, women stakeholders, farm and home visit, azolla cultivation, multiple regression.

DRY FLOWERS: AN UPCOMING VISTA IN INDIAN FLORICULTURE

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Seasonal variability restricts the availability of flowers for a longer period. Moreover, respiration and loss of turgour due to vascular occlusion shrinks the post-harvest life of cut-flowers, the most perishable horticultural products, to a great extent. To increase the availability of those perishable aesthetics, a possible inexpensive solution is dry flowers, which are long lasting, preparation is less cumbersome and requires a little care for preservation and display. Inherent water content affects various biological pathways and allows the pathogens to harbour inside responsible for the end of life processes and death and decay of cut-flowers. The drying process includes slowly

removal of moisture from the cut flowers through various techniques like Sun-drying, silica-gel-drying/embedded-drying, oven-drying, microwave-oven-drying, freeze-drying, vacuum-drying etc., retaining the original colour, form, look and texture. At a fixed temperature, variation in duration of drying is observed in different species due to water content and texture. Stage of harvesting of flowers is also important as post-prime flowers do not dry or retain the colour well. Dried products offer a wide range of qualities like novelty, longevity, flexibility and year round availability. These are used to prepare several floral-crafts. A major share of Indian export of ornamentals is constituted by dry flowers. India is a country having wide biodiversity with plenty of colourful ornamentals including the commercial flowers, suitable for drying. This industry not only deals with the traditional, rather, inclusion of newer species is an added advantage to break the monotony and create variation and so a promising enterprise for Indian subcontinent involving rural youth especially women self-help groups.

PHENOTYPIC TRAITS OF WHEAT RELATED TO RESISTANCE AGAINST SPOT BLOTCH CAUSED BY *Bipolaris sorokiniana*

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Wheat (*Triticum aestivum*.) is one of the most important cereal crop of the world, which constitutes a very important source of food to a vast population contributing more calories and more protein with niacin, thiamine and glutamine to the world's diet than any other food crops .India is the second largest producer of wheat next to China, India, USA, etc. The yield of wheat in hill and terai region of Eastern India is challenged by many diseases, with foliar blight being the most important caused by *Bipolaris sorokiniana, Pyrenophora tritici repentis and Alternaria triticina.* Phenotypic traits like phonological traits, morphological traits, physiological traits, biochemicals traits were recorded and an attempt was taken to relate the phenoticpic character of wheat germplasm with its resistance to the disease. Study was done with some of the selected germplasm of wheat which is compared with the susceptible cultivar in search of the resistant germplasm against foliar blight. 500 germplasm was tested against virulent *Bipolaris Sorokiniana* isolate to determine resistant genotype related to the phenotypic traits, its attributes resulting resistance and more output of the economic yield. Variation of resistance was classified under highly resistance, moderately resistance, moderately susceptible, susceptible and highly susceptible in wheat against Spot Blotch. The relationship between the phenotypic traits and disease development leading to formulation of diagnostic tools to identify resistant germplasm was worked out for further utilization in crop improvement. Among the phenotypic traits days to heading, days to flowering, days to greenness, chlorophyll content and superoxide dismutase are negatively correlated with disease development. Whereas, the canopy temperature and leaf angle were positively correlated with the disease.

Key words: *Bipolaris sorokiniana* , Phenotypic Traits, Germplasm, Resistance, physiological traits, biochemical traits

POLYPLOIDY IN ORNAMENTALS

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Polyploidy breeding is a breeding method for doubling the chromosome number of an organism. Genetic variations created through polyploidy can be further used in breeding programme. Polyploidy breeding holds immense prospects in developing desirable varieties in flower crops. With the help of polyploidy, changes in

morphology and cytology of plants are observed. Tetraploids obtained are more vigorous and larger in size. Mostly seen consequences of induced polyploidy are increase in size and shape of plants; leaves, branches, flower parts, fruits and seeds. Intensification of flower colour and fragrance is observed in Marigold plants following chromosome number doubling. In roses it has increased the ploidy level from diploid to tetraploid as the miniature roses were diploid but the hybrid teas and floribundas are tetraploids, In gladiolus there is presence of diploid, tetraploid and hexaploid. Anueploids are found to be fertile in gladiolus. Carnation flower has diverse ploidy level such as *D. chinensis*- tetraploid; *D.caryophyllus*- diploid, *D. gratianopolitanus*- both tetraploid and hexaploid, Many desirable plant characteristics are related to plant ploidy levels. In Chrysanthemum intra-species and intra-population variations in ploidy level occurs. Polyploids are widely distributed in evolution & regulation of flower size and flower population . Spontaneous triploid are found in *J. sambac* & *J. autumnale*, *J. grandiflorum*, Spontaneous tetraploidy in *J.calophyllum* ,Triploidy in *J.grandiflorum* which increase concrete content and thereby hold promise as useful avenue for improvement of this crop but attempt to induce tetraploidy in Jasmine as induced tetraploidy in *J. grandiflorum* did not reveal superiority. Colchicine remained the utmost used chemical for induction of polyploidy. Chromosome doubling using various chemicals was observed in flower crops viz., Marigold, Aster, Orchid, Jasmine, Lillium , Chrysanthemum, Anthurium , Rose and Gerbera.

Keywords: Polyploidy, Ornamental, Rose, Carnation

PROSPECTS OF HYDROPONICS IN VEGETABLE CULTIVATION

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Hydroponics is a system of growing crops in nutrient solutions with or without the use of a growth medium (e.g. sand, gravel, vermiculite, rockwool, peat moss, sawdust etc). Hydroponic crop production has significantly increased in recent years throughout the world, as it allows more efficient use of water and fertilizers through use of recirculated water, reducing root diseases, efficient use of applied fertilizer and improving quality of the produce that ultimately improve productivity and results higher economic return. Research have shown that 20-30% more plant growth and vigour can be achieved in hydroponic systems compared to soil bound cultivation. However, high relative humidity and soluble fertilizers invite harmful pathogen that encourage plant diseases like damping off, verticillum wilt etc. Different types of hydroponic systems namely Nutrient Film Technique (NFT),Drip Watering, Aeroponics, Ebb and flow method and Passive systems are largely used in vegetable production. Hydroponics is commercially explored in lettuce, celery, watercress, kale, swiss card where fresh leaves growth and biomass are much higher compared to traditional practices. Cultivation of radish, cabbage, cucumber is practised in NFT for quality economic product with higher market price. The world population is increasing and cultivable land is decreasing very fast. Farmers are turning towards new technologies to create additional channel of crop production. In this direction, hydroponics cultivation can play a major role in coming years. Awareness should be created among the vegetable farmers about the benefit and practical application of hydroponic systems in vegetable production. The full paper deals with the practical application of hydroponic technique in vegetable production along with problems related to hydroponics cultivation.

Key words: Hydroponics, Vegetable Production, NFT, Fertigation.

EFFECT OF DATES OF SOWING AND MOISTURE LEVEL IN DIFFERENT DEPTH OF GROWTH STAGE AND YIELD DYNAMICS OF FENUGREEK (*Trigonella foenum graecum* L.)

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The experiment was conducted to study the "Effect of date of sowing and moisture level in different depth of Growth stage fenugreek *(Trigonella foenum graecum L)* was carried out at the Horticultural Research Station, Mondouri, BCKV, Nadia, West Bengal during the year 2012-13 and 2013-14 in the months of November to March each year for identifying the best date of sowing and moisture contain in different depth to get the highest seed production under gangetic alluvial plains of West Bengal. The fenugreek was shown in five different dates namely D_1, D_2, D_3, D_4, D_5 with using three irrigation levels at different days interval viz. I_1, I_2 and I_3 in the different depth of soil (viz. 0-3 cm, 3-10 cm, 10-20cm, 20-30) and different phases of crop growth (viz. Sowing, seedling, branching, flowering, pod formation, pod development and harvesting) in both the years. The respective dates were 2nd November, 9th November, 16th November, 23rd November and 28th December in both the seasons. Sowing date had significant effects on seed yield and its components. Seed yield of fenugreek was dependent on irrigation scheduling. So the experiment was laid out in Factorial RBD replicated with 3 irrigation level (I_1, I_2 and I_3) respectively. The results obtained from the study showed significant variation with different dates of sowing and irrigation. Projected seed yield/hectare was maximum (1.37 and 1.4 t ha^{-1}) on 2nd November (17.66 and 17.9 g) in both the years. Among the three irrigation levels I_1 was found superior with respect to yield and yield attributing. It was evident from the results that the date of sowing and irrigation had significant influence on phenology, growth and yield of fenugreek. It may be concluded from the results that to obtain higher seed yield fenugreek should be sown earlier at 2nd November and irrigation should be given in all the major growth phases at seedling, branching, flowering, pod formation, pod development stages, particularly in the new alluvial zone of West Bengal.

Keywords: **Fenugreek. Sowing time, moisture level, Growth, Yield**

HYDROPONICS IN VEGETABLE AND SPICE CROPS

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Hydroponics is the technique of growing plants in aqueous solution of essential nutrients. This technique of crop production, especially for vegetable and spice crops, is nowadays gaining importance in India and abroad. Hydroponic gardens can produce disease free plants with saving of appreciable amount of water and land especially in city areas. No nutrition pollution is released into the environment because of the controlled system. There various growing substrates like Pea Gravel, Coarse Sand, Sawdust, Prelite, Vermiculite, Peat moss, Rockwool, Coconut fibre, Grow stones, Oasis cubes, etc. are used for this technique. Hydroponics has become much popular in some vegetable crops like radish, beet root ,lettuce ,melons ,tomato ,etc. and spice crops like ginger .This review paper attempts to explore the present scenario, feasibility ,importance and scope of this advanced technique of vegetable and spice crops cultivation.

Key words: Hydroponics, vegetable and spices, feasibility, scope.

NANOTECHNOLOGY IN VEGETABLE PRODUCTION–POSSIBILITIES AND LIMITATIONS.

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The word 'nano' is a Greek word meaning 'dwarf' refers to use of materials to the dimension of 10^{-9} or one billion of one meter or one million of a millimetre. Nanotechnology involves the design, production and use of structures through control of size and shape of materials at the nanometre scale. It is an emerging area in vegetable production, post harvest practices and disease pest management. Different nanotech based products are accepted in diverse vegetable crops.Nanofertilisers having higher use efficiency are commercially used in radish, cabbage, egg plant etc. for higher yield and early maturity. Nanoparticles are widely used in controlling growth of harmful microorganism in different food product. Nanofilms are used to increase strength, quality and packaging beauty.Nanobiosensor is utilized for labelling different processed product. Nanochips are used in the disease diagnosis, pathogen detection and residual analysis which become much more quick and precise. Research work on application of nanotechnology is going on around the world and a good number of technologies are on pipeline. In spite of several opportunities nanotechnology also suffers some major drawbacks which hamper large scale adaption in Indian vegetable industry. Essentiality of skill manpower and sophisticated laboratory restricts the research in big institute. Again most of the nano based products are tested in optimum controlled condition and large scale farm based research is still lacking. The present work discussed in detail the use of different nanotechnology based product on vegetable production, shelf life improvement and disease pest management. The major drawback of nanotechnology in vegetable production sector was also highlighted.

***Keywords*-Nanotechnology,vegetable production, nano-biosensors, nanochips, nanofertilizers**

EFFECT OF DIFFERENT PRE-TREATMENTS ON SEED GERMINATION BEHAVIOR OF *Swietenia mahagoni* Linn. Jacq.

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An experiment was carried out in the instructional field of the Department of Forestry, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during the year 2013 - 2014. The experimental site lies in the plains of *terai* zone of West Bengal at an elevation of 43 m above mean sea level which embodies Sub-tropical humid climate. Pre-treatment studies were carried out in nursery in open field condition consisting 24 treatments with one control for evaluating germination percentage, germination value, mean germination time, RG-50 and seedling vigour index. The average maximum germination value (4.04) was recorded in the seeds soaked with thiourea 500 ppm for 24 hours followed by 100 ppm kinetin (3.82). The germination value 2.95, 3.21 and 3.53 was observed in seeds pretreated with cold water soaking for 12, 24 and 48 hours respectively. The minimum value (0.58) was noticed in the seeds treated with 1000 ppm sodium fluoride for 24 hours. In different treatment of KNO_3, the highest value (3.33) was showed in 500 ppm and the minimum (2.76) was in 100 ppm treatment. Among the thiourea, the lowest germination value (2.17) was observed in seeds soaked with 1000 ppm whereas the germination value 2.67, 3.48, 3.03 and 2.83 was noticed in seeds soaked with GA_3 of 100, 250, 500 and 1000ppm concentration respectively. The germination value showed the declining trend in kinetin when the concentration increased. Germination value in control showed higher (2.81) than the seeds pretreated with all the concentration of sodium fluoride. Significant variations in germination value in different pre-treatment are observed among the different pretreatments and follow the same pattern as of germination percentage. The effect of various pre-treatments for mean germination time (days) among the treatments differed significantly (p=0.05). Highest and lowest mean germination time (37.68 and

30.64 days) are noticed in 1000 ppm of sodium fluoride and 500 ppm of thiourea indicating that the thiourea treatment takes lesser time for the seed to germinate. Higher seedling vigour index was absorbed in thiourea 500 ppm (2606.66) followed by kinetin 100 ppm (2589.41)

STUDIES ON SEED QUALITY PARAMETERS OF OKRA (*Abelmoschus esculentus* L.)

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Okra (*Abelmoschus esculentus* L) is also known as Lady's finger or Bhendi, belongs to the family Malvaceae. It is having chromosomal number 2n=8x=72 or 144 and is a polyploid. Okra seeds are affected by some internal and external factors for its seed quality. Dominant factors affecting the quality of okra seeds are the fruit set order within the plant, fruit age at harvest, and the duration of storage before seed extraction and moisture percentage. Cultural practices applied to the mother plants, such as fertilization, nutrient deficiency, Yellow Mosaic Virus and irrigation had a significant effect on seed quality in okra. Present study emphasize on the seed viability and vigour parameters of various okra varieties. Seeds of 10 okra varieties were evaluated by following tests standard germination, 1000 seed weight (test weight), seed density, electrical conductivity of seed leachates, speed of germination, root length, shoot length, seedling length, dry root weight, dry shoot weight, seedling dry weight, vigour index length, vigour index mass and seed vigour. From the study, it can be concluded that the variety Shakti has been identified as the best variety for the especially of these parameters in both farmers field and research forms. The varieties Shakti, Shivam and Bhendi Anjali were found superior for seed viability and vigour parameters. The analysis of variance (ANOVA) revealed presence of considerable variability among the varieties for all the characters.

Key words: Okra, seed quality, seed viability, seed vigour parameters.

SURVEY AND DOCUMENTATION OF MITES AND INSECTS ON MEDICINAL PLANTS AND THE ASSESSMENT OF BIOPESTICIDES ON MITE-FEEDING

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Medicinal plants have gained increasing importance globally and used exhaustively as herbal drugs. However, there is also corresponding increase in pest problem. Hence, to combat the pest setback of medicinal plants it is becoming essential to identify a substitution for pest management other than chemical pesticides, which will be safe for human health and yet effective. In this respect, survey of mites and insects was carried on medicinal

plants and bio-efficacy (mortality, antifeeding and repellency) tests of biopesticides were estimated on mite feeding. The survey yielded 29 species of mites under 11 families and 10 species of insects under nine families which included both phytophagous and predatory. Among them four species of mites and two species of insects were found to be most injurious. Also, 22 new hosts/habitats were recorded for mites. For the bio-efficacy study of botanical pesticide, five leaf extracts were used *viz.* Neem, Nishindha, Bhat, Palash and Karanja. Nishindha registered highest percentage mortality (98.33%) in case of *Tetranychus ludeni* infesting *Rauvolfia serpentina*. Repellency outcome was highest in Nishinda (80%). For antifeedant assay, the consumption of leaf area was lowest in case of Neem and Bhat, where no leaf was consumed. For the bio-efficacy study of entomopathogenic fungi and entomopathogenic fungi along with Neem, three fungi (*Metarhizium anisopliae, Beauveria bassiana, Paecilomyces fumosoroseus)* and their different concentrations were used. *Beauveria* (10^7) registered highest mortality. The use of botanical extracts (green pesticides) and pathogenic fungi are appearing to be quite promising as those can control the pest problem but will leave no residue because of being entirely natural products.

Keywords: Medicinal plants, mites, insects, biopesticides, bio-efficacy test

IMPACT OF ENCAPSULATING AGENT, MATRIX LEVELS AND MEDIA FORMULATIONS ON ARTIFICIAL SEED PRODUCTION OF *Rauwolfia serpentina* (L.) Benth. *ex* Kurz.

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Owing to the huge potential as anti-hypertensive property of bark- and root-derived reserpine, *Rauwolfia serpentina* (L.) Benth. *ex* Kurz. secures a major position in the pharmaceutical industry. Poor seed viability, little seed germination, and vast genetic variability are the key limitations for its marketable cultivation through conventional approach. Artificial seed production technology via alginate-encapsulation is currently accepted as a competent choice of both propagation as well as short- to mid-term storage, for several medicinal plants. Present research work establishes the protocol for artificial seed production and its conversion from shoot tips (STs) of *R. serpentina. In vitro* STs (3–4 mm long) were successfully uniformly encapsulated, using 3% (*w/v*) sodium alginate (SA) with 75 mM calcium chloride ($CaCl_2.2H_2O$) (CC) with maximum (84%) conversion frequency. SA lower than 3% concentrations were unsuitable as the beads formed were of indefinite shape and too soft to handle. On the other hand, SA more than 3% resulted in beads with dark colour, too viscous, harder that restricted conversion. The media formulations entailed of both liquid and semi-solid full strength Murashige and Skoog (MS), ½MS, ⅓MS or ¼MS, all containing 3% (*w/v*) sucrose. The maximum (88%) conversion of artificial seeds into plantlets was achieved on ½MS liquid medium presumably due to the optimum total concentration of nutrients in the gel matrix. Others formulations might be either inadequate for conversion or detrimental due to nutrient toxicity.

Key words: Calcium chloride, conservation, conversion, encapsulation, sodium alginate

Abbreviations: CC Calcium chloride; MS Murashige and Skoog (1962); SA Sodium alginate, ST Shoot tip

SCREENING OF OKRA GENOTYPES AND PRELIMINARY STUDIES ON INCIDENCE OF INSECT PESTS ON OKRA (*Abelmoschus esculentus* (L.)

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The study was conducted for preliminary screening trial of 08 genotypes of okra for relative susceptibility/resistance against pest complex during 2014 - 2015. From these screening trials differences were found to be significant among genotypes of okra during both the study years. Local cultivar showed maximum susceptibility while Nirmal - 101 was comparatively less susceptible. Among the insect pests that cause damage on okra, Aphid, Jassid, White fly, Flea beetle and Fruit borer have been observed on the cultivated plot of okra. The most average occurrence at 2.21 ± 0.42, 0.78 ± 0.27, 0.24 ± 0.07, 1.35 ± 0.23 and 3.95 ± 2.45 of jassid / leaf, aphid / leaf, white fly / leaf, flea beetle / plant and fruit borer infestation (%) were observed respectively. Effects of agroclimatic factors on the growth of insect pests were also observed during the duration of the study. Temperature, relative humidity and rainfall showed direct effect on the population trend of all insect pests.

Keywords: Okra, Pest complex, Okra genotypes, Susceptibility of okra, Population, Season

EFFECT OF SUCROSE ON BIOCHEMICAL PARAMETERS OF CUT GERBERA (*Gerbera jamesonii* Bolus ex. Hook.) cv. Lamborgini

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An experiment was conducted to find out the effect of sucrose on vase life and quality of cut gerbera. There were eight treatments are comprising of control (Distilled water), Sucrose 3%, 4%, 5%, 6%, 7%, 8% and 9%. Stalks of cut flowers of gerbera were dipped in 250 ml vase solution. Vase life of gerbera was significantly influenced by different concentrations of sucrose. Maximum vase life (9.45 days) was recorded with Sucrose 5% which was on par with Sucrose 6%.

Key words: Gerbera, Floral preservatives, Cut flower and Vase life.

POST HARVEST MATURITY INDICES OF SOME UNDERUTILIZED FRUIT CROPS

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The crops, which are neither grown commercially on large scale nor traded widely, may be termed as underutilized crops. There are quite a large number of underutilized fruit crops which are being used by the tribal inhabitants of the country. Apart from their nutritive and medicinal values, these underutilized fruits have excellent flavors and attractive color. Though having various quality attributes, most have not undergone any conscious phase of domestication and human selection. Wide diversity of edible plant species in the country serve as an indication to the rich genetic resources. But their cultivation is very restricted and grown wildly. Information on post harvest maturity indices, harvesting, handling, promotion or marketing strategies and utilization are very meager. An attempt has been made to deliver the information on maturity indices of some underutilized fruit crops such as **Noni** (*Morinda citrifolia*), **Date palm** (*Phoenix dactylifera*), **Avocado** (*Persea americana,* **Dragon fruit** (*Hylocereus undatus*), **Rambutan** (*Nepheleum lappaceum*), **Kokam** (*Garcinia indica*), **Kair** (*Capparis deciduas*), **Makhana** (*Eurayle ferox*) and **Passion fruit** (*Passiflora edulis*) which are highlighted in this document. However, a systematic study is required to be initiated for improvement, exploitation, collection, multiplication, standardization of post harvest and processing technologies along with value addition.

OFF-SEASON CULTIVATION OF VEGETABLE CROPS UNDER PROTECTED STRUCTURES: SCOPE AND LIMITATIONS

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Vegetable crops are the cheaper source of natural protective foods namely carbohydrate, protein, fat, minerals and vitamins and are the essential ingredients for daily kitchen. Demand of fresh vegetables prevails round the year but supply is restricted to cultivation season. Vegetable cultivation out of normal season increses .To increase the availability for longer period in addition to normal season and for better returns to the farmers, vegetable cultivation during off-season is getting popular among the growers. However the risk of adverse climate causes decline in production or even crop failure. As the performance of the vegetable crops is highly influenced by temperature and light fluctuation and that affects the growth, physiological process, flowering, fruit setting and finally yield and economic return. Summer crop of winter season vegetables under open field condition is not possible as scorching sun and higher day and night temperature adversely affects the vegetative growth, prompted flower and fruit drop. Again cultivation of summer crop during winter months in open field suffers from low temperature, cold waves and freezing injury. Through adopting of proper protection technology and proving favourable temperature and light, crops can be raised during off season. With the introduction of shade net which partially control the temperature and light and creates a favourable environment for crop growth that enables raise the crop under intense summer months with desirable yield and quality. Again poly house maintained higher temperature and light intensity compared to outside during winter months which favours the growth and yield of summer season vegetables. The full paper discussed the different aspects of off-season vegetable cultivation to make the production system economically viable and remunerative.

Key words: Off-season vegetable cultivation, agro shade net, poly house, temperature and light.

EVALUATION OF DIFFERENT TURMERIC GERMPLASM FOR TOLERANCE TO LEAF BLOTCH AND LEAF SPOT DISEASE

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Turmeric (*Curcuma longa* L), the ancient and sacred spice of India known as Indian saffron is an important commercial spice crop grown in India. India is the largest producer, consumer and exporter of turmeric in the world. But the productivity is low in West Bengal (2.66 t/ha against National average of 5.1 t/ha in 2013-14) and one of the factors for this low productivity is different foliar diseases mainly leaf blotch and leaf spot of turmeric. 11 different germplasm (4 from TNAU, Coimbatore, Tamil Nadu; 3 from RAU, Dholi, Bihar and 3 from UBKV, Pundibari, W.B.) along with a local check from 3 different states were screened at UBKV, Pundibari, Coochbehar for getting resistant germplasm against both the diseases. In pooled analysis for 2013-14 and 2014-15, it was found that TCP 129 recorded lowest leaf blotch (PDI 11.15) and leaf spot (PDI 6.56) disease severity among the 11 germplasm tested including the local check. TCP 14 produced the second lowest leaf blotch disease severity (PDI 11.98) and CL 52 produced second lowest leaf spot disease severity (PDI 7.78). The highest leaf blotch disease severity (PDI 41.75) was recorded by RH 407 whereas the highest leaf spot disease severity (PDI 43.25) was recorded by RH 410. The highest yield of 12.33 Kg/plot (24.86 t/ha) was obtained by TCP 129 which is followed by TCP 14 with 9.33 Kg/plot (18.81 t/ha) and CL 52 with a yield of 8.53 Kg/plot (17.20 t/ha). The lowest yield of 5.20 Kg/plot (10.48 t/ha) was recorded by RH 407.

EFFECT OF BIO-FERTILIZERS AND BIO-CONTROL AGENTS IN THE QUALITY PRODUCTION OF GLADIOLUS – A REVIEW

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Gladiolus (*Gladiolus grandiflorus)* belongs to family Iridaceae, mainly used as cut flower. It is considered to be the "queen of bulbous flowers". Being a heavy feeder and it requires considerable amount of manures and fertilizers to produce quality spikes. The agro-climatic condition of India favour the high yield and quality spike production of gladiolus but its successful cultivation often hinder due to some of the inherent problems of corm rot as well as wilt or yellows disease of gladiolus caused by *Fusarium oxysporum* f.sp. *gladioli* that threaten their economic value. The excessive use of chemical fertilizers to meet its nutrient requirement and application of chemical fungicides to control the inherent diseases of gladiolus often caused serious damage to the soil fertility, nutrient imbalance, accumulation of toxic chemicals which have an adverse effect on the soil productivity, environmental degradation and also affecting the yield and quality of the product in the long run. Biofertilizers is low cost and safer way of nutrient supplements to chemical fertilizers and save the addition of chemical fertilizers by 10-20%. Biocontrol agents provide a defence to the plant disease as well as plant growth-promoting rhizobacteria. Application of biofertilizers and biocontrol agents is the alternative source for sustainable production system with minimum Eco hazards as the need of the hour. This article reviews the innovations on the use of biofertilizers and biocontrol agents on the quality production of gladiolus.

Key words: Gladiolus, biofertilizers, biocontrol agents

GENETIC ANALYSIS FOR GRAIN YIELD IN BREAD WHEAT (*Triticum aestivum* L.) UNDER TERAI REGION OF WEST BENGAL

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In India, there was a growing assurance that it will achieve the 109 MT target requirement by 2020. But in the last few years, there has been a wide gap between the target and actual wheat production. Along with this area under wheat declined as a consequence of crop diversification efforts. Therefore, to achieve target wheat production, micro-level action plan focusing on NEPZ is required for increasing the nation's wheat production. To assess the performance of wheat genotypes the present experiment was conducted with thirty-seven potential wheat genotypes which were analyzed for different parameters of genetics and also evaluated for a number of morpho-physiological traits along with yield under Terai region of West Bengal.

Among 8 quantitative traits yield varied maximum near about a 5- fold range in grain yield (tonnes/hectare). Genotypic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV) revealed high variability for traits like grain yield (tones/hectare), tillers/meter, and spike length. While, high heritability coupled with high genetic advance was observed for grain yield (tones/hectare), tillers per meter etc. traits. Significant and positive correlation was observed between plant height (cm) and spike length (cm) both at genotypic and phenotypic level. Where, significant and negative correlation was observed between days to maturity and spike length (cm). Maximum direct effect on grain yield was contributed mostly by tillers/meter (0.399), followed by number of grains/spike (0.223) and spike length (0.167) and maximum negative direct effect was exhibited by 1000 grain weight (g) (-0.546), and followed by days to heading (-0.181). Among 37 genotypes, some were found promising like AKAW-4739 (5.47), GW-2010-287 (5.36), GW-2010-290 (5.16), in terms of grain yield (tonnes/hectare) and they can be selected as suitable genotypes for growing under Terai region of West Bengal.

STUDY ON LEAF BASED PHYSIOLOGICAL CHANGES IN RELATION TO WATER STRESS TOLERANCE OF CONTRASTING MUNGBEAN (*Vigna radiata* L. Wilczek) CULTIVARS

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The interactive effects of PEG induced moisture stress on leaf based physiological changes and water stress responses in two contrasting mungbean (Vigna radiata L. Wilczek) cultivars i.e. K 851 (drought tolerant) and PDM 139 (drought susceptible) during seedling development were studied. A range of four external water potentials (i.e. -1.0, -2.0, -3.0 and -4.0 bass), besides glass distilled water as control (0.0 bar), were used. Parameters like leaf area, relative leaf water content (RLWC), chlorophyll content, chlorophyll stability indexes (CSI) in both the cultivars were found to decrease with the increasing magnitude of stress. By and large phenols and ascorbic acid content were increased with the stress level but the trend was not consistent. However, steady rise in proline, hydrogen peroxide (H_2O_2) content and MDA contents was found with water stress. Out of two cultivars tested, drought tolerant cultivar K 851 was found to be better in leaf water balance and higher accumulation of phenols, proline and ascorbic acid than PDM 84-139.

REVIEW ON IMPORTANCE AND MICROPROPAGATION OF *Rauwolfia serpentina* - SARPAGANDHA – AN ENDENGERED MEDICINAL PLANTS

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Rauwolfia serpentina L. Benth. (family: Apocynaceae) is a woody perennial shrub which is indigenous to the Indian subcontinent and south East Asian countries. The plant is found in almost all parts of India up to an altitude of about 1000 m and found to grow in the wild in many parts of the country. It is found in West Bengal, Orissa, Bihar, Chhattisgarh, Madhya Pradesh, Andhra Pradesh, Tamil Nadu and Kerala states of India. The plant commonly known with different names; sarpagandha, snake root plant, chotachand, chandrika etc. The roots of this shrub have been used for centuries in ayurvedic medicines because most of the alkaloid present in the root bark. Around 50 indole alkaloids are found in *R. Serpentina* But due to rapid growth of world population, increasing anthropogenic activities, rapidly eroding natural ecosystem etc, the natural habitat of this important shrub Rauwolfia is dwindling. It is now an endangered species in India due to indiscriminate collection and over exploitation of natural resources for commercial purposes to meet the requirements of pharmaceutical industry, coupled with limited cultivation. The propagation of *R. serpentina* through seeds is difficult due to less viability and very low germination percentage. Whereas vegetative propagation through stem and root cuttings leads to destructive harvesting. At present application of plant tissue culture offers valuable ways to overcome all the problems that is found in natural propagation. Micro propagation of the plant allows production of clones at fast rate and in continuous manner. In vitro studies may be a best alternative to regenerate plant lets within a very short time. Explants of an alkaloid producing plant cultured in vitro and has been found to retain the capacity to synthesis alkaloids identical to that in the intact plant. Sometimes, high yield of secondary metabolites is observed in tissue grown callus masses produced during differentiation.

MODIFIED ATMOSPHERIC PACKAGING: INCREASE THE SHELF LIFE OF CUSTARD APPLE

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Combined effect of modified atmospheric packaging and storage temperature was carried out to improve the quality and shelf life of custard apple. Custard apple fruits are perishable, so under ordinary conditions, these fruits can be kept well only for 3-4 days after harvest. The uniform sized fully matured but unripe fruits of custard apple cv. Balangar at color turning stage were packed in medium density polyethylene bags (50µ density) with mixture of different gaseous composition and stored in ambient and 12°C temperatures up to 8 and 10 days respectively. Higher TSS and total sugar, retention of ascorbic acid, acidity, phenols and highest scores for overall organoleptic attributes were found in low concentration of O_2 and CO_2 in MAP and low temperatures storage. Finally this study indicated that custard apple fruit could be stored at 12ºC for 10 days with MAP (5% O2 and 10% CO2) with highest quality parameters. It also indicate that stored custard apple fruit can be marketed for extended period and used for making various products.

Key word: Modified atmosphere packaging, storage temperature, shelf life

LOCAL GERMPLAM AND LANDRACES DIVERSITY IN WEST SIKKIM

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Indigenous Knowledge (IK) of local community accumulates over generations of living in a particular environment. It encompasses all forms of knowledge and technologies, know-how, skills, practices and beliefs that enable the community to achieve stable livelihoods in their environment. High Yielding Varieties are doing the best with adequate input like fertilizer and plant protection measures but not in hill farming system. They never attain potential yield due to several factors. Keeping in mind the fragility of ecology in the hills, organic farming is much debated to be the best option. Farmers in the hills have evolved and selected several germplasm and landraces through their continuous efforts across several decades. These germplasm or landraces are now most suited for organic farming system. A study has been conducted in the West district of Sikkim to know the diversity of local landraces and germplasm being cultivated by farmers which are best integrated with organic farming.

THERAPEUTIC ORCHIDS OF DARJEELING HIMALAYA

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The present study is an attempt to identify the medicinal orchid species growing naturally in Darjeeling Himalaya of West Bengal. The information was collected from the extensive survey of existing literature and interactions with the traditional practitioners, herb collectors, local traders/ middlemen and villagers. Besides their ornamental value, orchids are also known for their medicinal usage especially in the traditional system of treatments. The paper lists the species of orchids which are used in traditional medicine by the local people of Darjeeling district. The work aims at presentation of this knowledge which would be valuable for the herbal drug industry and may lead to identification of new applications or resources.

Keywords: Orchids, herbal medicine, Darjeeling

STUDY OF RAPESEED EQUIVALENT YIELD ON DIFFERENT CROPS DURING *RABI* SEASON OF *TERAI* REGION OF WEST BENGAL

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A study was conducted during the *rabi* season of 2010-11 at the instructional farm of UBKV, Pundibari, Cooch Behar, West Bengal to determine the best performing crop based on rapeseed equivalent yield under *terai* region of west Bengal. Two cereal crops (*viz.* wheat and buckwheat), three pulse crops (*viz.* lentil, fababean and grasspea) and three oilseed crop (*viz.* rapeseed, linseed and niger) were taken for this experimentation. Rapeseed-equivalent yield (REY) was calculated for all the crops due to the dominance of rapeseed in this region. Among all

the crops, fababean recorded the highest rapeseed-equivalent yield (REY) (12.75 q/ha) during 2010-11 which was significantly higher over to that of wheat (12.3 q/ha) and buckwheat (11.76 q/ha) during 2010-11 followed by rapeseed (11.14 q/ha), lentil (10.91 q/ha), grass pea (10.06 q/ha), linseed (8.05 q/ha) and niger (6.43 q/ha) respectively. Among the cereals including pseudo-cereal (buckwheat), highest REY was recorded in wheat followed by buckwheat during the investigation. Among the pulse crops, highest REY was recorded in fababean followed by lentil and grass pea during investigation. Similarly among the oil seed crops, highest REY was recorded in rapeseed followed by linseed and niger during the investigation.

Key words: Rapeseed equivalent yield

SPECIES RICHNESS AND RELATIVE ABUNDANCE OF PEST FAUNAL COMPLEX INFESTING OKRA UNDER MID-HILL CONDITIONS OF EASTERN HIMALAYAS

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Field experiment was conducted to study the species richness and relative abundance of different pest species infesting okra at the Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong, West Bengal in the spring-summer season during the period from April to August, 2011 and 2012. Twenty four species of insect pests belonging to 16 families under 5 orders were found damaging okra right from the seedling stage upto the maturity of the crop. The leaf beetle (*Nisotra chrysomeloides* Jacoby), aphid (*Aphis gossypii* Glover), blister beetle (*Mylabris pustulata* Thun.) and whitefly, *Bemisia tabaci* (Gennadius) were found as the most common and major insect pests of okra. By number, leaf beetle was found to be the most frequent species followed by aphid, blister beetle and whitefly. The Shannon's diversity index (*H*) and Simpson's diversity index (*D*) for the pest faunal complex of okra was calculated as 2.18 and 6.854, respectively. Similarly, the Shannon's equitability (E_H) and Simpson's equitability (E_D) for the community were calculated as 0.69 and 0.286, respectively.

Keywords: Okra, pests, species richness, abundance, diversity indices

EFFECT OF MINIMUM TILLAGE, MULCHING AND VERMICOMPOST APPLICATION ON MAIZE

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A field experiment was conducted at AICRP on Integrated Farming Systems at the Central Research Farm Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya during 2011-12 on maize with an objective to determine the chemical and physical soil quality under minimum tillage and mulching condition (straw mulch@5 tha^{-1}). The experiment was conducted split-plot design with 8 treatments which replicated thrice. The treatments were., T_1-Minimum tillage, T_2-Conventional tillage, M_1-No mulch, M_2-Mulch, F_1- 100% RDF, F_2-75% RDF& 25% N through

vermicompost. Minimum tillage (T_1) resulted 1.32% reduction in BD, and increased 20% Mean Weigh Diameter (MWD), 6.5% Aggregate stability, 3.56% organic carbon, 11.25% available Nitrogen, 8.58% available P and 12.5 % available K compared to conventional tillage (T_2). Rice straw mulching@5 t ha^{-1} (M_2) led to a decreased in 1.32% BD and increased 7.89% organic carbon and 6.66% available P compared to no mulch treatment (M_1). 75%RDF+25 % N through vermicompost (F_2) results in a decrease in 1.32% BD and increases in 11.8 % MWD, 5.3% available N, 13.5 % available P and 9.7% available K compared to 100% RDF (F_2). From the result we can conclude that Minimum tillage is better as it conserves more nutrient and maintained greater soil aggregates in comparison to conventional tillage. Mulching (paddy straw@ 5t ha^{-1}) of crop improve the soil aggregates and maintained a higher organic carbon content of the soil as well as other macronutrients. Among the various nutrient combination 75% RDF+ 25%N through vermicompost improve the soil regarding nutrient status and soil structure.

BIO-ECOLOGY OF TWO-SPOTTED SPIDER MITE (*Tetranychusurticae* Koch.) (Acari: Tetranychidae) INFESTING POINTED GOURD (*Trichosanthesdioica*Roxb.) IN WEST BENGAL

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An experiment was carried out to study the incidence pattern and bio-ecology of two-spotted spider mite infesting pointed gourd along with the role of major abiotic factors on the population dynamics. Peak incidence was observed during last week of April to first fortnight of May during all the three years of study. It is revealed from the spatial distribution that the population builds up in a clumping forms and spread very fast. The biology of the mite was studied under laboratory ambient condition at 28°C temperature and 80% relative humidity. The biological stages, namely, incubation period, larval period, protonymphal period, deutonymphal period, longevity of the adult male and female were 3-4 days, 1-2 days, 2-3 days, 13-16 days and 17-21 days, respectively. The population of mite had high positive significant correlation with maximum temperature (r = +0.797) and bright sunshine hours (r = +0.622). On the other hand, the population was negatively correlated with both morning and evening relative humidity (r = -0.650 and -0.539 respectively, both significant). Similarly total rainfall had a negative correlation (r = -0.289) and very low but positive relationship were existed with soil temperature. Predictive models were developed from pooled data of two years (2008 and 2009) observations on population and weather factors. The model was verified with the pest and weather data of 2010. The predicted population of mite matched well with actual population observed.

Keywords: **Biology, incidence pattern, correlation, predictive model, spatial distribution**

EFFECT OF DIFFERENT TREATMENT COMBINATION ON THE PERFORMANCE OF DARJEELING MANDARIN ORANGE (Citrus reticulate Blanco)

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Citrus is one of the most important fruit crops in India. The most important citrus cultivars in India are mandarin (*Citrus reticulate* Blanco), followed by sweet orange (*Citrus sinensis* Osbeck) and acid lime (Citrus *aurantifolia* Swingle). It is also one of the important fruit crops of Darjeeling hills. Commercial citrus group like Darjeeling mandarin are grown in all the three subdivision of Darjeeling hills.Eight treatment combinations were formulated to see the effects. Where treatment 8 combination of 30 cm pruning with NPK and FYM +Vermicompost + Pig manure along with GA_3 15ppm and zinc and boron foliar Spray was found best effect combination treatment in all the aspect from fruit yield and quality followed by T_7 NPK+B+Zn+50% FYM +25% Vermicompost + 25% pig manure + GA_3 15 ppm. Different treatment combination had a significant effect on height, trunk girth, canopy and shoot length where, T_8 (30% pruning from the apex + NPK+50% FYM +25% Vermicompost + 25% pig manure + GA_3 15 ppm + Zn + B) recorded highest mean data i.e. 5.87m, 44.42cm, 463.56 cm^2 and 7.85cm due to integrated nutrient management approach compared to T_1 (control) recorded lowest mean data i.e. 3.43m, 25.49cm, 271.50 cm^2 and 2.39 cm.

BIOEFFICACY OF READY MIXTURE OF SPIROTETRAMAT 120 + IMIDACLOPRID 120 : 240 SC AGAINST SUCKING PEST ON BRINJAL

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Field experiments were conducted during the pre-*kharif*season for two consecutive years, 2009 and 2010to test the bio-efficacy of a ready mixture of Spirotetramat 120 + Imidacloprid 120 : 240 SCat three different combination doses (i.e 45+45 g a.i/ha, 60+60 g a.i/ha and 75+75 g a.i./ha) against the jassidandwhitefly of brinjal. Six standard checks Spirotetramat 150 OD @ 75 g a.i./ha, Imidacloprid 200SL @ 75 g a.i./ha, Dicofol 18.5% EC @185 g a.i./ha, Oxydemeton Methyl 25 EC @ 250 g a.i./ha, Dimethoate 30 EC @300 g a.i./ha and Thiamethoxam 25 WG @ 25 g a.i./ha along with a untreated check were also taken for comparison. The study revealed that combination of Spirotetramat 120 + Imidacloprid120 : 240 SC @ 75+75 g a.i./ha was the best treatment in terms of minimum pest population as well as maximum yield.

Keywords: Brinjal jassid, whitefly, red spider mite, Spirotetramat 120 + Imidacloprid120:240 SC formulation

EFFECT OF GROWING MEDIA AND GROWTH PROMOTING HORMONE ON ROOTING AND SHOOTING BEHAVIOR OF *Terminalia bellerica* (Roxb.) UNDER CONTROLLED CONDITION

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A study was conducted to examine the effect of growing media and growth promoting hormone on the rooting and shooting behavior of *Terminalia bellerica* were conducted at Research form of Chauras Campus of HNB Garhwal Central University (Uttarakhand), India. The rooting media like vermiculite, vermiculite + Sand (1:1) and garden soil as well as different concentrations of IAA, IBA and NAA viz., 100, 500, 1000 ppm and control in liquid hormonal solution and powdery hormonal treatment were used for experiment. The cuttings treated with IBA 500 and 1000 ppm performed the best in all aspects. The rooting and shooting percentage as well as overall growth rate of rooting and sprouting was found good in liquid hormonal solution as compared to powdery hormonal treatment.

Key words : *Terminalia bellerica*, growing media, hormone, cutting, growth

EFFECT OF PLASTER OF PARIS ON COLLAR ROT DISEASE OF POTATO CAUSED BY *Sclerotium rolfsii*

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Effect of plaster of paris (@ 2.5g/infected collar region of plant) on two different growth stages of *Sclerotium rolfsii* (mycelial stage and sclerotial stage) isolated from infected potato plant was determined. Plaster of paris was applied directly as powder form over the infected area and observation was taken at 10 days after application. Adverse effect of plaster of paris on the fungus was recorded. The whitish mycelial growth from collar region of all the treated plants was found disappeared. Further formation of sclerotia was stopped. The existing sclerotia became deformed and dried. The sclerotia and small bits of treated infected plant tissue when transferred to PDA medium for mycelial growth and sclerotial germination, no further growth was recorded at 10 days after incubation. In case of untreated infected plants, growth of thick whitish fan-shaped mycelial growth was formed with huge numbers of sclerotia. A field experiment was also conducted using four biological agents (*Pseudomonas fluorescens*, *Trichoderma viride, Azotobacter chroococcum*, *Glomus fasciculatum*), two organic amendments (vermicompost and neem cake enriched with neem oil), and one building material (plaster of paris) for managing collar rot disease of potato at Benuria under Red and Lateritic Agroclimatic Zone of West Bengal during 2013-14. Randomized Block Design was adopted with three replications. The treatments, vermicompost @ 6kg/plot i.e. 5.5t/ha, neem cake enriched with neem oil @ 2.2kg/plot i.e. 2t/ha, *Pseudomonas fluorescens* @ 10g/plant, *Trichoderma viride* @ 10g/plant, *Azotobacter chroococcum* @10g/plant, *Glomus fasciculatum* @10g/plant were directly applied in the field just before planting only one time. The plaster of paris @ 6g/plant was dusted twice at the collar region of plant at fifteen days interval starting from 15 days after planting. Severity of the disease recorded highest in control plots (8.95 and 19.88%) followed by *Glomus fasciculatum* (4.92 and 8.11%), neem cake (4.55 and 5.51%) and *Trichoderma viride* (2.50 and 4.74%) treated plots while lowest disease severity recorded in plaster of paris (0.70 and 2.65%) followed by vermicompost (1.05 and 3.80%), *Pseudomonas fluorescens* (1.41 and 4.30%) and *Azotobacter chroococcum* (1.38 and 4.20%) treated plots at 60 and 75 days after planting, respectively. The per cent disease control (PDC) at 75 days after planting was highest in plaster of paris (90.24%) followed by vermicompost (85.82%),

Azotobacter chroococcum (83.73%) and *Pseudomonas fluorescens* (83.38%) treated plots. *Trichoderma viride* (73.96%) revealed better than Neem cake (62.33%) and *Glomus fasciculatum* (52.21). There was no phytotoxic effect for the application of plaster of paris ($CaSO_4.½ H_2O$).

Keywords: Collar rot, plaster of paris, potato, *Sclerotium rolfsii,* fungicide, management

EFFECT OF VERMICOMPOST AND PHOSPHORUS ON ZINC AVAILABILITY IN AN ACID SOIL OF WEST BENGAL

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Zinc (Zn), a Group II B element of periodic table, is an essential micronutrient for plants, animals and human beings. Zinc is considered to the least toxic of the so called heavy metals. Phosphorus (P) is the most important element interfering zinc availability in soil. Phosphorus and zinc deficiencies are widespread nutritional constraint on crop production in many parts of the world particularly in acid soil. The antagonism between phosphorus-zinc is observed mainly when both nutrients are deficient. The experimental soil was collected from Bankura having pH value 5.2, phosphorus content of 25.98 kg ha^{-1} and Zn content of 0.29 mg kg^{-1}. The laboratory incubation study for 15 and 30 days at 30^0C taking graded doses of Zn, P and vermicompost showed that DTPA-extractable Zn was higher in general in all treatment combinations receiving higher Zn addition. The application of P reduced the Zn extractability of soil and *vice-versa.* The application of vermicompost increased the availability of the P but decreased the DTPA extractable Zn in soil. The time of incubation period increased the P as well as Zn contents in soil.

PATTERNS OF PRE-WEANING PIGLET MORTALITY AND ECONOMIC LOSSES IN FIELD CONDITION

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The study was purposively taken up with the objective to find out the patterns of pre-weaning piglet mortality and economic losses in field condition. The study was purposively taken up in the Darjeeling hills where pig farming is a common practice. The study shows that overall pre-weaning piglet mortality was 15.62 percent where it was slightly higher in exotic than indigenous breed. Highest pre-weaning mortality was recorded among 0-15 days age group piglets mainly during winter months and in third parity of dam. The major reasons of pre-weaning piglet mortality found in the study area were chilling, piglet anaemia and scouring. Overall economic losses due to pre-weaning piglet mortality were more than 12 lakhs during last 3 years in which it was around Rs 3.5 lakhs in indigenous breed and around 8.5 lakhs in exotic breed during last 3 years. Economic losses due to pre-weaning piglet mortality was recorded highest for scouring followed by chilling and low birth weight in indigenous breed whereas it was highest for piglet anaemia followed by chilling and scouring in exotic breed.

Keywords: Piglet mortality, Indigenous breed, Exotic breed, Piglet anaemia

STUDIES ON DISTRIBUTION OF ZINC FRACTIONS IN SOILS OF COOCH BEHAR UNDER TERAI REGION OF WEST BENGAL

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A survey was conducted to collect the soil samples for analysing the distribution of zinc fractions for the twelve blocks of Cooch Behar District under the *Terai* region of West Bengal. The soils of the surveyed area were acidic in nature (pH 4.9 - 6.9). The DTPA-extractable Zn varied from 0.57 to 10.58 kg ha^{-1} of the collected samples. The results showed that, among the different Zn-fractions i.e (exchangeable zinc, organic matter bound zinc, manganese iron oxide bound zinc, amorphous iron oxide bound zinc, crystalline iron oxide bound zinc), amorphous iron oxide- bound zinc was the dominant fraction followed by crystalline iron oxide-bound zinc while the exchangeable zinc was the least fraction at the given soils. The soils of Mekhliganj block recorded significantly higher amorphous iron oxide-bound zinc and the Cooch Behar II was found relatively lower for the same fraction. This might be due to the free iron oxide content present in an amorphous form of the soil samples.

Keywords: Acid soil, Terai region, Zinc fractions

A RAPID SOIL TESTING METHOD FOR DIAGNOSIS OF SULFUR DEFICIENCY IN SOILS

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Sulphur deficiency in agricultural soils is widespread throughout the world with the potential to threaten future food supply if left unchanged, again it is 4th important major nutrient that enhances the plant's ability to absorb macronutrients and micronutrients. A rapid and reliable method for diagnosis of sulfur deficiency in soils was developed with 181 numbers of soil samples. The different S contents of soils showed different characteristic turbidity. Turbidity increased with increase in S content. The soil samples that had 19.75 kg S ha^{-1}or less did not show turbidity. The samples having 20 – 50 kg S ha^{-1} showed faint turbidity (presence of tinge of whitish colour). The samples having 70 – 120 kg S ha^{-1} showed slightly whitish turbidity (more turbid than above). The samples that had 150–250 kg S ha^{-1} showed some what whitish turbidity (more turbid than above). Absence of turbidity for samples having S content below critical limit (i.e., < 20 kg S ha^{-1}) detects S deficiency in soils. This method does not require expensive instruments. The method is so simple that any person (even a farmer) can easily perform it. It can be accommodated in soil testing kits and suffice in areas where soil testing laboratories are not available.

Key words: Sulfur deficiency, Turbidity, Soils, Diagnosis, Rapid method.

PERFORMANCE OF GINGER GERMPLASMS IN COORDINATED VARIETY TRIALS OF TERAI REGION OF WEST BENGAL

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A coordinated variety trial was conducted in field gene banks of Uttar Banga Krishi Viswavidyalaya of 11 elite germplasms with one national check (Varada) and one local check (GCP-5). Planting was done in raised beds with 3m x 1m plot and spacing of 30 cm row to row and 20 cm plant to plant. The planting was done in consecutive two kharif seasons of 2013-14 and 2014-15. The performance of elite germplasms were observed in order to screen out better performing variety(s) in this region. The standard agronomical practices were adopted in order to carry out the experiments in the experimental field. The germplasms undertaken were V1S1-2**,** Aswathy**,** ACC-219, Athira, RG-32, RG-3, ACC-65,Karthika, GCP-49, Varada (national check) and GCP-5 (local check). Analysis of the data showed that plant height, number of tillers, leaf length, leaf breadth, Pseudo steam girth, rhizome yield of ginger. The genotype GCP-49 showed the highest projected yield (23.21 t/ha.), followed by Karthika (17.83 t/ha). Highest disease incidence was recorded in genotype ACC-65 (68.33%) and lowest in genotype GCP-49 (13.33%). GCP-49 was found to be the best germplasm among other germplasms suitable for cultivation in this terai region of West Bengal.

Key Words: co-ordinated Variety trial, highest yield, projected yield, disease incidence, rhizome yield

PRECISION NUTRIENT MANAGEMENT IN WHEAT (*Triticum aestivum* L.) UNDER TERAI ZONE OF WEST BENGAL

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To optimise nutrient usage and maximise wheat yield, an experiment was conducted at Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, West Bengal during *rabi,* 2014-15. The experiment was conducted in split plot design with two tillage options *i.e*., conventional tillage (CT) and zero tillage (ZT) in main plots and five nutrient management options in sub plots. The yield recorded was significantly higher under conventional tillage as compared to zero tillage. Among the nutrient management options, site specific nutrient management (SSNM) treatment in which nutrients were applied based on nutrient expert software recorded maximum grain yield closely followed by site specific nutrient management (SSNM) + leaf colour chart (LCC) treatment in which 70% nitrogen (N) along with full dose of phosphorus (P_2O_5) and potassium (K_2O) was applied based on nutrient expert software and remaining N was guided by LCC over recommended dose(RD) as well as higher dose (150% of RD) of N application under both CT and ZT. Agronomic nitrogen use efficiency (ANUE) was recorded maximum (39.41% under CT and 35.2% under ZT) in SSNM based nutrient expert + LCC treatment. The results indicated the superiority of SSNM based on nutrient expert software + LCC combination in achieving higher productivity with more ANUE.

Key Words: N management, Nutrient Expert, Wheat, Zero tillage

ARSENIC IN FOOD WEB: AN ALERT FOR PUBLIC HEALTH

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Arsenic in groundwater and its contamination in food stuff are found severely in India particularly in both bank of river Ganges. In West Bengal, groundwater resources are quite rich and a major part of the groundwater is used for drinking, agricultural and industrial purposes. In some areas of West Bengal, the concentration of arsenic (As) in groundwater exceeds the guideline concentration set internationally and nationally at 10 µg L^{-1}. Presently 50 million people of West Bengal live in arsenic prone areas. Contaminated groundwater is also used for irrigation and this makes it possible for arsenic to enter the human food chain through locally grown food, fodder, forage crops and vegetables. Some cases arsenic also found in the poultry bird, cow, milk, fish and shellfish. Generally root portion of rice and root vegetable absorb more amount of As and they act as a major source of exposure. Agricultural produce transport arsenic affected areas to non affected area so that we are all consume more or less arsenic.

Key words: Arsenic, contamination, foodstuffs transportation, health effect

EFFECT OF INTEGRATED WEED MANAGEMENT IN *KHARIF* MAIZE

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Field experiment was conducted with 7 treatments replicated thrice following RBD during *kharif,* 2013 & 2014 at Central Research Farm, BCKV, Gayeshpur, Nadia, and West Bengal with an objective to study the effect of integrated weed management against weeds of *kharif* Maize.

The treatments consisted of 2,4-D ethyl ester 80% EC @ 0.5, 1.0, 1.5, 2.0 lt. a.i. ha^{-1}, respectively applied at 20 DAS + one wheel hoeing at 40 DAS , Atrazine 50% WP @ 1.0 kg a.i. ha^{-1} (applied at 5 DAS) + one hand weeding at 40 DAS, two hand weeding at 20 & 40 DAS and un-weeded check.

The predominant weed species were *Echinochloa colonum, E. crusgalli, Eleusine indica, Cynodon dactylon, Cyperus rotundus, Amaranthus viridis, Phyllanthus niruri, Ageratum conyzoides, Commelina benghalensis*.

All weed control treatments significantly decreased population of weeds and their dry weight over untreated control. Hand weeding (twice) showed the best performance with 4.20 t ha^{-1} grain yield and 84.37 % weed control efficiency at 60 DAS. Among the herbicide treatments 2,4-D ethyl ester 80% EC @ 2.0 lt a.i. ha^{-1} + one wheel hoeing at 40 DAS gave the second highest grain yield of 4.05 t ha^{-1} , WCE of 81.43 % at 60 DAS and highest B:C ratio of 1.92 followed by 2,4-D ethyl ester 80% EC @ 1.5 lt a.i. ha^{-1} + one wheel hoeing at 40 DAS with a grain yield of 3.67 t ha^{-1}, 78.85 % WCE at 60 DAS & B:C ratio of 1.76. Whereas unweeded check plot showed the worst performance in all aspect. Treatments showed no phytotoxicity effect to maize plant.

2,4-D ethyl ester 80% EC @ 2.0 lt a.i. ha^{-1} + one wheel hoeing at 40 DAS was significantly at par with hand weeded (twice) treatment in case of grain yield, also resulted no phytotoxicity to maize and non-toxic to microbes as well as give more benefit. As hand weeding is costly, time consuming & laborious it can be replaced by 2,4-D ethyl ester 80% EC @ 2.0 lt a.i. ha^{-1} + one wheel hoeing at 40 DAS in case of *Kharif* Maize.

***Key word:* 2, 4-D, Maize, phytotoxicity, WCE, grain yield.**

ECOLOGICAL IMPACT OF MGNREGA: AN ASSESSMENT THROUGH VILLAGERS' PERCEPTION IN COOCH BEHAR DISTRICT OF WEST BENGAL

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Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) aims not only at enhancing the livelihood security of people in rural areas by providing 100 days of wage employment but the ecological aspect inset in it is also one of the best features that designates a balance between human action and natural resources. The MGNREGA activities have the potential to provide environmental services, conserve and enhance natural resources (soil, water, grass and forest resources) which develop the community resilience mechanism. The present study was undertaken in Cooch Behar district of West Bengal taking the perception of the respondents on different aspects like the enrichment of the condition of soil, decreasing air and water pollution, better yield of fish due to pond renovation, better livestock rearing, strengthening ecological foundation through tree plantation, improving rural connectivity through rural road reconstruction, prevention of soil erosion through the works under MGNREGA.

From the study it was seen that bulk of work implemented under MGNREGA are mostly linked to land development works such as land levelling, rural road construction, conservation bench terracing, field bunding, pasture development etc., which ultimately results in reduced surface run off and reduction in soil erosion. Besides the works like pond excavation, renovation of traditional water bodies have contributed to improved ground water level and drinking water availability. MGNREGA helps to strengthen ecological foundation by forestation and tree plantation.

Key words: MGNREGA, Ecological Impact, Environment, livelihood.

EVALUATION OF GINGER GERMPLASMS AGAINST PHYLLOSTICTA LEAF SPOT DISEASE

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Sixty three local germplasm maintained by AICRP on Spices UBKV, Pundibari was screened against *Phyllosticta zingiberi* to study its reaction during 2014 under natural epiphytotic condition. The disease severity was recorded using 0-9 scale which was self devised. It was observed that none of the gernplasm was free from the disease. Lowest disease severity was recorded in H2 and GCP-60 with 4.44%, whereas, highest disease severity of 66.67% as recorded in GCP-52. Highest yield of 16.57 kg/plot was recorded in GCP-33 and lowest with 1.35 kg/plot was recorded in S1.

Key words: Ginger, germplasm, *Phyllosticta zingiberi*

EVALUATION OF MUNGBEAN (*Vigna radiata* L.) CULTIVARS FOR RESISTANCE TO YELLOW MOSAIC VIRUS.

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Two year field screening was undertaken during Kharif season of 2011 and 2012 with eight varieties of Mungbean to ascertain its resistance against Yellow mosaic virus disease. The pooled data indicated that no varieties/ lines showed complete resistance to YMV disease during both the consecutive years 2011 and 2012 but it was found that the incidence of the disease varied from 36.70% to 9.12%. The significant lowest incidence was recorded in Sukumar (9.12%), followed by Meha (9.39%). Highest yield was recorded in Sukumar (1.80 kg/plot) and it was at par with Meha (1.71 kg/plot). Significant lowest disease severity was also recorded in Sukumar (3.60 %) and it was statistically at par with Meha (3.91 %). Although PM 05 gave significant higher yield but disease severity and incidence were not statistically at par. Results indicate that both Sukumar and Meha could be cultivated in the plains of West Bengal as a tolerant variety and can also be used as parental lines. The other variety PM 05 may also be used as parental line from the genetic point of view.

Key words: Mungbean, YMV, Severity

FORECASTING OF RAPESEED-MUSTARD YIELD FOR *TERAI* REGION OF WEST BENGAL

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The data of *rabi* rapeseed mustard yield and weather parameters of twenty five years (1998-2011) were used for the developing the statistical model for the three districts of West Bengal state. The pre-harvest forecasting models were developed for rapeseed mustard yield for Coochbehar, Jalpaiguri and North Dinajpur districts respectively. The mean deviation for all the districts for the two years (5.88 and 7.25%) shows over estimation of yield. However, the forecasted yield for 2014 was lower than the average yield of all the districts. The results revels that the lower or higher prediction of yield for rapeseed and mustard was highly influenced by the combination of weather parameters. The lower yield prediction for 2014 for most of the districts may be due to increase in minimum temperature as the model is purely weather based and the minimum temperature has relation with good seed germination.

Keywords: **Rapeseed mustard, pre-harvest, yield forecast, weather parameters and minimum temperature.**

EFFECT OF PLANTING TIME ON YIELD AND QUALITY OF STRAWBERRY IN WEST GARO HILLS, MEGHALAYA

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A study was conducted to standardize the planting time of strawberry (*Fragaria ananassa*) cv. Festival in the West Garo Hills of Meghalaya during 2014-2015.West Garo Hills district is situated approximately between the longitudes 90° 30' and 89° 40'E, and the latitudes of 26° and 25° 20' N.The effect of planting time on plant growth, flowering and fruiting behavior; yield and physico-chemical characters of fruits were studied. Planting of strawberry runners were carried out on six different dates *viz*. 10th, 20thand 30thof September and October, 2014. Growth parameters in terms of plant height, spread (East-West and North-South direction) and number of crowns were recorded highest in runners planted on 10thSeptember. Highest fruit weight and fruit length, yield per plant and productivity per hectare were observed when planted on 30thSeptember. Vitamin C, sugar content and TSS/Acid ratio were highest when planted on 10th October, 10th September and 30th October respectively.

Keywords: Strawberry, Yield, Quality, West Garo Hills, planting time

IMPACT OF INSECT-PESTS AND NATURAL ENEMIES AGAINST POPULAR RAPESEED-MUSTARD VARIETIES IN TERAI AGRO-ECOLOGICAL CONDITIONS OF WEST BENGAL, INDIA

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The present study was undertaken to find out the suitable variety(s) against insect pests attack as well as incidence of natural enemies and their effect on yield on three groups of *Brassica* varieties in Terai agro-ecological conditions of West Bengal. Among the different insects the important ones were aphid, flea beetle, diamond back moth and saw fly. Natural enemies include lady beetle, syrphid and spider. Contrast analysis revealed that all the pest, natural enemy population and yield varied significantly among the three groups of *Brassica* under consideration. In Terai Zone of West Bengal, Bhagirathi (Indian mustard variety) showed medium insect-pest reaction as well as moderate natural enemy population and provided maximum yield (736 kg/ha) and considered to be the best fitted variety. This variety can replace the Benoy (B9) variety which enjoys the largest area in this zone, in order to make the cultivation more remunerative in this zone.

SEASONAL VARIATIONS OF SECONDARY LEAF NUTRIENT (CA, MG AND S) STATUS OF CASHEW PLANTATIONS IN COASTAL DISTRICTS OF ANDHRA PRADESH

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The investigation was carried out during 2006 and 2007 in different cashew plantations of 12 mandals of coastal districts of Andhra Pradesh to study the seasonal fluctuation in nutrient uptake pattern during its growth phases in both fruiting and non-fruiting terminals of the cashew plants. The leaf nutrient contents Ca, Mg, and S ranged from 0.216 to 1.532% (low to high range), 0.132 to 0.226% (low to adequate) and 0.087 to 0.174% (low to high range) respectively.

Both in fruiting and non- fruiting terminals maximum peak was observed during the month of September and November, indicating depletion of nutrients due to consequent mobility of Ca to developing fruits. There was a declining trend of leaf Ca content after November month that leaf Ca would have been utilized by sinks of flower bud initiation and flower bud differentiation. With respect to the trend of mean leaf Mg content in between the leaves of the terminal shoots, in general, the non-fruiting recorded comparatively higher values in September and November months both in fruiting and non-fruiting terminals and declining trend was observed from July to May. A similar result was reported by Chadha *et al.* (1984). It is noted that the mean leaf S content was found to be increasing from July to January and thereafter a declining trend up to March afterwards. It explains that the greater nutrient concentration in both fruiting terminals and non-fruiting terminals during the period of November to January coinciding with the flower bud initiation and formative stage of cashew nut under coastal districts of Andhra Pradesh conditions. Non fruiting terminals showed highest nutrient contents than fruiting terminals of all the months of study.

Key words: Cashew, Leaf nutrients.

POISONOUS PLANT, *Strycnos nux vomica*: A SOURCE OF BOTANICAL MITICIDE IN MANAGEMENT OF RED SPIDER MITE INFESTING TEA PLANTATION

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The mite killing properties of methanol extracts from seed of a poisonous plant, Kuchila (*Strynos nux vomica*: Longaniaceae), keeping the material and solvent ratio 1:5 (v/v), on three developmental stages of red spider mite, *Oligonychus coffeae* (Nietner) were studied both under laboratory and field condition during 2010-2011 at Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal. A series of concentrations of kuchila seed extract (KSE) were prepared and sprayed on mites in standard modified leaf disc technique of mass rearing of mite. As the dose increased, mortality of all three stages of tea red spider mite was also increased at each concentration of KSE. It is evident from studies that the LC_{50} value at 5 days after treatment of KSE was the lowest (0.11%) on the egg stage and highest against the adult stage (8.80%). The Index of Persistent Toxicity (PT) of KSE when applied @ 0.24% on egg stage was 491.38 followed by one day old larva and adult were 25.49 and 21.06, respectively. Also, Average Residual Toxicity (T) i.e. 49.14 was highest in egg stage than other stages which persisted for Period (P) of 10 days. PT_{50} value of this botanical extract on egg was maximum i.e.2.20 days. The highest reduction in egg hatchability, larval and adult mortality was 100.00 (at 8 DAT), 89.95 (at 7 DAT) and 90.98% (at 7 DAT), respectively at a concentration of 0.50%. None of treated concentration i.e., 0.24, 0.48 and 0.72% of KSE showed phytotoxicity on tea leaves. It indicates that KSE was most toxic to the egg stage followed by one day old larva and adult stage of

mite. Finally, it was concluded that KSE possesses good ovicidal, larvicidal and adult killing toxic properties and it can be included as eco-friendly botanical miticide in IPM of tea.

Key words: Botanical miticide, kuchila seed extract, *Oligonychus coffeae,* toxicity, *Strynos nux vomica,* tea.

DARJEELING HIMALAYAS: A HUB OF BIODIVERSITY FOR MEDICINAL PLANT

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Darjeeling Himalayas, well known for harboring one of the richest biodiversity in the world i.e. amongst 25 global hotspots for its varied range of vegetation and diversity of ethno medicinal. The biodiversity of this region contributes significantly to the country's ecological heritage and to the global and national ecological balance. This paper deals with medicinal plants diversity and resources of Darjeeling district of Eastern India Himalaya. Field survey was extensively conducted in the region of Darjeeling district and medicinal plant species were collected and some are maintained at the Herbal Garden of Regional Research Station, Hill Zone, and UBKV. Important particulars about their medicinal properties and usages were garnered from the local herbal practitioners and senior citizens. Identification of 115 plants species from genera belonging to 75 families with their vernacular name (*Nepali*), plant parts used, disease ailments, were recorded.

STUDIES ON UTILIZATION OF AONLA FRUIT (*Emblica officinalis* Syn.) FOR PREPARATION OF JAM AND PRESERVATION OF AONLA FRUIT PRODUCTS.

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The aonla (*Emblica officinalis* Syn. *Phyllanthus emblica*) fruits is valued highly among indigenous medicines in India. It is valued as an antiascorbic, diuretic, laxative, antibiotic and acidic cooling refrigerant. It belongs to the family Euphorbiaceae and sub family Phyllanthoidae. For the present investigation “studies on the physico-chemical changes in jam of three cultivars of aonla during storage” was carried out at Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh during the year 2004-05 and 2005-06. The experiment consisted of three treatments and each treatment was replicated three times under split plot design. Storage of products (Jam) was done under room condition. The effect of various treatments on physico-chemical changes in jam was analysed at 30 days intervals and Banarasi aonla jam was found to be excellent in quality by recording the ideal TSS (57.82 per cent), ascorbic acid (109.00 mg/100 g), reducing sugar (45.65 per cent), total sugar (52.14 per cent) organoleptic score (6.81/10.00), colour score (6.19/10.00) and appearance score (6.91/10.00) with lowest acidity (6.64 per cent) at the end of storage period i.e., five months.

ORNAMENTAL FLOWERS- A POTENTIAL SOURCE OF NUTRACEUTICALS

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The quality of life in terms of income spending and lifestyle has improved with economic development. However it has also thrown up a major challenge in the form of lifestyle diseases. The first victim of this lifestyle change has been food habits. Consumption of junk food has increased manifold which has led to a number of diseases related to nutritional deficiencies. Nutraceuticals can play an important role in controlling them. Nutraceutical is coined from Nutrition and Pharmaceutical which provides both nutrition and prevents disease. This promising term reflects lucrative market opportunities for domestic as well as international pharmaceutical and Nutraceutical companies. Nutraceuticals has a spectacular annual growth rate of 6.3% from 2012 to 2017. Plants are one of the most important resources of human foods and medicines. Rapidly increasing knowledge on nutrition medicine and plant biotechnology has dramatically changed the concepts about food health and agriculture, and brought in a revolution on them. With these trends improving the dietary nutritional values of fruits vegetables ornamentals and other crops or even bioactive components in folk herbals has become targets of the blooming industry. In developing countries like India and China there is a good market for these products. A number of domestic as well as international companies are investing in Indian nutraceutical industry. Nutraceuticals are bioactive compounds extremely active and have profound effect on cell metabolism and often have little adverse effect and involves in a wide array of biological processes. In many parts of the world the feeding of people continues with old traditions and the assortment of foodstuffs produced begins to be markedly extended with edible flowers which increases and improves the appearance taste and aesthetic value of these foodstuffs. Apart from these ornamental flowers possess many medicinal values. The present paper discusses about nutraceuticals and use of ornamental flowers and their role in therapeutic activity.

Keywords: chronic diseases, functional foods, nutraceutical ,anti-oxidants. Rose, lotus

CHARACTER ASSOCIATION STUDIES IN EARLY SEGREGATING GENERATION OF MUSTARD CROSSES

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Twelve high yielding mustard varieties viz. Local Rajasthan, Varuna, Pusa Bahar, Seeta (B-85), Pusa Bold, Bhagirathi sel-2, Pusa Barani, Pusa Jaikissan, Chaitra Local and Kranti and two locally selected lines Rajasthan local sel-1 and Rajasthan local sel-2 were crossed in a half diallel design during rabi season 2008, at the Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar. From the crosses generated by half diallel model 15 were selected to proceed to F_2 generation and were evaluated during rabi season 2010 in randomized block design with three replications for nine biometrical characters to study their association and cause and effect relationship. Seed yield/plant exhibited significant correlation with plant height, primary branches/plant, secondary branches/plant, leaf breadth and siliqua/plant in positive direction while it was negatively associated with leaves/plant. Plant height imparted the highest positive direct effect on seed yield/plant followed by siliqua/plant and leaf breadth. Thus character association studies revealed that plant height and siliqua/plant should be considered as the most important characters during selection for yield improvement in segregating generations of mustard.

Key Words: Correlation coefficient, direct effect, mustard, segregating generation, residual effect.

EFFECT OF PHOSPHORUS ENRICHED VERMICOMPOST ON YIELD AND PHOSPHORUS UPTAKE OF GROUND NUT (*Arachis hypogaea* L.)

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The experiment was carried out at the farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal from August to October of 2011-12 and 2012-13, respectively. To investigate the effect of phosphorus enriched vermicompost on yield of ground nut under irrigated conditions. The experiment was laidout in a RBD design with 14 treatments which replicated thrice . Highest pod yield was obtained from T_7, that receiving 150% phosphorus through rockphosphate enriched vermicompost grade-I) (2400.50 kg ha-1) whereas, the treatment receiving 100% recommended dose through sole application of chemical fertiliser (T_1) (1479.00 kg ha-1) was lowest yield. Phosphorus uptake varied significantly with treatments It was observed that the uptake increased consistently with crop age up to 120 days after sowing. Pooled data revealed that T_7(258.6 kg ha-1) performed better in all sampling days. The lowest uptake was observed in T_1 (100% phosphorus through SSP) (153.26 kg ha-1).

Key words: Groundnut, Phosphorus enriched vermicompost, Yield and Phosphorus uptake.

IMPACT OF WATERSHED DEVELOPMENT PROGRAMME ON ADOPTION OF CROP PRODUCTION AND WATERSHED TECHNOLOGIES

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Watershed is a natural hydrological entity that covers a specific area expanded on land surface, within whose boundaries the entire rainfall run-off ultimately passes through a specifically defined stream. It is a unit of land on which all water that falls collects by force of gravity, runs via common outlet. It is thus an area of land that contributes run-off to a common point and is separated from adjoining areas by a natural ridgeline. Watershed development is a holistic approach to build and strengthen the basic resources, so as to enable the establishment of sustainable life support. This is an integrated approach on a natural hydrological unit, “a watershed”. In many countries watershed approaches have increasingly lost focus on ‘water’, instead becoming a holistic approach to natural resource management and rural development through improved land management and rainfed crop production. To most people from the water sector, watershed management is essentially to do with better water resources management. In this backdrop, the present study has been undertaken in Cooch Behar district of West Bengal to assess the adoption status of different production technologies in different crops and also the adoption of different watershed technologies. The study was undertaken in a micro-watershed area with a control area. It is found from the study that level of adoption of watershed technology is higher in watershed area than in the non-watershed area. Adoption of general cultivation practices was also higher in watershed area than in non-watershed area.

Key word: Impact, watershed, adoption, watershed technology, cultivation practices

OVERALL ENTREPRENEURIAL COMPETENCY OF THE POSTGRADUATE STUDENTS OF ANAND AGRICULTURAL UNIVERSITY

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Agricultural entrepreneurial competency has major three components viz; knowledge, skill and attitude. The knowledge of entrepreneurial competencies or traits has been sharpening over last five decades. One should develop these competencies through training, experience and guidance. Entrepreneurs do new things or do old things in a new skilful manner. Thus, the significance of the factors responsible for entrepreneurial competencies of postgraduate students of Anand Agricultural University, Anand and also the course of action to be undertaken to build up their ability in projecting and running of the agro-based enterprise in future, Which will help them to reframe their efforts to motivate, establish and thus increase self- employment ability. To measure entrepreneurial competency of the postgraduate students the scale developed by Entrepreneurship Development Institute, Ahmadabad (www.ediindia.org) which having 13 components each describing the characteristic of an entrepreneur was used and a sample of 150 postgraduate students were selected for the present study. The study indicated that majority (82.00 per cent) of the postgraduate students possessed high level of entrepreneurial competency, followed medium and very high level of entrepreneurial competency. This indicated that postgraduate students had the aptitude to be successful entrepreneur ability to accept an alternative career option.

Keywords: Entrepreneur, Competency, Agro-Based Enterprise.

INTEGRATED PEST MANAGEMENT (IPM) OF RICE – ITS IMPACT AND ADOPTION BY THE FARMERS OF DARJEELING HIMALAYA

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An investigation on adoption of Integrated Pest Management of Rice (*Oryza sativa*) by the farmers' of Darjeeling Hills covering g ten rice growing of Darjeeling district showed that 52.5% of the 'trained farmers' had high (above 50%) level of knowledge but none of 'non-trained farmers' had high level of knowledge. It is also observed that, amongst the trained farmers the level of knowledge on IPM of rice was found to be higher in insect-pests management than diseases. In case of management of insects, the level of knowledge found in descending orders of management of case worm (76.3%), Grasshopper (73.7%), Gandhi bug (68.7%), leaf hopper (67.5%) and yellow stem borer (61.3%). The level of adaption of IPM among the trained farmers was found to higher on insects-pests than diseases.

SYMPTOM EXPRESSION IN TURCICUM LEAF BLIGHT DISEASE OF MAIZE

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Turcicum leaf Blight disease is the most severe among the different foliar diseases affecting maize in Darjeeling hills. This disease is caused by a fungal pathogen *Exserohilum turcicum.* In this paper, the symptom expression of the disease was studied in detail by inoculating the pathogen in laboratory as well as field condition. In susceptible varieties, the first symptom appeared as a small spots on the lower leaves spreading upwards. The lesion varied in length ranging from 2.0 cm to 15.5 cm and breadth ranging from 0.5 cm to 2.0 cm., the lesion together forms bigger spot and covers whole leaf area. In tolerant varieties, a yellow colored halo surrounded the lesion restricting its growth. It has been observed that the symptoms are absent on the cob and other parts of the plant.

Keywords: *Exserohilum turcicum,* Maize, symptom

EFFECT OF ORGANIC RESOURCES OF NUTRIENTS FOR CORMS AND CORMLET PRODUCTION OF THREE CULTIVARS OF GLADIOLUS (*Gladiolus grandiflorus* L.) IN THE HILLY TRACT OF WEST BENGAL

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The experiment was carried out in two consecutive years 2009 and 2010 at Regional Research Station (Hill zone) of Uttar Banga Krishi Viswavidyalaya, Kalimpong, Darjeeling, West Bengal to study the effect of organic resources of nutrients for corms and cormlet production of three cultivars of gladiolus (*Gladiolus sp.*) namely Candyman, American Beauty and Jester. The different organic sources of nutrients namely bone meal (5t/ha), Farm yard manure (FYM) (50t/ha), vermicompost (5t/ha) were used alone and in combination with bio-fertilizers namely VAM (2g/plant), Phosphobacteria (2g/plant) and Azospirillum (2g/plant). The cv. Jester performed better in production of number of corm per plant (2.28), equatorial diameter of corm (6.54 cm), average weight of corm (62.94 g) and average weight of cormlet (38.41 g). The higher polar diameter of corm (3.79 cm) and greater number of cormlet per plant (125.01) were produced by the cv. Candyman. Among the different treatments of manures and bio-fertilizers the application of FYM (25t/ha), vermicompost (2.5t/ha), bone meal (5t/ha) and trichoderma @ 20g/m2 (T_4) produced greater number of corm per plant (3.07), equatorial diameter of corms (6.42cm) and number of cormlet per plant (123.83). On the other hand, the treatment consisting of bone meal @ 5t/ha, VAM, phosphobacteria and azospirillum each @ 2g/plants and Trichoderma @ 20g/m2 in T_9 was found better in respect of polar diameter of corm (3.90 cm) and average weight of corm (65.0 g). Among the combination of treatments, the propagation co-efficient was found

maximum with the cv. Jester (495.60%) in the case of T_9 (VAM @ 2g/plant + Phosphobacteria @ 2g/plant + Azospirillum @ 2g/plant + Bone meal @ 5t/ha + Trichoderma @ 20g/m2).

Keywords: Gladiolus, organic, corm and cormlet.

SCREENING FOR SPOT BLOTCH INFESTATION OF WHEAT GERMPLASM UNDER AGROBIODIVERSITY PLATFORM (COMPONENT II)

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A trial had been carried out at Cooch Behar centre, Pundibari, Uttar Banga Krishi Viswavidyalaya, to evaluate one thousand four hundred eighty three (1483) accession of wheat germplasm supplied by NBPGR during the year 2014-15. As this station is hot spot location for screening against foliar bight diseases, major emphasis has been given on this trait.

Leaf blight appeared on several germplasm lines under natural condition. The data was recorded on flag and one leaf below flag at 59-64 stage in ZADOK'S Scale, in double digit scale (0-9). Among the genotypes, 607 were found highly resistant, 619 were resistant and 147 genotypes were moderately resistant, 110 lines were found to be susceptible. No single genotype was found to be highly susceptible. Beside, leaf blight disease, infestation of leaf rust was also found on some entries during the dough development stage of crop growth period during this year.

BIO-EFFICACY OF SOME NEW GENERATION PESTICIDES AGAINST FOLIAGE FEEDING APHID (*Rhopalosiphum maidis*) IN WHEAT.

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Field evaluation of bio-efficacy of different pesticides at different dosages was conducted at Regional Research sub-station (Terai Zone) UBKV, Kharibari, Darjeeling, West Bengal, India during Rabi season 2013-14 and 2014-15 against foliage feeding aphid (*Rhopalosiphum maidis*) infesting wheat. Total eight (08) no. of different formulations were tested against this pest namely Confidor (Imidacloprid 17.8 SL), Dantotsu (Clothianidin 50 WDG), Flubendamide (Fame 480 SC), Pride (Acetamiprid 20SP), Actara (Thiamethoxam 25 WG), Chlorantranilipride 18.5 SC(Coragen), Thiamethoxam 35 FS (Crusier), Rogar (Dimethoate 30 EC). Highest reduction in aphid population was found in case of clothianidin 50WDG at 15g a.i/ha which controls 100% aphid infestation over untreated control plot and no aphid population was found after seventh day of spray. The aphid control efficacy of Flubendamide 480 SC @ 20g a.i/ha was found to be 99.65% followed by Thiamethoxam 35 FS @ 70 ml a.i/ha (98.48%) and Imidacloprid 17.8 SL (97.47%). Dimethoate 30EC @ 300ml a.i/ha was found to control aphid population by 99.87% than untreated control plot.Regardless of the doses and type of pesticide molecules used in the experiments no phytotoxicity effect such as epinasty, hyponasty, scorching, chlorosis and wilting was observed in wheat plants.

Key words: Wheat, *Triticum aestivum, Rhopalosiphum maidis, new generation pesticide.*

Heliotropium indicum, A NEW HOST FOR *Sclerotium rolfsii* THE INCIDENT OF BASAL ROT DISEASE IN TERAI REGION OF WEST BENGAL, INDIA

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Heliotropium indicum, commonly known as Indian heliotrope, is an annual, hirsute plant that is a common weed that belongs to the family boraginaceae, and is commonly found on the bunds of the crop fields, wastelands, around the houses, on roadsides etc., where the soil is porous and rich in organic matter. The plant has been used as a traditional medicine, the extracted juice from the pounded leaves of the plants is used on wounds, skin ulcers and furuncles. The juice is also used as an eye drop for conjunctivitis. Between June and September 2014, a disease survey was conducted in different place of Cooch Behar district in West Bengal State. A new root rot disease was observed on young Indian heliotrope plants in all areas surveyed. Symptoms first appeared as yellowing and drooping of leaves, with wilting of plants and white cottony mycelial growth at the collar region. The mycelial growth spread to the stem and roots, with associated tissue rotting. On the diseased areas, brown sclerotia were observed. A fungus was consistently isolated from diseased roots plated on potato dextrose agar medium and incubated at 25 ± 2°C. The mycelium of the fungus was hyaline, branched at clamp connections and septate. The abundant sclerotia were round to oblong, initially white and later brown. On the basis of morphological studies it was recorded that the fungus having white branched hyphae of 4.27 µm (3.0 – 6.25 µm) diameter, with clamp connections. Sclerotia smooth, spherical to ellipsoidal, light brown becoming dark brown with age and 139.41 µm (134.86 – 200.46 µm) in diameter. The morphological and cultural characteristics of *S. rolfsii* of *Heliotropium* isolate was compared with *Parthenium* and ground nut isolates. The ground nut and *Parthenium* isolates of *S. rolfsii* produced sclerotia 72 and 84 hrs after inoculation of PDA media whereas, *Heliotropium* isolate developed the sclerotia at 148 hrs after inoculation. highest time required for the formation of sclerotia in *Physalis* isolates of *S. rolfsii* as compaired to other isolates. The average size of the sclerotia of *Physalis* isolates (139.41 µm) was much lesser than that of groundnut isolates (286.03 µm). The growth rate in PDA medium of *Parthenium* isolate was faster as compared to groundnut and *Heliotropium* isolates. On the basis of compatibility study it was also observed that *Heliotropium* isolates was not compatible with groundnut and *Parthenium* isolates with varied degrees of non-compatibility. To the best of our knowledge, this is the first report of *S. rolfsii* infecting *Heliotropium indicum* in India.

EFFECT OF SEED BACTERIZATION WITH FLUORESCENT PSEUDOMONADS ON GROWTH PROMOTION AND INDUCTION OF DEFENSE IN JUTE (*Corchorus Olitorius*)

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The Fluorescent Pseudomonads were isolated from rhizosphere of fifteen different crops and screened based on their antagonistic effect and effect of metabolites against Jute stem rot pathogen. The five selected isolates were used for seed bacterization to study their effect on seed germination, root length, shoot length and vigour index. The treatment with UBPF20 resulted in 42.41% increase in root length over control followed by UBPF14 (36.22%) and UBPF24 (23.83%). Regarding shoot length all the isolates showed increase in length over control. The isolate UBPF24 increased 47.57% shoot length over control followed byUBPF20 (27.35%).The highest vigour index was

found with the treatment of UBPF24 (20.96%) over control followed by UBPF20 (20.18%) and UBPF14 (19.38%). Better plant growth was observed in the plants treated with the selected isolates as compared to control. Jute seed treatment with five selected Fluorescent Pseudomonads isolates induced the plant to synthesize defense related enzymes like Phenylalanine Ammonia Lyase (PAL), Poly Phenol Oxidase (PPO) and Peroxidase (PO). The maximum increase in activity of PAL was found in UBPF14 followed by UBPF24 and UBPF18. The isolate UBPF18 showed highest activity of PPO followed by UBPF24, UBPF22 and UBPF14. The activity of PO was also found higher in all the plants treated with isolates than control.

Keywords: Fluorescent Pseudomonads, seed bacterization, Jute, defense induction, PAL,PPO,PO

EFFECT OF GROWTH HORMONES ON SPROUTING AND ROOTING RESPONSE OF *Ginkgo biloba L* UNDER NURSERY CONDITION

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Ginkgo biloba L. known as living fossil tree is an oldest living tree species with pharmacological properties. The present study was carried out in the Nursery and Research Centre, School of Forestry and Environment, S.H.I.A.T.S, Allahabad. The experiment was conducted in order to study the survival percentage, shoot length, number of root and root length, per cuttings at 120 days under root trainers and potting media.The cuttings were treated with ie; IBA, NAA, GA3 at 100, 200 and 300 ppm each replicated thrice for root trainers. *Gingko biloba* cuttings was treated with different concentration of growth hormones reveled that the maximum number of what was observed after 120 DAS in IBA 100, and IBA 200 ppm. The survival percent observed maximum in T_1 (0.87). However the minimum survival percent was recorded T_0(50.50) in control. Sprouted length observed maximum in T_2 (2.03), and minimum sprouted length/cutting was recorded in T_0 (1.46) in control. Number of roots was observed maximum in T_2 (3.67). Whereas T_0 (2.00) which was recorded minimum, and Root length was observed maximum in T_2 (3.18). However the minimum T_0 (1.40) root length recorded control.

Key words: *Gingko biloba* IBA, NAA and GA_3.

PROSPECTS AND PROBLEMS OF ORGANIC FARMING IN SIKKIM: A REVIEW

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With the declaration of Sikkim as an organic state the government has provided an economic door for the development and prosperity of the people of Sikkim. The benefits gained from organic farming will be innumerable but on the other end it will also pose a challenge for the state and its people to maintain the sustainability and productivity of agricultural produce, soil and environment. This review paper attempts to understand the possible outcomes and impact of organic farming in Sikkim.

Key word: Organic, impact, benefits.

BACKYARD FORESTRY PRACTICES BY THE FARMERS—A BENCHMARK STUDY IN COOCH BEHAR DISTRICT OF WEST BENGAL, INDIA

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The present study was undertaken in the Cooch Behar district of West Bengal, India. 90 farm families were studied to understand the forestry practices undertaken as a backyard activity. The study revealed that the farming community of Cooch Behar allotted 0.17 to more than 1 ac of land under forestry. The common trees like teak, ghoraneem, raintree, gamar etc. were planted in the backyard forestry. They plant it in both continuous as well as scattered system of plantation. The forestry crops are used as a short term insurance towards their short and medium level of household necessity like repairing of house, meeting ceremonial needs etc.

Key word: Backyard forestry; Forestry usage; Forestry; Cooch Behar; Household forestry

FRESHWATER PRAWN FARMING: A POTENTIAL AVENUE FOR IMPROVED LIVELIHOOD SUPPORT IN TERAI REGION

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Northern part of West Bengal particularly terai agro-climatic zone being considered earlier as a very inappropriate area for freshwater prawn farming has recently been proving its suitability for expansion of this lucrative enterprise in aquaculture sector. The present investigation carried out in UBKV fish farm as well as farmers field has been proving the suitability of culture of *Macrobrachium rosenbergii* in terai region with an average specific growth rate (SGR) of 2.84% (5.47g) in 15PL phase and 2.72% (14.36g) in juvenile stage during two and half month (July 15 –September 30, 2015) when fed twice daily with commercial feed. Laboratory experiment in aquaria conducted with only juvenile for two months fed with different lab manufactured feed treatments demonstrated average SGR of 2.18% (1.90g) in T_2, 2.15% (1.83g) in T_3, 1.67% (1.01g) in T_4 and 2.28% (2.14g) in T_5 whereas T_1 (control) showed average SGR of 2.17% (1.86g) . All the data in parenthesis indicate the final weight of individual prawn. Feed constituted with broken rice grain, maize, soyabean, dry fish and calcium tablet (T_2) in combination with spirulina powder (T_5) elicited respectively 2% and 15% increase in juvenile weight gain as compared with control (T_1 – commercial feed). The result achieved so far is definitely guiding us towards use of specific probiotic in feed for better growth and development of *Macrobrachium rosenbergii* in terai zone and at the same time indicating a potential avenue for livelihood improvement of our stakeholders.

Keywords: fresh water prawn, juvenile, nutrition, probiotic.

POTENTIAL OF AMISTAR TOP 325SC (Azoxystrobin 18.2% + Difenoconazole 11.4% w/w SC) FOR MANAGEMENT OF RED ROT OF SUGARCANE INCITED BY *Colletotrichum falcatum* Went.

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Red rot caused by *Colletotrichum falcatum* is one of the major biotic constrains in tropical and sub tropical sugarcane growing areas of the world. The disease causes reduction in cane weight by 29 to 83%, in juice extract by 24 to 90% and reduces the expected sugar recovery approximately by 31 to 75% at different infection levels. The pathogen is soil and seed transmissible and hence is very difficult to manage the disease. Chemical management is the most widely adopted approaches to combat the pathogen where carbendazim (0.2%) is recommended for application through sett treatment. During recent years various strobulirin based mixture fungicides are coming in market, which need rigorous screening to determine their fungitoxicity against the target pathogens. In the present investigation field experiment was conducted during 2013 and 2014 to evaluate the bio-efficacy of Amistar Top 325SC (Azoxystrobin 18.2% + Difenoconazole 11.4% w/w SC) applied through sett treatment for reducing the severity of red rot in sugarcane. The test fungicide @1.0 ml/l and 1.25 ml/l were found to be most effective reducing the severity of red rot to the extent 78-87% and increased the cane yield by 22-30% compared to untreated check. The individual component fungicides i.e., Azoxystrobin 23SC and Difenoconazole 25EC resulted 59.5-64% and 44.5-47.5% reduction in disease severity, respectively, whereas carbendazim 50WP showed 43-47% reduction. No phytotoxic effect was found even with higher dose (2ml/ lit of water) of the test fungicide. Therefore, Amistar Top 325SC @1.0ml may be recommended for sett treatment of sugarcane before planting to reduce red rot damage in this region.

EFFECT OF DIFFERENT ORGANIC OPTIONS ON COWPEA IN RICE BASED CROPPING SYSTEM

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The distinguishing feature of legume crop is their ability to fix nitrogen from air thereby reducing the use of synthetic nitrogen fertilizer. They also contribute to lower green house gas emissions besides contributing to diversifying crop rotations. Using legume crops reduces the growth of weeds, disrupts parasite life cycles and can reduce the use of pesticides. Further there is a world consensus that sole dependence on chemical inputs based agriculture may not be sustainable in the long run and only integrated plant nutrient management system involving combination of fertilizers, organics & microbial inoculants is essential to sustain crop production, preserve soil health, plant health and soil biodiversity.

Keeping the above points in mind a field experiment with different organic based fertilizers were evaluated on six rice based cropping sequence during 2013-14 at the experimental farm of UBKV during kharif (June-Sept), rabi (Oct-Jan) and summer season(Feb-April). Leguminous crops like cowpea was used in all the cropping sequence.Each of the sequences were grown under four differently managed nutrient systems which includes biofertilizers, slow release fertilizers, combination of biofertilizers and slow release fertilizers and chemical fertilizers. It was observed that yield of cowpea and dehydrogenase activity grown under treatment combination of biofertilizers and slow release fertilizers increased by 17.7% and 4.7 % respectively over chemical fertilizer.

Key words: cowpea, cropping sequence, organic fertilizers, chemical fertilizers.

PERFORMANCE OF TURMERIC VARIETIES GROWN UNDER CONVENTIONAL AND ORGANIC NUTRIENT MANAGEMENT PRACTICES UNDER TERAI REGION OF WEST BENGAL

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Two nutrient management practices namely, conventional (120:60:60 kg NPK/ha + FYM @ 15 tonnes/ha) and organic (FYM @ 15 tonnes/ha + vermicompost @7.5 tonnes/ha + *Azophos* @ 5 kg/ha) were employed to study performance of eleven turmeric varieties. Conventional nutrient management practice gave significantly better results for growth and yield parameters whereas organic nutrient management practice recorded better quality attributes. Among different varieties, Suranjana recorded the highest fresh rhizome yield of 24.91 tonnes/ha followed by Narendra Haldi-1(24.74 tonnes/ha), BSR-2 (24.67 tonnes/ha), Duggirala Red (24.01 tonnes/ha), Rajendra Sonia (23.93 tonnes/ha) and Alleppy Supreme (23.44 tonnes/ha). Considering quality parameters, Narendra Haldi-1 showed the highest drying percentage of 28.04% followed by Roma (27.09%) and BSR-2 (27.05%). Pratibha showed the highest oleoresin content of 15.86% followed by Alleppy Supreme (13.31%) and Megha Turmeric (13.29%) and Rajendra Sonia showed the highest curcumin content of 8.00% followed by Roma (7.78%) and Megha Turmeric (6.44%). Under conventional nutrient management practice, growing of Narendra Haldi-1 was found to be highly economical with B: C ratio of 4.09 followed by Duggirala Red (3.80) and BSR-2 (3.77) whereas under organic nutrient management practice Narendra Haldi-1 was found to be highly economical with B: C ratio of (3.69) followed by BSR-2(3.62).

Key words: Turmeric, Organic nutrient management, Variety, Economics.

EFFECT OF NUTRIENT MANAGEMENT ON CULTIVARS OF ECONOMIC SEED PRODUCTION OF JUTE (*Corchorus* sp) IN TERAIREGION OF WEST BENGAL

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A field experiment was conducted at the farm of Uttar Banga Krishi Viswavidyalaya, for identification of the most suitable variety & optimization of the fertilizer dose with regard to the quality seed production of Jute. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 2 factors, three replications and total eighteen treatment combinations. The level of factor I *i.e.*Variety was six (**V1** - JRO-524, **V2** - JRO-8432, **V3** - JRO-204, **V4** - S-19, **V5** - JRC-321&**V6** - JRC-212) & the level of factor II *i.e.* fertilizer dose(N: P: K Kg ha^{-1}) was three (**F1** - 20:10:15, **F2** - 40:20:30&**F3** - 60:30:45). Cultivar V6 (JRC 212) performed the best in term of highest primary branches(11.76) and secondary branches (4.20) per plant at harvesting respectively, capsules per plant (85.1) seed yield (8.8 q ha^{-1}) gross return (Rs. 76206.30 ha^{-1}), net return (Rs. 40575.30 ha^{-1}) & benefit: cost ratio (2.14). Nutrient doses were concerned, performance of F3 i.e. NPK @ 60: 30: 45 Kg ha^{-1} was the best in term of all growth attributes like number of primary branches(7.46) & number of secondary branches(3.26) per plant at harvest leaf area index (6) at 60DAS & dry matter production(43.31 g $plant^{-1}$) at 90 DAS per plant. Fertilizer dose F2 i.e. NPK @ 40:20:30 Kg ha^{-1} performed best in term of all yield parameters like seed yield(7.49 q ha^{-1}), highest net return (Rs. 31418.91 ha^{-1}) & B : C ratio (1.88) The treatment combination V6F2 proved to be the best in terms of seed yield (9.59 q ha^{-1}), net return (Rs. 45524.00) & B : C ratio (2.28).

Key words:Dry matter, leaf area and leaf area index, primary and secondary branches, B: C ratio,pods per plant, seed yield

STUDIES ON MICROBIAL ACTIVITIES IN RELATION TO DEEP SOIL CARBON STATUS UNDER RICE AND NON-RICE ECOLOGY

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Soil sampling has been conducted from two locations of eastern India viz. Gayeshpur KVK farm, Bidhan Chandra KrishiViswavidyalaya, West Bengal and Indian Statistical Institute experimental farm at Giridih, Jharkhand . Both of the sampling areas were part of long term field experiment and all the data of different laboratory experiments had been analysed statistically using factorial RBD design. It showed significant decrease in clay content with depth in soils of Gayeshpur farm, B.C.K.V, but increase clay content with depth in soils of ISI farm, Giridih. There was significantly low total C as well as O_{org} in deep subsoil layer (in comparison to surface soil layers) in soils of both locations as found earlier. It was also found that there were higher total as well as organic C in soils under rice based cropping system in comparison to non-rice cropping system. As per the analysis, deep subsoil layers also contained significantly low microbial biomass C and represented low soil enzyme (Urease) activities.

Keywords: Deep subsoil, soil microbial biomass, total C, organic C, rice based cropping.

OPTIMIZATION OF SUGAR SUBSTITUTES IN THERAPEUTIC BEVERAGES USING RESPONSE SURFACE METHODOLOGY

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The aim of the present study was to optimize sugar substitutes into fixed ratio of aloe vera and pine juice blend using response surface methodology approach. A blend of aloe vera gel and pineapple juice was used in the study. The effects of sugar substitutes on therapeutic beverages responses viz. pH, acidity, TSS, vitamin C and overall acceptability were studied using response surface methodology (RSM). The blend ratio (70:30) of aloe vera gel and pineapple juice as therapeutic beverage base and physicochemical and sensory effects were studied after optimized level of sugar substitutes in the beverages. Thebest sugar substitute's combination level were optimized using RSM which was aspartame, saccharine and neotame 0.30:0.03:0.00 respectively. Hence it is concluded that RSM was used successfully to optimize the level of sugar substitutes and significant effect on low calorie and therapeutic values.

Key words: Therapeutic Beverages, low calorie beverage, sugar substitutes, Aloe vera and pineapple blending beverages.

STANDARDIZATION OF DEHYDRATION TECHNOLOGY OF SOME ORNAMENTAL FLOWERS AND FOLIAGE

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The floral ambience is God's greatest gift to man. Flowers symbolize the rich cultural heritage of India from time immemorial. The beauty and charm of flowers often makes one think that the season remains forever. Dry flowers are nothing but dehydrated flower and parts of plants. The terms dried flowers and dried flower arrangement are broadened worldwide. The flower drying is an important post-harvest technique for enhancing keeping quality and providing value addition. The flower drying technique involves reducing moisture content of flowers to a point at which bio-chemical changes are minimized while maintaining cell structure, pigment level and flower shape. The present investigation is being carried out under two different instrument and 3 flowers African marigold, French marigold, rose and 2 foliage mussaenda , croton are used .In first experiment, the flowers were given drying treatments in hot air oven (at 45^0C) after embedding them in Fine Silica Gel (FSG, 60-120 mesh) and Fine River Sand (FS). In hot air oven flowers and foliages were dried for 6 hrs, 12 hrs, 18 hrs, and and24 hrs. In second experiment, the flowers were given drying treatments in microwave oven (assuming at 100^0C) after embedding them in Fine Silica Gel (FSG, 60-120 mesh) and Fine River Sand (FS). In microwave oven flowers and foliages were dried for 1 minutes, 2 minutes, 3 minutes, 4 minutes and 5 minutes. In the experiment the data were recorded for various parameters and were subjected to statistical analysis using 2 factorial completely randomized design (CRD) with four replications, embedding media is treated as factor A and time is treated as factor B. 4 parameters viz. moisture reduction percentage , colour, appearance and texture were assessed by means of sensory evaluation by scoring on average ten point scale. In case all the flowers and foliages while using hot air oven silica gel provide maximum moisture reduction percentage at 24 hrs. Which is gradually increased with time. In case of visual properties maximum colour retention, maximum shape retention and maximum texture at 6 hrs. which is gradually decrease with time followed by sand media. While in case almost all the flowers and foliages while using microwave oven silica gel provide maximum moisture reduction percentage at 5 minutes which is gradually increase with time and. In case of visual properties maximum colour retention, maximum shape retention and maximum texture at 1 minute which is gradually decrease with time followed by sand media. Finally at the end of the experiment it is concluded that for African marigold it will be best at 18 hrs. in silica gel when using hot air oven and 4 minutes in silica gel when using microwave oven , for french marigold will be best at 12 hrs. in silica gel when using hot air oven and 3 minutes in silica gel when using microwave oven, for rose will be best at 12 hrs. in silica gel when using hot air oven .It will be best at 3 minutes in silica gel when using microwave oven ,for mussaenda will be best at 6 hrs. in silica gel when using hot air oven and 2 minutes in silica gel when using microwave oven lastly croton will be best at 12 hrs.in silica gel when using hot air oven .and 3 minnutes in silica gel when using microwave oven .

PRESENTATIONS
FOR
BEST THESIS AWARD

DOCTORAL THESIS

ELICITOR MEDIATED INDUCTION OF SYSTEMIC RESISTANCE AGAINST *XANTHOMONAS CAMPESTRIS* PV. *CAMPESTRIS*

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ABSTRACT

Black rot of cabbage is considered to be the most important disease of crucifers worldwide (Williams, 1980). In India, the disease was first reported on cabbage from Bombay province by Patwardhan in 1928 and subsequently on cauliflower by Patel *et al*., in 1949. Chattopadhyay and Mukherji as early as in 1955 reported the incidence of this disease in West Bengal. They reported that the cultivation of cabbage on commercial scale in West Bengal was already facing with serious problem on account of black rot disease. The use of resistant varieties, though very effective over a period, they are not easily available always, and even where available, they may succumb soon to a newly emerged virulent race of the pathogen. Six races were defined within *X. c.* pv. *campestris* (Kamoun *et al* ., 1992; Vicente *et al*., 2001), and additional three races were recently described within *X. c.* pv. *raphani* (Fargier and Manceau, 2007). Thus, one has to depend on chemical control quite often. Continuous use of toxic chemicals not only causes environmental hazards and residual toxicity problem, but also it may result in the selection of naturally occurring mutants of the pathogen which are resistant to chemicals. The adverse effects of toxic chemicals / antibiotics on environment and beneficial microflora are evident and so an economic and viable alternative for black rot management is essential. Thus, the proposed research work offers thorough investigation on pathogenic fitness and variability of *Xanthomonas campestris* pv. *campestris* and exploration of induction of systemic resistance through the use of biotic / abiotic elicitors along with the biochemical mechanism for long term management of black rot disease of cabbage in a sustainable manner.

Thirty one isolates of *Xcc* from cabbage and cauliflower, two isolates of *Xac* associated with lemon were isolated from different agro-ecological region of West Bengal and one each isolate of *Xcp, Xam* and *Xoo* obtained from Division of Plant Pathology, IARI, New Delhi were used in the present study. All the thirty one isolates of *Xcc* were found to be pathogenic on five different *Brassica* hosts (cabbage, cauliflower, broccoli, knolkhol and red cabbage) and the level of virulence varied and approximately 67.7 % of the isolates of *Xcc* of alluvial-agro-ecological region of West Bengal were found to be moderate to highly virulent. Irrespective of isolates, red cabbage was the most susceptible host followed by cabbage. Considering the average virulence on all the hosts, isolate 2.2 and 1.3W were found to be highly virulent isolates and *Xcc* isolates of ND, 1, 2, 6 and 3.1 were found to be low virulent.

Based on morphological, biochemical and molecular detection using the primers XCF and XCR, targeting *hrpF* homologous to *nolX* host recognition protein, producing an amplification fragment of 525 bp, all the thirty one isolates isolated from cabbage and cauliflower were identified as *Xanthomonas campestris* pv. *campestris*. Cultural characteristics revealed considerable diversity among the *Xcc* isolates based on colony colour, shape and size. Based on the sugar utilization of *Xcc* it may be observed that, all the *Xcc* studied were positive for the utilization of cellobiose, galactose, mannose, maltose and xylose and negative for rhamnose and dulcitol. However, *Xcc* isolates were found to be variable for the utilization of lactose, trehlose, sorbitol, mannitol, arabinose and inocitol. The virulent isolates of *Xcc* of West Bengal were found to be 6-15 times more tolerant against tetracycline as compared to *Xcc* isolates of New Delhi, India. Based on protein profiling *Xcc* isolates exhibited approximately 66 % similarity among themselves. Bands with Rf value 0.26 and 0.38 in protein profiling were found to be specific for *Xcc* and may be used as protein marker for detection of *Xcc*. Based on isozyme profiling *Xcc* isolates exhibited approximately 58 % similarity among themselves. The band of Rf value 0.44 in α- esterase and Rf value of 0.39 in β-esterase may be used as biochemical marker for

detection of *Xcc*. Using RAPD technique, 9 *Xcc* isolates and four other *Xanthomonas* sp. showed 17 - 45 % similarity except *Xam* but 38-100% similarity existed among *Xcc* isolates. ERIC-PCR profile generated wide range of variability among *Xcc* isolates. Other *Xanthomonas* species and pathovars were clearly differentiated from *Xcc* indicating usefulness of ERIC-PCR for assessing genetic variability among xanthomonads. ERIC-PCR could distinguish highly virulent and less virulent isolates of *Xcc* and the correlation study of ERIC-PCR banding pattern with virulence of *Xcc* identified several bands as markers of virulence. In the present study, however, *Xcc* isolates could not be distinguished from other xanthomonads based on their ITS-RFLP pattern. Various xanthomonad isolates were grouped in two major clusters using ITS sequence alignment and very high degree of similarity among *Xcc* isolates were observed. However, 70.4 to 100 % similarity was observed among different xanthomonads. *Xcc* isolate 1.3W was identical to the *X. c.* pv. *raphani* and very closely related to *Xoo* whereas highly different from *X. melonis, X. albilineans* and *X. sacchari.*

Dehydrogenases of plant pathogens are of special importance in neutralising the host defence mechanisms. Peroxidases (POX) have several functions which could have an effect on the resistance of a plant. Phenylalanine ammonia lyase (PAL) is the first enzyme in phenyl propanoid pathway. Soluble phenolics and phytoalexins which are fungitoxic and antibacterial are also synthesized through activation of PAL. Therefore, studies were undertaken analyse the response of cabbage cultivar to *Xcc* in terms of defence related enzymes associated with host-pathogenic interaction. The suppression of PAL leads to the weakening of defense mechanisms in *Xcc* inoculated plants in the early stage of infection. PAL and phenol content were found to play significant role in host-pathogen interaction in cabbage-*Xcc* system. Induction of POX-1 at three days of inoculation and enhanced band intensity of POX-1 and POX-4 up to 5 days after inoculation was observed. These two isomers might be related with the susceptible cabbage host and *Xcc* interaction. Induction of SOD-1 might be associated with susceptible host-pathogenic interaction. ASM (acibenzalor-S-methyl) at 0.5 mM concentration was found to be the best abiotic elicitors for reduction of black rot disease severity. PT1 and PB3 identified as *Pseudomonas aeruginosa* were found to be the effective antagonistic isolates against *Xcc* under in vitro condition. Seed treatment, root dipping and foliar application of PT1 was found to be the effective treatment for management of black rot disease of cabbage. POX, PAL and PPO are the three most important enzymes contributing in the biotic elicitor-mediated induction of systemic resistance in *Xcc*-cabbage system.

STUDIES ON THE MELON FRUIT FLY (*BACTROCERA CUCURBITAE* COQUILLETT) INFESTATION AND ITS MANAGEMENT IN ALLUVIAL ZONE OF WEST BENGAL

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2014

Objectives:

1. To survey on the melon fruit fly population and level of infestation on cucurbitaceous vegetables in some districts (alluvial zone) of West Bengal.
2. To study on the life cycle of melon fruit fly in laboratory condition.
3. To establish the effective management of fruit fly on cucurbitaceous vegetables by the use of various attractants and baits.
4. Evaluation of some new and safer chemicals against fruit fly infestation on different cucurbitaceous vegetables in field.

Summary:

Melon fruit fly (*Bactrocera cucurbitae* Coquillett) belongs to the Order Diptera, one of the serious pests causing havoc damage to cucurbitaceous vegetable crops. A survey was conducted throughout the year to identify the incidence pattern of melon fruit fly, their infestation level and life cycle, effective management by using different coloured traps and various attractants and baits and insecticidal management. The objectives of the study were to evaluate some new groups of insecticide and attractants and poison baits against melon fruit fly in field.

- The field experiment was conducted for population dynamics study of melon fruit fly on cucurbitaceous vegetables at farmers' field on/nearby cucurbit vegetables growing areas during 2012 and 2013 at three locations, each in Nadia, North 24 Parganas and Hoogly districts of West Bengal.
- During 2012, the population of melon fruit fly was attained the peak *i.e.* 13.60 catches/trap/day during 31st standard week in Nadia, 12.29/trap/day during 37th standard week in North 24 Parganas and 9.95/trap/day during 25th standard week in Hooghly district and during 2013, the population was 43.12 during 36th, 16.14 during 30th and 32.67 during 34th standard week in Nadia, North 24 Parganas and Hoogly district respectively.
- Correlation coefficient between populations of melon fruit fly with weather parameters exhibited a significant positive correlation coefficient with maximum temperature, minimum temperature, RH-II, rainfall and average soil temperature and negative correlation coefficient with bright sunshine hour in both the years.
- During 2012 and 2013, the highest fruit infestation *i.e.* 51.66% and 58.88% was recorded both during 25th standard week on pointed gourd, 56.56% and 49% was recorded during 25th and 24th standard week on bottle gourd, 40.14% and 54.71% was recorded during 22nd and 14th standard week on bitter gourd and on ridge gourd, the highest fruit infestation was 49.36% and 53.46% during 32nd and 25th standard week.
- The numerical values of correlation coefficient between per cent infestations by melon fly with weather parameters exhibited a significant positive correlation coefficient with maximum temperature, minimum temperature and RH-I and negative correlation coefficient with RH-II.
- Melon fruit fly consists of four stages of life cycle: egg, maggot, pupa and adult. The total life span of adult male melon fruit fly was 20 ± 3.4 and 56.9 ± 11.12 days during June-July and November-December in 2011 and 36.5 ± 7.12, 24.6 ± 3.6, 18.8 ± 2.78 and 42.5 ± 12.2 days

during February-March, May-June, July-August and November-December in 2012 respectively. The total life period of adult female was found to be 25.2 ± 3.82 and 54.1 ± 13.65 days during June-July and November-December in 2011 and 41.2 ± 4.57, 26.7 ± 3.4, 19.6 ± 3.63 and 41.4 ± 10.05 days during February-March, May-June, July-August and November-December in 2012 respectively. Variation of sex ratio was also noted too some extent at different season.

- During winter months the duration of immature stage (egg, maggot and pupa) was much prolonged, but the adult longevity was shortened than summer months. Female flies survived more days than male flies.
- To study on the effective management of melon fruit fly, the highest number of fruit fly catches (0.85/day) was recorded in yellow coloured traps in pointed gourd field; but in ridge gourd, bitter gourd and bottle gourd, the maximum number of fruit flies were attracted in transparent coloured traps (3.19, 1.56 and 1.01/day respectively) and lowest number was recorded in blue coloured traps. In the next year 2013, the highest number of fruit fly catches was recorded in transparent coloured traps (1.15, 3.93, 1.85 and 1.13/day) in pointed gourd, ridge gourd, bitter gourd and bottle gourd respectively and lowest in blue coloured traps.
- To determine the effective management of melon fruit fly through comparative study, seven different types of baits were evaluated in three locations of Nadia district. The highest number of fruit fly catches was recorded in cuelure + malathion baited traps (8.98/trap/day) followed by methyl eugenol + cuelure + malathion baited traps (8.9 /day) and fishmeal + carbosulfan baited traps (3.34/day) during 2012. But the trend of the efficacy of these baits was different in next year. The highest number of melon fruit fly catches was observed in methyl eugenol + cuelure + malathion baited traps (17.17/trap/day) followed by cuelure + malathion baited traps (16.64/day) and yeast + malathion + cucurbit vegetable smash baited traps (2.92/day) and the least effective bait was black tulsi + spinosad baited traps (0.26 and 0.32/day) during 2012 and 2013, respectively.
- For bio-efficacy studies, field experiment was laid out with twelve treatments, comprised of deltamethrin (Synthetic Pyrethroids), flubendiamide (Pthallic acid diamide), acephate and triazophos (Organophosphate), cartap (Nereistoxin), neemazal, karanja oil and citronella oil (Botanical), spinosad, chlorfenapyr and emamectin benzoate (Microbials) along with one untreated control. Recommended dose of insecticides were applied at 15 days intervals during pre-*kharif* and *kharif* season and observations were taken on the basis of reduction of per cent fruit damage and on yield.
- The overall best performance in reducing the fruit damage and on yield was found in chlorfenapyr during both seasons followed by deltamethrin and acephate during pre-*kharif* season and spinosad and acephate treated plot during *kharif* season of 2012 on pointed gourd. The lower performance was observed in neemazal and karanja oil during respective seasons.
- In bottle gourd, the lowest infestation was recorded in chlorfenapyr followed by acephate and deltamethrin and the least performance was noticed in karanja oil during 2012. The overall mean of fruit infestation was lowest in acephate followed by chlorfenapyr and emamectin benzoate and highest per cent of fruit infestation was recorded in citronella oil during 2013. Highest yield was recorded in chlorfenapyr followed by acephate during both years.
- Spinosad provided to be most effective in reducing fruit damage and highest yield of bitter gourd followed by acephate and chlorfenapyr against melon fruit fly during pre-*kharif* season and the lowest fruit infestation with highest yield was noticed in acephate followed by chlorfenapyr and spinosad during *kharif* season of 2013.
- Chlorfenapyr provided to be most effective in reducing fruit damage and on yield of ridge gourd against melon fruit fly in both the years and karanja oil provided the highest fruit infested plots.

Conclusion:

- The peak population of *B. cucurbitae* was recorded during 25th to 37th standard week *i.e.* 17th June – 9th September and the highest fruit infestation was recorded during 14th to 32nd standard week *i.e.* 7th April to 5th August in all cucurbitaceous vegetable crops. Population of melon fruit fly exhibited a significant positive correlation coefficient with maximum temperature, rainfall and average soil temperature at 5 cm and negative correlation coefficient with RH-II and the infestation by melon fly exhibited a significant positive correlation coefficient with maximum temperature, minimum temperature and RH-I and negative correlation coefficient with RH-II.
- During cooler month the duration of immature stage was long but adult longevity was comparatively less than summer months.
- Melon fruit fly are more attracted to transparent colored traps and cuelure + malathion and methyl eugenol + cuelure + malathion baited traps.
- Chlorphenapyr, acephate, spinosad and deltamethrin are the most effective bio rational insecticide for managing melon fruit fly and always provided higher yield.

DEVELOPMENT OF A NEED BASED INTERACTIVE GOAT HEALTH MANAGEMENT INFORMATION SYSTEM

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SUMMARY AND CONCLUSIONS

Past studies on knowledge level of livestock farmers about scientific healthcare and management practices shows that livestock farmers were generally having a low level of knowledge. A NSSO survey has further revealed that only 5.1 percent of the farmer households in India are able to access any information on animal husbandry against 40.4 percent of the Indian households accessing information on modern technology for crop farming.

Goat farmers are in real need of timely, accurate and relevant information need about goat health care and management at their doorstep. Although sporadic extension efforts are also being done by various veterinary universities, NGO's and private sectors.

Still now Public Sector animal husbandry and veterinary extension service is the main role player in disseminating the information in relation to animal husbandry practices in country and is having several lacunae. The resultant knowledge gap can be reduced through provision of information on efficient management of goat and their treatment against common diseases in a user friendly manner for all provided by information systems. Besides location specific information in local language can help farmer in solving their problems related to disease identification, treatment with prevention and control of disease in goats. Keeping all these points in view, the present study has been taken up with the following objectives:

Major Objective

Developing a need based interactive goat health management information system

Specific objectives

1. To assess and prioritize the goat health management information needs in the field situation.
2. To develop a need based interactive goat health management information system (GHMIS)
3. To study the effectiveness and perceived utility of information system among the goat owners, veterinary students and professionals.

Research Methodology

The present study was conducted in purposively selected two states of the country namely West Bengal and Uttar Pradesh which are main goat rich states in terms of population, chevon production and goat milk production in India. One district was randomly selected from each state. Two blocks were randomly selected from each district; again three villages from each block were randomly selected. From each village, 15 goat farmers were selected for data collection. In all, 90 goat farmers were selected for data collection from each state. For assessment and validation of information need in goat diseases 20 Veterinary professional were also selected from the respective district. Again, from each state 40 veterinary students who had completed their graduation and were somehow related with treatment were also selected for need assessment and validation of information need in goat diseases. Thus, the total sample size for the study consists of 180 goat farmers, 40 veterinary professional and 80 veterinary students. After development of the information system it was again tested among half of the total respondents previously interviewed. Data was collected using the pre-tested interview schedule. The collected information was analyzed by using suitable statistical tool such as frequency, percentage, mean, standard deviation, chi-square, t-test, correlation and regression.

The present research was carried out in three steps:

1. Assessment and prioritization of goat health management information need.

To study the specific information needs on goat health and management, a total of 180 goat owners, 40 veterinary professionals and 80 veterinary students were selected randomly and health management related information was be prioritized. Secondary data from State department of animal husbandry and veterinary services and annual report from CIRG were also followed for prioritization of needs in the study area.

2. Development of need-based and interactive goat health management information system (GHMIS):

An interactive information system was developed on the basis of the need priorities encompassing the major aspects of the identified problem area. The development process includes the collection of scientific information from reliable sources, storage, processing, classification, and display of the information with audio backup in English, Hindi and Bengali.

3. Effectiveness and perceived utility of need based information system among goat owners, veterinary professionals and veterinary students:

The information system so developed was administered at field level among half of randomly selected 90 goat owners from the concerned districts, 20 veterinary professionals and 40 veterinary students from those who were previously selected from need assessment for evaluation of its perceived utility, opinion, and its effectiveness in transmitting the information to the target audience.

Salient findings of the study

Socio-personal characteristics of the goat farmers

The average age of the respondents was 41.46 years. The average age of goat farmers in WB and UP was 40.74 and 41.56, respectively. Majority (47.78%) of the respondents were middle aged group (34-42 years), and was so in WB (42.22%) and UP (53.33%) followed by young aged group (29.44%) and old age group (22.78%).

Majority of the respondents were illiterates (51.67%) followed by 19.44 percent of them who had completed primary school, about 13 percent each of them completed Junior and high school level of education. Only 1.11 percent had completed intermediate and graduate level of education.

The mean FES was 2.03 in the study area. FES was found to be higher in WB (2.34) than in UP (1.71). Majority (56.72%) of the respondents had medium FES followed by low (32.25%) and high (11.12. The t- test analysis also shows that there was highly significant difference between FES of goat farmers in two states.

Majority of respondents were possessing nuclear families (71.11%) followed by joint families (28.89%) in the study area.

Mean family size of the goat farmers were about 7 members. The mean family size of goat farmers in WB and UP was about 6 and 8 members respectively. Majority (78.89%) of the respondents involved in the goat rearing belong to the small sized family with 4-8 members followed by medium (15.565%) sized families with 9-12 members and large (5.56%) sized families with 13-16 members. The t- test analysis also shows that there was highly significant difference between family size of goat farmers in two states.

Most (71.67%) of the respondents were followers of Hinduism.

Majority (41.67%) of them belong to general category followed by schedule caste (30.00%), other backward class, (16.11%) and schedule tribes (11.11%).

The mean social participation of goat farmers in the study area was low (i.e., 0.33,) while it was 0.44 in WB and 0.23 in UP. Majority of the goat farmers had no participation (74.44%)

followed by member in one organization (18.33%), member in more than one organization (3.33%) and office bearer of any organization (3.89%).

Majority (75.56%) of the respondents, as their parents were rearing goats. At the same time a sizeable mass (24.44%) have started rearing goats at later part of their life. The average experience in goat farming was about 14 years. Average experience in goat farming was 13.54 and 17.17 years in WB and UP respectively. The data also shows that majority (38.89%) had high period of experience in goat rearing followed by very high (33.89%), moderate (18.33%) and low (8.89%) experience.

Majority (95.56%) of the respondents had not received any kind of formal training in goat farming.

Socio-economic characteristics of the goat farmers

Agriculture was the primary occupation for majority (50%) of the respondents, followed by 23.33 percent of them were labour. Only 13.89 percent of them had animal husbandry as primary occupation.

The mean land holding of the goat farmers were 0.592 hectares in the study area.

It needs to be mentioned that mean land holding of the goat farmers in WB and UP were 0.396 hectares and 0.789 hectares respectively. However, majority (46.11%), of the respondents were marginal followed by landless (34.44%), small (10%) and medium (9.44%). None of the goat farmers falls in large category of land holding.

The average flock size was small (i.e., 18.11±38.02) and range varied from 3 goats per family to more than 150 goats. Average flock size in WB was very small (i.e., 7.18 goat) while in UP it was medium (i.e., 26.12 goat). Majority (91.11%) of the farmers in WB had very small flock size (≤10 goat). While in UP, majority (31.11%) of the farmers had medium flock size followed by 24.44 percent had small flock size, 22.22 percent had very small flock size. Only 11.11 percent of the respondents had very large (31-40) and 3.89 percent had large flock size (≥41). The t- test analysis reveals that there was highly significant difference between flock size of goat farmers in two states.

The mean annual income from goat farming was low (i.e., ₹15927.78±16653.81). The mean annual income from goat farming in WB was ₹10366.67 per year where as it was ₹19022.22 in UP. Majority (60.00%) of the goat farmers had a very low annual income (≤₹12000) from goat farming. While 71.11 percent of the respondents in WB and 48.89 percent of the respondents in UP had a very low annual income (≤₹12000) from goat farming. The t- test analysis reveals that there was highly significant difference between annual income of goat farmers in two states.

The mean annual family income of the goat farmers was low (i.e., ₹76,544.44± 49,594.14). The mean annual family income was low in WB (i.e., Rs. 65,744.44) as well as in UP (i.e., ₹87,344.44). Majority (45.00%) of the goat farmers had a low annual family income (₹50001-100000) followed by 36.11 percent who had very low (≤₹50000). Only 2.22 percent had very high (≥ ₹200001) family income. It needs to be mentioned that majority (46.67%) of the goat farmers in WB had very low family income while majority (48.89%) of the goat farmers in UP had low family income.

Cent percent of the goat farmers in WB were found to be rearing the native Black Bengal breed. Only 2.22 percent of the respondents from WB had recently started rearing Jamunapari. Majority of the farmers in UP were found to be rearing non-descript breed (53.33%) followed by Jamunapari (26.67%), Barbari (25.56%), Sirohi (20.00%) and Jhakrana (5.56%).

Majority (66.11%) of the respondents reared goat for meat purpose followed by dual purpose (33.89). Almost all the respondents in WB rear goat for meat purpose.

Respondents who reared goat for dual purpose (65.56%) were mainly from UP.

Majority (90.56%) of the respondents were found to be having mobile phone followed by bicycle (86%), electricity connection (68.33%), television (60.56%) and radio (20.56 %).

Patterns of information use

Cent percent of respondents had reported that they had facilities of assessing newspaper followed by television (60.56%), exhibition (22.22%), radio (20.56%) and internet (19.44%). Only 1.11 percent of the respondents had accessibility of educational film. Cent percent of the respondents had reported that they had facilities to get information from Paravet followed by 88.33 percent had facilities to get information from both Veterinary doctors and Livestock Asst., Bank staff (46.11%), private livestock companies (20.56%), NGO (19.44%) and 5.56 percent had facilities to get information from both University teachers and Subject Matter Specialist (SMS).

The mean mass media sources utilization of goat farmers was low i.e., 0.54±1.21. The result also shows that mean mass media sources utilization score of goat farmers was low in WB (0.83±1.49) as well as in UP (0.24±0.72). The t- test analysis reveals that there was highly significant difference between mass media utilization of goat farmers in two states.

The study also shows that mean formal interpersonal contact of goat farmers was low i.e., 2.26. The mean formal interpersonal contact of goat farmers in two different states was also low (i.e., 2.93 in WB and 1.58 in UP).

The mean informal interpersonal contact of goat farmers was low i.e., 5.86. The result also shows that mean informal interpersonal contact of goat farmers was low (i.e., 5.52) in WB while medium (i.e., 6.20) in UP.

Knowledge level in health management

Knowledge level about general symptoms of diseases

The mean knowledge score of the respondents about general symptoms for sickness was medium i.e., 5.19 in a ten point score. The mean knowledge level of goat farmers about general symptoms for sickness was also found medium in both the states but was comparatively more in WB (5.53) than UP (4.85). Correlation coefficient analysis shows that education of the respondents, mass media sources utilization, formal interpersonal contact and social participation of the respondents had highly significant and positive association with knowledge level about general symptoms for sickness in respondents. Land holding of the goat farmers in respondents also had significant and positive association with knowledge level about general symptoms for sickness. The multiple regression of knowledge level about general symptoms of diseases with selected independent variables reveal that education of goat farmers, flock size and mass media sources utilization were the main contributing factors to farmers‘ knowledge level about symptoms of diseases.

Knowledge level about for control measures of diseases

The mean knowledge score of the respondents for control measures of diseases was medium (4.07) on a ten point score. The mean knowledge level on control measures of diseases was more in WB (4.56) than UP (3.53). Correlation coefficient analysis shows that education of the respondents, flock size, mass media sources utilization, formal interpersonal contact and social participation of the respondents had highly significant and positive association while experience in goat farming had significant and positive association with knowledge level in control measures of diseases in respondents. Family size had highly significant but negative association with knowledge level in control measures of diseases in respondents. Multiple regressions reveal that education of the respondents and experience in goat farming were the main contributing factors to farmers‘ knowledge level on control measures of diseases.

Knowledge level about kid health management

The mean knowledge score of the respondents in kid health management was medium (i.e., 3.62) on eight point score. The mean knowledge level in kid health management was slightly high in WB (3.94) than UP (3.30). Correlation coefficient analysis shows that FES, flock size, experience in goat farming and income in goat farming had significant and positive association with knowledge level in kid health management in respondents. Multiple regression reveal

that income in goat farming, experience in goat farming and FES were the main contributing factors to farmers' knowledge level in kid health management.

Knowledge level on healthcare management

The mean knowledge level of the respondents on healthcare management was medium (i.e., 4.19) on nine point score. The mean knowledge level on health management in WB (4.20) and UP (4.18). Correlation coefficient analysis shows that education of the respondent, land holding, mass media sources utilization, formal interpersonal contact and social participation of the respondent had highly significant and positive association with knowledge level on healthcare management in respondents. Multiple regression reveals that mass media exposure, education, informal interpersonal contact, landholding and flock size were the main contributing factors to farmers' knowledge level on healthcare management.

Knowledge level on overall health management practices

The mean knowledge for overall health management practices was medium i.e., 16.58 from thirty seven point score. The mean knowledge level for overall health management practices was comparatively higher in WB (18.24) than UP (14.91). Correlation coefficient analysis shows that education of the respondents, FES, mass media exposure, formal interpersonal contact and social participation had highly significant and positive association while family size had highly significant but negative association with knowledge level on overall health management practices. Multiple regression reveals that education and mass media exposure were the main contributing factors to farmers' knowledge level on overall health management practices.

Adoption level of health management technologies

Adoption level in control measure of diseases

The mean adoption index of the goat farmers from eight packages of practices for control measure of diseases was 27.61, whereas it was found to be 30.06 in WB and 25.17 in UP. Correlation coefficient analysis shows education of the respondents, knowledge level for control measure of diseases, mass media exposure, formal interpersonal contact and social participation of the respondent had highly significant and positive association with adoption index for control measures of diseases in respondents. FES had significant and positive association and family size had significant but negative association with adoption index for control measures of diseases. The multiple regressions reveals that knowledge level, mass media exposure, income in goat farming and family income were the main contributing factors to farmers' adoption index for control measures of diseases.

Adoption level about kid health management

The mean adoption index of the respondents from eight packages of practices on kid health management was 31.56 whereas it was found to be 34.79 in WB and 28.33 in UP. Correlation coefficient analysis shows education of the respondent and knowledge level had highly significant and positive association with adoption index in kid health management in respondents. Mass media exposure also had significant and positive association with adoption index on kid health management in respondents. The multiple regression shows that knowledge level in kid health management and social participation were the main contributing factors to farmers' adoption level in kid health management.

Adoption level on healthcare management

The mean adoption index of the respondents from nine packages of practices on healthcare management was medium (i.e., 34.60), while it was 32.56 in WB and 36.63 in UP. Correlation coefficient analysis shows education of the respondent, land holding, knowledge level, mass media sources utilization, formal interpersonal contact and social participation of the respondent had highly significant and positive association with adoption index for healthcare management in respondents. The multiple regression shows that knowledge level in healthcare management, formal interpersonal source utilization, flock size and experience in goat farming were the main contributing factors to farmers' adoption index in healthcare management.

Adoption level on overall health management

The mean adoption level of the overall health management practices was medium (i.e., 31.26), while it was 32.47 in WB and 30.04 in UP. Correlation coefficient analysis shows that education of the respondents, knowledge level, mass media sources utilization, formal interpersonal contact and social participation of the respondent had highly significant and positive association with adoption index for overall health management practices. FES and land holding had significant and positive association while family size had significant but negative association with adoption index on overall goat health management practices. Multiple regression reveals that knowledge level, mass media sources utilization and farming experience were the main contributing factors to farmers' adoption index for overall health management practices.

Incidence rate and economic loss due to important diseases

The study shows that peste des petits ruminants had highest (78.89%) occurrence with 26.03 percent of morbidity and 15.85 percent of mortality rate. economic loss was found highest (₹4,26,699) due to peste des petits ruminants among the respondents. Morbidity losses per goat due to peste des petits ruminants was about ₹301 among the respondents.

Assessment of goat health management information need

Top ranked or prioritized among 35 diseases or health problems in goat, the goat owners had ranked peste des petits ruminants (rank I) followed by bloat (rank II), contagious caprine pleuro pneumonia (rank III), enterotoxaemia (rank IV), gid (rank V), endo parasite (rank VI), coccidiosis (rank VII), kid diarrhea (rank VIII), contagious ecthyma (rank IX) and tetanus (rank X).

The veterinary professional had ranked peste des petits ruminants (rank I) followed by contagious ecthyma (rank II), coccidiosis (rank III), enterotoxaemia (rank IV), ecto-parasite (rank V), endo-parasite (rank V), kid diarrhea (rank VII), contagious caprine pleuro pneumonia (rank VIII), bloat (rank IX) and goat pox (rank X).

The veterinary students had ranked PPR (rank I) followed by enterotoxaemia (rank II), bloat (rank III), contagious ecthyma (rank IV), kid diarrhea (rank V), coccidiosis (rank VI), haemorrhagic septicaemia (rank VII), goat pox (rank VIII), gid (rank IX) and tetanus (rank X).

The final rank from all the three types of the respondents were PPR rank 1st among all the goat diseases followed By enterotoxaemia, bloat, contagious ecthyma, coccidiosis, kid diarrhea, contagious caprine pleuro pneumonia, endo-parasite, gid, goat pox, ecto-parasite, tetanus, haemorrhagic septicaemia and foot and mouth disease. Endo-parasite and Ecto-parasite so ranked as VIII and XI in rank order in need assessment but were not included among important diseases as deworming schedule were incorporated in the information system.

Development of the need based goat health management information system (GHMIS)

A need based goat health management information system has been developed using multimedia software for text, image, audio, designing, animation and interactivity. The primary goal of developing the information was to develop a user-friendly and standalone interactive information system that will be able to address the important diseases or health disorder found in goat for Bengali and Hindi speaking farmers from WB and UP.

The software was developed in three phases. In the first phase, information need of the goat owners regarding the health management was studied in the region. An interactive information system covering the important health problems was developed based on the need assessment. Secondary data of diseases incidence were also considered for finalizing the content of the information system. Contents were first developed in English, Hindi and Bangla. Images and animations supporting the text were collected. Voice recordings of English Hindi and Bangla script were done. Text, image and sound were put together to give clear understanding for less educated as well as illiterate farmers. Interactivity was given through navigations buttons to go to desired pages as per the need as well as moving to next or previous page in the software.

The information system has been developed in Adobe flash and can be played in any operating system after installing flash player, which is free software.

In the beginning, the first page of the information system asks for a 'product key' to start. On entering the correct product key, the page leads to the language selection page, which has buttons to select the language between 'English' , 'Hindi' and 'Bangla'. On clicking a language button, the 'Home page' of the information opens in that language.

The home page contains four major link buttons those link to major content groups as Spotting of sickness, Important diseases, Vaccination schedule and Deworming schedule. When the cursor is taken over the button, the button gets highlighted and the audio starts playing which reads the title of that button. On clicking the button, it opens the concerned _menu'. The visuals and the audio with the button helps in easily navigating to the appropriate menu as desired by the farmer. It also helps less educated and illiterate farmers to operate without even reading.

Each menu contains buttons those lead to particular disease or disorder. Each button displays the visuals or animation that describes the concerned disease. When the cursor is taken over any button, the audio reading the title of that button starts playing and the button gets highlighted. On clicking the button, it opens the first page of the concerned disease.

On the first page of each disease, four navigation buttons as 'epidemiology', 'symptoms', 'treatment' and 'prevention and control', are placed those appear with audio reading out the title. When a button is pressed, the concerned page opens. On the bottom of the page, each page contains link buttons to all the above four pages so that the user can navigate to any page whenever he wants.

The bottom bar contains navigation button for 'Home page' and 'Menu'. It also contains an 'Exit' button at the bottom right corner, which on press closes the information system.

Each topic consists of four sub headings as epidemiology, symptoms, treatment and prevention and control. Each page contains the contents in the form of text supported by audio and suitable visuals in form of images or animations. It helps the less educated or illiterate people to easily get the information from the information system.

The epidemiology page deals with the general information about the disease. It includes the definition of that disease, causative factor or agent, animals or age group affected and predisposing factors.

The symptoms page deals in details about the symptoms observed in that disease. It also describes the possible criticality associated with delay or negligence.

Treatment page, deals with how urgent or serious is the condition. What are the immediate actions that need to be taken.

Prevention page includes the preventive measures those should be taken by the farmer in order to prevent the disease. The preventive measures have been explained along with how they work to prevent the disease or problem.

Assessment of effectiveness and utility of the information system

GHMIS was perceived to be highly effective in enhancing knowledge by 91.11 percent of the goat farmers, 65 percent of the veterinary professional and 75.5 percent of the veterinary students. None of the respondent in any category found it ineffective.

GHMIS was perceived to be highly useful by 75.56 percent of the goat farmers, 65 percent of the veterinary professional and 80 percent of the veterinary students.

GHMIS was perceived to be very simple by 65.56 percent of the goat farmers, 65 percent of veterinary professional, and 80 percent of veterinary students.

Majority (57.78%) of the goat farmers perceived that they can operate and use the information system by themselves without taking help from others and cent percent of the veterinary professional

and students had perceived that they can operate and use the information system by themselves without taking helps from others.

About 54.44 percent of the goat farmer, 55 percent of the veterinary professional and 57.5 percent of veterinary students had the opinion that the content of the GHMIS is appropriate to the topic presented.

GHMIS was perceived to be presented in a precise way by 65.56 percent of the goat farmers, 60 percent of veterinary professional, and 80 percent of veterinary students.

Majority (88.89%) of the goat farmers opined that the overall look of the software

GHMIS is very good, GHMIS will be very effective and has ability to arouse curiosity and interest was opined by 81.11 percent of the goat owners, 65 percent of the veterinary professional and 67.5 percent of veterinary students.

Majority (42.22%) of the goat owners had considered nearby school as suitable access point, followed by panchayat building (33.33%), personal house (10%) and veterinary hospital (7.78%) as suitable access point.

Most (68.89%) of the respondents were not willing to pay for purchasing the CD, but they were ready to pay a bit per access for the information system.

5.6.2. Effect of GHMIS on change in knowledge level of goat owners

The mean knowledge score for respondents with respect to general symptoms for sickness during pre-exposure was 3.96 and post-exposure to GHMIS was 8.51. The mean score of difference was found to be 4.55. The t-value was 26.306 which was found to be highly significant.

The mean knowledge score for respondents with respect to control measure of diseases during pre-exposure was 3.90 and post-exposure to GHMIS was 6.72. The mean score of difference was found to be 2.82. The t-value was 15.064 which was found to be highly significant.

The mean knowledge score for respondents with respect to kid health management during pre-exposure was 3.47 and post-exposure to GHMIS was 5.21. The mean score of difference was found to be 1.74. The t-value was 12.300 which was found to be highly significant.

The mean knowledge score for respondents with respect to healthcare management during pre-exposure was 4.31 and post-exposure was 7.12. The mean score of difference was found to be 2.81. The t -value was 17.288 which was found to be highly significant.

Among all variables for goat health management practices, the study reveals that highest gain in mean knowledge was found in case of general symptoms of diseases due to GHMIS.

5.7. Conclusions and implications

The present study was undertaken with the objective of developing a need based interactive goat health management information system for goat owners. The socio-personal profile of the goat owners in the study area revealed that majority were illiterate but had medium family education status with nuclear family and small family size of 7 family members. Though the goats owners were illiterate but other members in the family were literate which indicates that suitable educational interventions for enhancing knowledge and adoption in scientific health management practices for goat health management can be undertaken. General caste people were more involved in goat farming but other castes in the society were not away from it. This again proves that goat farming is free from any social taboos and is well accepted by every section in the society.

Although average farming experience of the goat owners in the study area was about 14 years but most of them had not received any formal training. This reveals that animal husbandry extension services have been more focused on dairy animals and the goat owners had been neglected.

The socio-economic characteristics depicts that goat owners had small flock size which contribute about 20 percent (0.15 lakh) of their annual family income. It is also interesting to see that an average flock size of 7 goat can earn them ₹0.10 lakh in WB but ₹0.19 lakh is earned from an

average flock size of 26 goats in UP. This might be due the fact that the cost of chevon per kg was quite high in WB than in UP and so there was less price for live animals in UP as compared to WB. These cost variation in per kg chevon may be due to meat quality of Black Bengal goat which is known for its meat and skin quality. Also, variation might be due to high demand of chevon in the market which is free from any social taboo and is well consumed by non-vegetarians. Therefore, it might be the reason that more number of respondents in WB compared to UP had newly started goat farming whose ancestor were not a goat farmer. Since the goat meat has a great export potential and ready internal market, therefore entrepreneurship development can be launched in these areas. Local educated but unemployed youth need to be encouraged to take up goat farming on commercial basis under semi-intensive and extensive system of management. Imparting skill oriented training leading to entrepreneurship can be thought seriously. Hence, there is an urgent need to focus more on goat sector which can generate more revenue for resources poor or the landless farmers to run their livelihood in a better way.

Even though rearing of goat can generate more revenue but high mortality and morbidity due to some of the important diseases causes a huge economic loss in goat sector. About 79 percent of respondents had observed diseases like PPR in their flock followed by endo-parasite, ecto-parasite, kid diarrhoea, bloat and enterotoxaemia so on. This may be due to the reason that vaccination against important diseases of goat and deworming is not fully adopted by the goat owners. Non adoption of vaccination and deworming might be due to poor accessibility of animal health services in the study area or and due to poor knowledge and awareness regarding the prophylactic measures. Hence, the extension agencies need to make aware goat owners about some of the deadly diseases for which vaccination is very much essential and deworming against parasites. The study also revealed that economic loss due to mortality in PPR was estimated around ₹14.26 lakh in the study area, whereas morbidity loss per goat due to PPR was around ₹301. Similarly morbidity loss per goat due to HS, kid diarrhoea, FMD and goat pox were ₹207, ₹148, ₹147 and ₹114 respectively. These economic loss due to diseases were generally assumed to be due to insufficient animal health services at their door. But this study have shown that these respondents were also having low to medium knowledge level in general symptoms of sickness, control measure of diseases, kid health management and healthcare management and so was the adoption level for control measure of diseases, kid health management and healthcare management. Hence, it is foremost required to provide animal health service at their door step at the same time awareness and knowledge about prophylactic measures should have to be disseminated.

Information utility from mass media sources was low among the goat owners. It might be due to the fact that majority of the respondents did not have accessibility to mass media sources due to non possession of the electronic gadget or even electricity connectivity. It can also be concluded that mass media was not reaching the farmers who have accessibility to these sources in right manner or the farmers may not be aware of getting livestock related information from the existing mass media sources. Hence, the extension agencies need to focus on making the farmers aware about the mass media sources and in delivering media programmes according to the farmers need and locally available resources in more interesting manner.

Contact with extension agency was in low level among the goat owners. This means that the farmers were aloof from these agencies. This may be due to the insufficient extension agents in the study area. So the government, NGOs and policy makers need to focus on providing door step facilities, making field visits to such kind of farmers. Similarly, the farmers social participation of the goat owners were less. Some incentives and rewards should be initiated by the policy makers and governments for making them to participate in some social organization.

The study revealed that independent variables like education of the respondents, FES, mass media exposure, formal interpersonal contact and social participation had highly significant and positive association with knowledge level on overall health management practices. Comparative study between two states reveals that education of the respondents, FES, flock size, farming experience, mass media exposure, formal interpersonal contact and social participation had highly significant and positive correlation with overall knowledge level in goat health management practices in WB. In case of UP, education of the respondents, FES, mass

media exposure, formal interpersonal contact and social participation had highly significant and positive correlation with overall knowledge level in goat health management practices. The study further reveals that education of the respondents and mass media exposure were the main contributing factors to farmers' knowledge level on overall health management practices. So, the extension agencies and policy makers need to intervene to improve these factors for making them to gain more knowledge on goat health management practices.

The study also revealed that independent variables like education of the respondents, family education status, knowledge level, mass media exposure, formal interpersonal contact, social participation had highly significant and positive correlation while family size also had significant but negative association with adoption level on overall goat health management practices. Comparative study between the two states reveals education, land holding, flock size, experience in goat farming, income in goat farming, knowledge level, mass media, formal interpersonal contact and social participation had highly significant and positive association with adoption index for overall health management practices while family size had significant but negative association with adoption index for overall health management practices. In case of UP education, knowledge level, mass media, formal interpersonal contact and social participation had highly significant and positive association with adoption level for overall health management practices. It was also found that knowledge level, mass media exposure and experience in goat farming were the main contributing factors for adoption of goat health management practices. But, it has been found that the goat owners had low mass media contact, low informal interpersonal agency contact and low informal interpersonal contact. Further, the delivery system or extension in animal husbandry is more focused to dairy animals. Therefore, an urgent need for development of an information system as a training tool was felt which can be helpful to goat owners for information dissemination. Further practices like quarantine for newly purchased animals, vaccination of healthy animals, rotational grazing, disinfection of shed, use of footbath, personnel hygiene, proper litter disposal, proper carcass disposal and proper disposal of litter and carcass were not at all to partial adopted by the sizeable percent of the respondents. Therefore, farmers need to be aware to some of the important aspect that adoption of these practices can not only reduces the chance of susceptibility of diseases to their animals but also can save themselves. Method of disposal of dead animal in open place of the villages may cause public health hazards. Therefore, owners may be encouraged to adopt burning or burying method of the animals through extension programmes. Practices like cutting of naval cord with sterilized blade, dipping of naval cord with antiseptic solution, deworming of newborn within a month, antibiotic coverage for neonatal kid, weaning at 3 months of age were not at all to partially adopted by the sizeable percent of the respondents. Therefore, farmers need to be trained through various extension programmes and make them aware about the economic importance that adoption of these practices can save their flock and can check the economic loss due to mortality or morbidity to some of the important diseases.

Low to medium knowledge and adoption level of goat health management practices among goat owners and assessment of information need were the basis for selecting the contents in the information system. Need assessment of the goat farmers revealed that farmers had less need in vaccination schedule, deworming schedule and also general symptoms of disease as compared to some of the important diseases they had probably observed in their flock. This might be due to the fact that prophylactic measure have no visibility of effect for the interventions whereas treat have visibility. But the need assessment for the goat farmers by the veterinary professional and veterinary students revealed that the information system should contain vaccination schedule, deworming schedule and general symptoms of sickness along with the important diseases for enhancing knowledge among goat owners in prophylactic aspects too. Further, various multimedia tools with audio backup with local language were used to develop the information system so that even illiterate can use it and enhance their knowledge and similarly adopt health management practices.

The software when assessed for effectiveness and utility, it was observed that it has significantly enhance the knowledge level in goat health management practices during post-exposure to GHMIS. Although, majority of the farmers were not willing to purchase the information system but they

were ready to pay a little bit per access for the information system but they desired to access the information if provided free of cost at near by primary school or panchayat building. The goat owners were not willing to purchase the information system may be due to the reason that goat owners were resources poor who were not possessing the required gadgets for accessing the information and as well as there was no electricity connectivity at their residence. It can be concluded from the significant knowledge gain that the software has huge potentiality to enhance knowledge in goat health management practices as this software is made on local and simple language with audio back up which was easily understood even by the illiterates but the inputs likes computers, power supply and human resources has to be provided to access the information. In this regards, the policy makers need to focus on establishing more numbers of village information centres which can play a big role in popularity of the cyber extension. Further, this software can be an important training tools for goat health management which will supplement the effort of the extension personnel and can be used effectively by various organizations involved in goat development for quicker transfer of information.

Now, there is a need to train the farmers on goat health management to save the animal against some of the important disease and to check economic losses. Unfortunately the formal extension agencies are hampered by shortage of man power to carry out this job efficiently. Lack of formal organizations to bring the goat farmers under one umbrella has further complicated the problem of educating them. In these circumstances ICT tools like GHMIS is of great value in educating and helping the farmers to make right decision at the right time to save their flock from some of the deadly disease which causes a huge economic loss in form of mortality and morbidity.

These kinds of ICT tools can be made easily available to farmers through web portals, local NGOs, extension agencies. Capacity building of the goat farmers through cyber extension using such ICT tools developed in local language can create opportunities of growth and prosperity and create more efficient network of knowledge and information in the country.

EFFECT OF NUTRIENT MANAGEMENT ON CUTTING PRODUCTION, STORAGE AND ROOTING OF CARNATION (*DIANTHUS CARYOPHYLLU* L.)

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ABSTRACT

Studies on the "Effect of nutrient management on cutting production, storage and rooting of carnation (*Dianthus caryophyllus* L.)" were carried out at the experimental farm of the Department of Floriculture and Landscaping, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan during 2010-12 on commercial carnation culitvars *viz*.; 'White Wedding', 'Farida', 'Niva' and 'Madras'. The studies included two experiments. First experiment was conducted during 2010-11 on the effect of nutrient management on cutting production of carnation. The second experiment was carried out during 2011-12 to see the effect of storage on rooting of carnation cuttings using best nutrient management treatment obtained from first experiment applied for cutting production. One week before planting, full dose of phosphorous and potassium and half dose of nitrogen were incorporated into the beds according to the treatment requirements and the remaining half dose of nitrogen was applied at the time of planting. Besides the application of basal dose of N, P and K, different doses of N and K were also applied through fertigation which was given twice a week. Application of biofertilizers (VAM, *Azospirillum* and PSM) @ 3 g/plant and vermicompost @ 1 kg/m^2 was done ten days after planting. Findings of the first experiment revealed that fertilizer module FM_5 comprising of 20-5-5 g/m^2 NPK as basal application along with 200 ppm N + 280 ppm K as fertigation given twice a week resulted in the production of cuttings with maximum diameter (0.75 cm), weight (5.22 g), number of cuttings per plant per harvest (4.25), total number of cuttings (16.98), yield of cuttings per metre square (152.78) and cost benefit ratio (1:1.95). Results of the second experiment revealed that cuttings stored for 7 days resulted in minimum percentage of weight loss (3.48 %) and maximum cost benefit ratio (1:3.55). Cuttings that were stored for 7 days (S_1) and 14 days (S_2) resulted in 100 per cent rooting. The studies also indicated that carnation cuttings can be stored up to 35 days at 2°C without significant change in quality and quantity of cuttings.

MASTER'S THESIS

PLANT GROWTH PROMOTING POTENTIALITY OF NATIVE *AZOTOBACTER* SP. AND THEIR MOLECULAR TYPING

RAJIB DEY

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2015

Summary and Conclusion

The beneficial plant-microbes interactions in the rhizospere are determinants of plant health and soil fertility (Jeffries et al., 2003). For sustainable agricultureal production, these interactions play a pivotal role in transformation, mobilization, solubilization of nutrients from a limited nutrient pool in the soil and subsequent uptake of essential plant nutrients by the plants to realize full genetic potential of the crops. In the biogeochemical cycles of both inorganic and organic nutrients in the soil and in the maintenance of soil health and quality, soil microorganisms are very important (Jeffries et al., 2003). Nitrogen fixation can be considered as one of the most interesting microbial activity as it makes the recycling of nitrogen on earth possible and gives a fundamental contribution to nitrogen homeostasis in the biosphere (Aquilantia et al., 2004). *Azotobacter* is a free-living nitrogen-fixing bacterium, which is used as a biofertilizer in the cultivation of most crops. It has several metabolic capabilities which create interests to scientists, who are working towards a better agriculture. *Azotobacter* sp. has the highest metabolic rate of any organisms**.**

- A total number of twenty two *Azotobacter* spp. were isolated in Ashby's N_2 free media from wheat and other crop rhizosphere of Terai and Gangetic regions of West Bengal of which 10 (34.48%) were charecterized based on their plant growth promoting potentiality.
- Regression model with soil physico-chemical parameters as independent variables and '*Azotobacter* population' as dependent variables showed that the soil pH and available P_2O_5 content of soil were the major predictor of *Azotobacter* population in wheat rhizosphere.
- Colony forming unit (cfu) of *Azotobacter* ranged from 9.8×10^4 to 7.5×10^3 Cfu g^{-1} soil sample from wheat rhizosphere of diferent agro-ecological regions of West Bengal. Highest cfu count was found in soil sample collected from Domkal, Murshidabad and the lowest was found in Jalpaiguri soil sample.
- Isolates were all Gram negative, mostly rod shaped and varying degrees of pigment production were observed *viz*., from transparent to brown- black.
- They all can grow in N_2 free media and some are motile.
- They all showed a positive 250bp DNA fragment by primer pair Nif H-g1 ensuring their genus *Azotobacter*.
- All the isolates can promote plant growth by producing IAA. Amongst them AZT8 was recorded the best, showing chili vigor index 1105.44 and producing IAA 118.08 µg/ml.
- Isolate AZT3 was found to be the most antagonistic against *Rhizoctonia solani*, exhibiting percent inhibition at 72.2%.
- Calculating Pearson correlation by SPSS 19.0 it has been found that antagonistic activity is highly positively (significant at 1% probability level) correlated with siderophore production, value: 0.928, whereas, vigor index is highly positively correated with IAA production, value: 0.990.
- Through ERIC-PCR finger printing analysis it has been found that there are four clusters at 31% similarity level and by BOX- PCR finger printing analysis it is observed that there are five clusters at 37% similarity level. Thus BOX-PCR is found to be more effective in determining genetic diversity among the *Azotobacte*r isolates.
- Due to the innate potentiality of producing an array of antifungal metabolites and plant growth promoting substances the consortium of isolates AZT3 and AZT8 can be exploited for bio-intensive disease suppression in sustainable agriculture.

GENETIC CHARACTERIZATION OF SOME GENOTYPES OF WHEAT (Triticum aestivum L.) FOR GRAIN YIELD AND OTHER AGRONOMIC TRAITS

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Summary and Conclusion

Results of different experiments are summarized below:

5.1. Characterization, Grouping and Genetic divergence among genotypes of wheat

Characteristic features of the sixty-seven genotypes have been documented taking different morphological characteristics as described in the Annexure I.

The genotypes were again grouped into different categories as per the different characters like presence of anthocyanin, waxiness, hairness, days to heading and maturity, growth habit, plant morphology etc.

5.2. Studies on variability, heritability, GCV, PCV, Genetic divergence

The genotypes were varied significantly for days to heading(75%), days to maturity, tillers per meter, plant height (in cm), spike length(in cm), no of grains per spike, 1000 grain weight (g), and yield per plant (g). environmental effect was significant for plant height, days to heading, days to maturity and 1000 grain weight characters only. This indicated that traits like plant height, days to maturity and 1000 grain weight were highly affected by different growing seasons i.e. these traits are not stable in nature. Genotype and environmental interaction was also non-significant for all the traits.

Higher values for GCV and PCV were shown for tillers per meter (33.18), yield per plant (30.33) and spike length (18.26).). High heritability (with more than 80%) was observed for 1000-grain weight (g) (1.00), days to heading (75%) (0.99), days to maturity (0.87), tillers per meter (0.83), and spike length in cm (0.80) characters. This indicated that characters are governed by additive gene action. Hence improvement in these traits is possible by direct selection.

D2 analysis of sixty seven genotypes revealed high genetic diversity among them. Maximum D2 value was found to be 19694.54 and the lowest one is 16.18. Again, genotypes were grouped into six clusters on the basis of D2 value among them. Cluster VI had the largest number of genotypes (31) followed by cluster I (28), and all other clusters had only two genotypes each. The inter cluster distance varied from 56.00 (clusters IV & VI) to 15.19 (clusters II & V). the characters like 1000 grain weight, days to heading, spike length contributed most towards the genetic divergence while, yield par plant, days to maturity, plant height, grains per spike, and tillers per meter contributed very poorly.

Finally, it can be conclude that all the sixty seven genotypes were highly divergent, and they were highly heritable in nature, stable and uniform. Further, genotypes can be selected from mostly divergent cluster group for inter varietal crossing programme and selection can be made on the segregation population directly for improvement of most of the characters under study as they are mostly controlled by additive gene action.

EFFECT OF WEATHER AND EDAPHIC FACTORS ON DISEASES OF POINTED GOURD

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SUMMARY AND CONCLUSION

Successive cultivation of pointed gourd crop in the Gangetic Alluvial regions of West Bengal has provided a continuum of susceptible host tissue for the disease to gain alarming proportion rapidly. Management of any disease and more importantly polycyclic disease is dependent on development of management strategies based on the epidemiological aspects of spatial and temporal spread of the pathogen species.

Scanning of literature indicated that scanty information is available on the aspect of epidemiology and disease prediction based on weather variables and different edaphic parameters of soil for foliar and fruit diseases of pointed gourd crop.Application of mathematical and statistical models and computer technology to describe the dynamics of plant diseases in space and time is an integral aspect of my research program whose primary goal is to develop management decisions based on risk assessment and prediction of outbreaks of epidemics. Therefore, in the present investigations major emphasis were given to find out the critical weather factors and soil physico-chemical factors associated with the disease and epidemic development of important diseases mainly downy mildew and fruit and vine rot of pointed gourd.

The findings of the present investigation are summarized below.

1. Periodical survey for the diseases of pointed gourd was conducted in 10 different places of Gangetic Alluvial Region of West Bengal and six important diseases were identified to cause damage to the pointed gourd crop.
2. In accordance to weather variation downy mildew and fruit and vine rot disease of pointed gourd contribute major disease of the crop in Gangetic Alluvial Region of West Bengal. Downy mildew disease prevalent throughout the year with maximum incidence from month of January to March and July to September. The highest disease incidence was observed at February with estimated PDI of 28.7%. Fruit and vine rot (*Pythium/Phytophthora* sp) was another and one of the most devastating diseases of pointed gourd occurring from July to September and peak incidence was observed in September with PDI of 46.2%.
3. From the infected leaf samples collected during survey, three pathogens were isolated viz., *Fusarium* sp., Isolate C and Isolate G. Isolate G was found to be most related to *Glomerella magna.*
4. In pathogenicity test conducted by detached leaf assay, *Fusarium* sp. was found to be most aggressive and virulent one. Total rotting of the inoculated leaf was observed within 7 days at 30°C.
5. *Fusarium* sp. produced off white and fluffy mycelial growth in PDA. Colony produces olive yellow to buff coloured pigmentation. Average growth rate of this isolate was 11.3 mm/day after 7 days of incubation at 25±1°C. Length and breadth of macroconidia ranged between 22 – 30 µm and 2.5 – 5 µm and in case of microconidia the range was 10 – 15 µm and 1 – 3 µm, respectively.
6. In PDA media, colony colour of Isolate G was grayish white to dark grey. The fungus produced black perithecia like fruiting bodies after 1 week of incubation at 25±1°C. The fungus produced hyaline, aseptate, narrow to broadly oblong one end tapered conidia of 17 – 26 µm in length and 2.5 – 3.75 µm in width. Based on the cultural characteristics of Isolate G in PDA media, microscopic observation of mycelium, and morphology of conidia it can be concluded that the pathogen is one of the species of *Glomerella.*
7. Isolate C produced small black pin-head like structures after 10 days of incubation at 25±1°C. Hyphal aggregates hold globular brown shaped thick resting bodies. Average diameter of sclerotia was found to be 408 µm in micrometric observation.

8. In studies of growth biology for Isolate C and Isolate G at four different temperatures, optimum mycelial growth was observed at 30°C.
9. In PDA media, Isolate G was unable to produce any type of fruiting body at 15°C and 20°C. Fruiting body was first initiated at 6 DAS at 30°C. However, highest number of fruiting body was observed 14 days after incubation at 25°C.
10. Isolate C was unable to produce any sclerotia at both 15 and 20°C. Highest number of sclerotia was produced at 25°C at 14 days of incubation. Maximum germination of sclerotia of Isolate C was observed at 2 days after plate-inoculation at 30°C compared to 25°C.
11. On the basis of molecular characterization based on ITS sequencing isolate G causing leaf blight and rotting (anthracnose) was identified as *Glomerella magna.*
12. To understand the effect of soil physico-chemical parameters (pH, OC, Av N, P_2O_5 and K_2O content) on fruit and vine rot disease of pointed gourd, various level of disease severity was correlated with the concomitant physico-chemical parameters of soil. From the correlation matrix it was observed that organic carbon and potassium content of soil showed negative correlation with this disease severity at 1% level of significance. The stepwise multiple regression models indicated that the Av. K content and Org. C in the soil could explain the variation in pointed gourd fruit and vine rot disease severity by 79 %. Therefore, these two parameters can be considered as major predictors of the fruit and vine rot disease severity in Gangetic Alluvial Region of West Bengal.
13. In the field screening of 22 number of germplasm of pointed gourd for the occurrence of fruit and vine rot disease, BCPG-32 showed maximum disease severity (PDI: 29.4%) followed by BCPG-33 and BCPG-31 and are statistically at par with BCPG-32. The minimum pointed gourd fruit and vine rot disease severity was recorded on BCPG-16 (11.3 %) and the genotypes (BCPG 35, BCPG 14, BCPG 1, BCPG 29, BCPG 30 and Swarna Aloukik) were statistically at par with BCPG-16 (11.3 %). Therefore, it may be concluded that BCPG-16 is the most tolerant germplasm against fruit and vine rot disease of pointed gourd whereas BCPG-32, BCPG-33 and BCPG-31 are most susceptible.
14. Monthly disease incidence of downy mildew of pointed gourd was correlated with the average of weather variables in monthly basis. Here wind velocity is negatively correlated with diseases incidence at 5 % level of significance. Other factors like maximum temperature, minimum and maximum RH were found to be the important predictors for predicting downy mildew disease severity of pointed gourd.

EFFECT OF PLANTING DATE AND SPACING ON YIELD AND QUALITY OF RICE HYBRIDS DURING *BORO* SEASON

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SUMMARY

Mean cultivar period for vegetative, reproductive and ripening stages of rice hybrids were 70.77, 32.20 and 29.84 days, respectively. Higher temperature regime prevailing during vegetative and reproductive phases (sowing to flowering) in January 25 sown crop (D_3) accelerated the rate of development of the phenophases, thereby shortened the life cycle. The summed GDD, HTU and PTU for entire life cycle were recorded as 2028.93°C, 17802.04°C hour and 24591.79°C hour, respectively.

Average vigour index for rice hybrids was 1265.78, being lower than the optimum mainly due to low (16.31–19.63°C) mean air temperature during the period from sowing to fourth leaf emergence. Both rice hybrids belonged to semi-dwarf type having plant height of 108.95 cm (KRH 2) and 103.31 cm (Kumud). Delay in planting from January 29 (D_1) to February 27 (D_3) resulted in shorter plant height, lower tiller production and leaf area index leading to lower DM throughout the cropping period. There was a near-linear relationship between LAI and LTR with 3.57 (28 DAT), 3.33 (49 DAT) and 1.65% (70 DAT) significantly greater light interception in February 27 (D_3) planted crop than January 29 (D_1) planting. The light extinction co-efficient values (k) of both rice hybrids showed little increasing trend from 28 DAT (0.27-0.28) to 70 DAT (0.30) against consistent decreasing trend of LAI for the period. The reduced k values described the canopy architecture with more upright leaves of both rice hybrids.

Rice hybrids planted on January 29 (D_1) produced the highest grain yield (5.92 t ha^{-1}), which was reduced by 14.53 and 31.42% for delayed planting on February 12 (D_2) and February 27 (D_3), respectively. This might be due to significant improvement in number of panicles m^{-2}, filled grains $panicle^{-1}$ and 1000 grain weight in early planted crop (D_1) than late planted ones (D_2 and D_3). Close spacing (15 cm × 15 cm) resulted in higher grain yield (5.13 t ha^{-1}) due to more number of hills in 1 m^2 area (44 *vs*. 33 hills m^{-2}) than wide spacing (4.89 t ha^{-1}).

Early or normal planting (D_1) of rice hybrids resulted in greater brown rice (76.37%), lower head rice recovery (51.47%), longer kernel length (6.32 mm) and wider kernel breadth (2.18 mm), while other grain quality parameters remained unaffected due to variations in dates of planting in the study. Rice hybrids (KRH 2 and Kumud) had long bold (LB) type white kernels, but differed in alkali spreading value (2.56 *vs*. 3.61) and kernel elongation ratio (1.60 *vs*. 1.51).

Thus the result described above led to the following conclusions:

Delay in planting of rice hybrids January 29 to February 27 reduced the life cycle by 15.42 days and plant height by 9.54 cm. Mean cultivar period for vegetative, reproductive and ripening stages were 70.77, 32.20 and 29.84 days, respectively. The summed GDD, HTU and PTU for entire life cycle were recorded as 2028.93°C, 17802.04°C hour and 24591.79°C hour, respectively. Based on yield associated characters, grain yield and quality; early planting (January 29) of KRH 2 at a spacing of 15 cm × 15 cm could be recommended for cultivation during dry (*boro*) season in New Alluvial Zone of West Bengal.

CANDIDATE GENE PREDICTION IN QTL REGIONS AND EXPRESSION ANALYSIS IN FIELD EVALUATED NEAR ISOGENIC LINES (NILs) CARRYING STAY-GREEN AND WATER USE EFFICIENCY QTL COMBINATIONS IN THREE RECURRENT BACKGROUND OF *RABI* SORGHUM

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Abstract

Stay-green (*stg*) and water use efficiency (*wue*) are important target traits considered for improving drought tolerance in sorghum. The zygosity of introgressed quantitative trait loci (QTLs) of *stg* and *wue* was determined in three recurrent backgrounds of NILs derived from SPV86, SPV570 and M35-1. The NILs were field evaluated to assess impact *stg* and *wue* QTLs. Significant positive correlations were observed between yield and stay-greeness of different stages in SPV 570 background indicating NILs possessing *stg* trait have significant yield advantage under post-anthesis drought stress condition. Three different *ab initio* gene prediction algorithms *viz*. FGENESH, GENSCAN, GENMARK indicated number of predicted genes anchored within targeted QTLs. Five genes (*NSP, NAD, PHD, MADS, MLO*) for stay-green QTL *qSTG1A* (1.82 Mbp), ten (*IAA, SORBIDRAFT, CYP450, GAG/POL, PK, GENE X, UGTS, MTC, AGP16, VP25*) for *qSTG2* (2.54 Mbp) and one (*SF CC1*) for *qSTG3* (2.18 Mbp) were predicted on sorghum chromosome No. 3 and 1, *qCID2* (2.33 Mb) on chromosome 10. Based on the predicted features and functions of candidate genes, total of 24 predicted genes from different transcription factor families like *MADS, PHD, NAD, EIF-4A* and *SPLICING FACTOR*, *CYP450, IAA* were tested for their expressional analysis through quantitative real-time PCR in 15, 30 and 45DAF leaf tissue samples from introgressed line with M35-1 genomic background. Among all tested samples most of the candidate genes were found to be up regulation with fold change of 3 to 6 and 6 to 10 folds. Senescence related gene *DIN1* was down regulated in M-35-1 introgressed lines. Result indicated the potential use of *stg* and *wue* QTL pyramided lines for improving sorghum performance under drought stress.

STUDY ON FLOWERING BEHAVIOR AND FLORAL TRAITS OF PARENTAL LINES OF HYBRID RICE DURING EARLY *AHU* AND *KHARIF* SEASONS

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Summary and Conclusion

The present investigation was undertaken to study the flower and plant characteristics of two CMS lines (1A and 2A) with their maintainer lines (1B and 2B) and two restorer lines LuitR and IR 36R. The experiment was conducted in ICR farm, AAU, Jorhat during early *Ahu* and *Kharif* seasons, 2014. The results of the present investigation are summarized below:

1. Analysis of variance showed that significant variation was present for all traits except number of pollen deposition on the stigma lobe, per cent seed set, anther length, filament length, number of pollen grain per anther and flag leaf area in early *Ahu* season and except for spikelets per panicle and pollen sterility in *Kharif* season.
2. Pooled analysis of the two seasons exhibited significant difference between the two seasons for all traits except glume opening angle, flag leaf angle, anther breadth and filament length.
3. The salient features of the parental lines are given in Table 6.1.

Table 6.1. Salient features of the parental lines

Parent line	Salient features
IR 58025A	Plant height 79-97 cm (*Ahu-Kharif*), longer stigmata and styles, higher L:B ratio, more panicle exsertion, more number of spikelets per panicle, longer and broader flag leaf with more flag leaf area than IR 68888A. Higher number of pollen deposition and seed set percentage.
IR 68888A	Plant height 75-86 cm (*Ahu-Kharif*), broader stigmata, wider glume opening angle and higher pollen sterility% than IR 58025A.
IR 58025B	Plant height 85-91 cm (*Ahu-Kharif*), more spikelet number per panicle, longer and broader flag leaf with more flag leaf area than IR 68888A. Showed broader anthers during *Kharif*.
IR 68888B	Plant height 77-85 cm (*Ahu-Kharif*), longer anther with more number of pollens per anther and longer filaments than IR 58025A. Showed broader anthers in early *Ahu*.
LuitR	Plant height 85-96 cm (*Ahu-Kharif*), longer anthers with more number of pollens per anther and longer filament, broader anthers during *Kharif* than IR 36R
IR 36R	Plant height 112-104 cm (*Ahu-Kharif*), more number of spikelets per panicle, longer and broader flag leaf with more flag leaf area, broader anthers during early *Ahu* season than LuitR.

4. Correlation coefficient analysis revealed that per cent seed set was positively correlated with number of pollen deposition on stigma and stigma breadth in *Kharif* and negatively correlated with glume opening angle in early *Ahu.*
5. Path analysis revealed that style length, pollen sterility percentage, flag leaf length and stigma breadth had positive direct effect on seed set during early *Ahu* season and during *Kharif* season, number of pollen deposition on stigma and stigma breadth had positive direct effect on seed set percentage.

6. 2A/LuitR was the best combination followed by 1A/LuitR for pollen dispersal and seed setting during *Kharif*, and *Kharif* season was more favourable than early *Ahu* for hybrid seed production.

CONCLUSION

For a successful hybrid seed production, it is essential to synchronize flowering and anthesis between parental lines. Results from the present investigation on flowering behavior of parental lines indicate that seed set percentage was relatively low, particularly in early *Ahu* season. This could be due to environmental conditions particularly temperature, humidity and rainfall plays an important role in governing the flowering process and seed set. Another reason for low seed set could be non-synchrony of the parental lines. However, the CMS lines and the pollen parents showed desirable characters for outcrossing, except relatively narrow glume opening angle of the CMS lines. Therefore, characterization of the parental lines in respect to their sterility, floral traits and plant characteristics offers better understanding of the parental lines for their efficient utilization in hybrid rice seed development programme.

CHARACTERIZATION OF WILD RELATIVES OF TOMATO

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2014

The present investigation was outlined to characterize five wild *Solanum*species employing 17 morphological qualitative characters and 28 different quantitative characters including different plant and fruit characters, fruit quality and physiological characters. Some important characteristic features of the wild *Solanum*species emerged from the study are summarized hereunder.

1. Indeterminate growth habit was the characteristic feature of all the wild *Solanum*species.
2. Less leaf let segments was the characteristic feature of the wild *Solanum*species.
3. Leaf and inflorescence characters of *Solanumperuvianum*were distinctly different than the other *Solanum*species.
4. Lobed leaf let and bipartite inflorescence was the characteristic feature of *Solanumperuvianum.*
5. Style position was inserted inside the anther cone in *Solanumpimpinellifolium*and *Solanumlycopersicum*var. *cerasiformae.*
6. Exserted stigma was the characteristic feature of *Solanumchilence, Solanumcheesmaniae*and *Solanumperuvianum*.
7. Fruits were small and round to slightly flatten in shape with flattish-round blossom end in all the *Solanum*species.
8. *Solanumpimpinellifolium*and *Solanumlycopersicum*var. *cerasiformae*were the only pure red-fruited wild species.
9. Ripe fruits of *Solanumcheesmaniae*were orange-red and that of *Solanumchilence*was yellow.
10. Ripe fruits of *Solanumperuvianum*remained light green.
11. The wild species was characterized by their very high fruited ness and this character can be utilized to develop high fruited tomato genotype.
12. Yellow fruit colour of *Solanumchilense*was not the indicator of high β carotene content in the ripe fruits.
13. *Solanumpimpinellifolium*and *Solanumlycopersicum*var. *cerasiformae*can well be utilized in breeding tomato for improving ascorbic acid, total sugar and lycopene content in the fruits.

CHARACTERIZATION OF BEGOMOVIRUS ASSOCIATED WITH YELLOW MOSAIC DISEASE OF RIDGE GOURD [*Luffa acutangula* (L.) Roxb.]

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2015

SUMMARY AND CONCLUSIONS

The present investigations with respect to ridge gourd yellow mosaic virus disease incidence, molecular detection, molecular characterization of the causal agent, host range, detection tool and varietal reaction against the disease under glass house conditions were carried out during 2014-15 at KRCCH, Arabhavi. The salient features of the present investigations were summarized here under.

The roving surveys were carried out during March to April 2015 and collection of virus isolates were carried out in ridge gourd growing areas of southern India states *viz.,* Karnataka, Andhra Pradesh and Tamil Nadu revealed that disease incidence ranged from 30-100 per cent.

A total of 63 samples out of 66 samples collected during surveys were found detected for both DNA-A and DNA-B components of begomovirus indicating that all detected samples were associated with bipartite begomovirus.

PCR analysis of surveyed samples of yellow mosaic disease of ridge gourd with beta and alpha-DNA satellites specific primers revealed that absence of both satellite DNAs in all the samples.

Representative surveyed sample subjected for molecular characterization by sequencing the complete genome. This isolate has both DNA-A and DNA-B components. The DNA-A component consisted of 2,739 nt and DNA-B of 2,693 nt which was appropriately similar to other begomoviruses (ToLCNDV).

Comparison of complete nt sequence analysis of DNA-A of ToLCNDV-[IN:Kar:Bgk:Rid:15] with other selected begomovirus isolates showed that high nt sequence identity of 97.55 per cent with ToLCNDV-[IN:Kar:Bel:Rid:14], followed by next close association having 92.06 per cent nt sequence identity with ToLCNDV-[TH:Mus:07].

Phylogenetic tree based on alignment of complete DNA-A nt sequences of other selected begomovirus with the present study virus revealed that the ToLCNDV-[IN:Kar:Bgk:Rid:15] was clustered in the group of ToLCNDV isolates and formed the distinct close branch clustering with ToLCNDV-[IN:Kar:Bel:Rid:14], thus the begomovirus isolated from ridge gourd is a new variant of ToLCNDV-[IN:Kar:Bel:Rid:14].

Comparison of complete nt sequence analysis of DNA-B of ToLCNDV-[IN:Kar:Bel:Rid:15] with other selected begomovirus isolates showed that high nt sequence identity of 97.44 per cent with ToLCNDV-[IN:Kar:Bel:Rid:14], second highest nt identity 81.96 per cent with ToLCNDV-[IN:ND:Tom:94], followed by ToLCNDV-[PK:Dar:Tom:07] 81.16 per cent nt identity.

Phylogenetic analysis of complete nt sequence of DNA-B with other selected begomovirus through MEGA6.06 version revealed that the ToLCNDV-[IN:Kar:Bgk:Rid:15] was clustered in the group of ToLCNDV isolates and formed the distinct close branch clustering with ToLCNDV-[IN:Kar:Bel:Rid:14], thus the begomovirus isolated from ridge gourd is a new variant of ToLCNDV-[IN:Kar:Bel:Rid:14].

The heat map generated using SDTv 1.2 indicated that the virus isolated from the ridge gourd had highest nt sequence similarity with ToLCNDV-[IN:Kar:Bel:Rid:14] and also to ToLCNDV species when compared with other characterized viruses.

Complete nt sequence of DNA-B component of the begomovirus isolated from ridge gourd was aligned by using CLUSTALW with other selected begomoviruses and sequence was analyzed by using the SDTv 1.2 software package to get heat map which showed highest nt sequence similarity with ToLCNDV-[IN:Kar:Bel:Rid:14] and also to ToLCNDV species when compared with other characterized

viruses which provides the information that the present study virus is the variant of ToLCNDV-[IN:Kar:Bel:Rid:14].

The recombination analyses through Spits-Tree version 4 which clearly revealed the evidence of phylogenetic conflict of the ToLCNDV-[IN:Kar:Bgk:Rid:15] isolate with ToLCNDV-[IN:Kar:Bel:Rid:14] and along with other reported viruses used in the analysis.

RDP analysis of DNA-A of virus indicated the breakpoint positions in the viral genome. Major parent found was ToLCNDV-[TH:Mus:07] and the minor parent was identified as ToLCNDV-[IN: Bah:Chi:07], which shows the intraspecific recombination.

Common region of both components of begomovirus isolated from ridge gourd consisted of "TATA" box, the non coding nanonucleotide sequence "TAATATTAC" and the iterons with the sequence of "GGCGT" and also found in other isolates also.

GC content found in the DNA-A and DNA-B component of begomovirus isolated from the ridge gourd was 45.09 per cent and 41.80 per cent respectively.

Commercially available restriction enzymes sites like EcoRI, NdeI, BglI, BstXI, EcoRV, BamHI, PstI, HindII, EcoRII and XbaI were found in DNA-A, where as EcoRII, EcoRI, XbaI and XhoII in DNA-B component were observed.

Isoelectric point of proteins of begomovirus isolated from ridge gourd were determined *i.e.* Rep protein 6.85, TrAP-9.23, REn-10.10, AC4-12.39, AC5-9.74, CP-10.63, AV2-7.59, NSP-8.26, MP-7.92.

The improbability of expression in inclusion body was determined for proteins of begomovirus *i.e.* Rep-0.72, TrAP-0.96, REn-0.64, AC4-0.65, AC5-0.78, CP-0.61, AV2-0.53, NSP-0.90, MP-0.86.

Predicted the secondary structure of proteins of begomovirus such as alpha helix, extended strand, beta turn and random coil using methods like PREDATOR, MLRC and SOPMA.

The Physico-chemical characterization of sequence for all proteins in DNA-A and DNA-B was done for understanding the various physical and chemical parameters of respective proteins. Instability index reveled that AC3 (REn) and AC5 are stable in nature reaming protein are unstable in nature. The aliphatic index of a protein is provide relative volume occupied by aliphatic side chain in a protein. GRAVY value indicates AC3 (REn) protein is having polar nature and remaining proteins are non-polar.

By using the online software Phyre[2] for designing Rep protein 3D structure of begomovirus and identified the two alpha-Helices and six beta-Sheets.

Homology modeling study proved that two template (1l5i.1.A and1l2m.1.A) sequences with the highest quality are found against the target sequence (Rep protein of ToLCNDV-[IN:Kar:Bgk:Rid:15]) which were selected for building the model of Rep protein of ToLCNDV-[IN:Kar:Bel:Rid:15]. This homology modeling study can be utilized to study various structural proteomics and to design *in silico* antiviral agent against begomoviruses.

LAMP assay is rapid, specific and requires minimal equipment for performing the reaction. In this study LAMP assay was established for the detection of begomovirus associated with yellow mosaic disease in ridge gourd. LAMP compared with conventional PCR. LAMP yielded more accurate results, and was more convenient and less time-consuming especially for field detection. This method has potential application in early diagnosis.

PCR analysis of sample from leaf curl disease infected pumpkin revealed that association of DNA-A and DNA-B fragments of begomovirus. This result indicated that association of bipartite begomovirus with pumpkin leaf curl and also first time report of bipartite begomovirus with pumpkin leaf curl in India.

Off the twenty six plant species used to identify host range of the virus. None of the crop species showed symptoms and no amplification of begomovirus found through PCR.

Twenty one varieties and seven hybrids were tested against disease in order to find out source of resistance. All the hybrids/varieties showed highly susceptible reaction where as one (URRG-39) showed susceptible reaction. None of the varieties showed resistant reaction.

Based on host range, molecular detection and complete genome sequence information of the full length genome of the causal agent isolated from ridge gourd causes yellow mosaic disease is identified as new strain of ToLCNDV which belongs to the genus bipartite *begomovirus* of the family geminiviridae.

The present *in-silico* analysis data may further helps in understanding the protein function, number and types of epitopes, immunogenic portions, suitability for antibody production, taxonomic studies, evaluation studies, virus diagnostics and development of diseases resistance/management strategy for yellow mosaic diseases on ridge gourd.

RELATIVE PERFORMANCE OF DIFFERENT WHEAT (*Triticum aestivum L.*) GENOTYPES ON MICRONUTRIENT APPLICATION UNDER *TERAI* AGRO - CLIMATIC SITUATION OF WEST BENGAL.

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Summary and Conclusion

The present investigation was conducted to evaluate a set of sixty-nine genotypes of wheat under three different doses of zinc application (0, 5 and 10 Kg ZnSO4/ha.).The genotypes showed enough variability for different morpho reproductive characters under study along with yield. The effect of zinc application was also found significant while the mean yield changed positively only upto soil application of $ZnSO_4$ at 5 kg /ha. The genotype x zinc interaction was also found significant for all the characters under study which revealed that zinc had significant impact on the performance of these genotypes.

Among the characters under study, zinc had positive influence on all the characters under study except days to heading and days to maturity which showed negative effects. This might be due to the role of zinc in biosynthesis of auxin and thus initiation of flower primordial early. Yield was found highest at Zn1 (5 kg ZnSO4/ha) which revealed higher zinc application had positive effect on yield only up to 5kg ZnSO4/ha. Higher values for GCV were shown for yield (30.41), tillers per meter (23.80), and plants per meter (21.52). ECV was found high for plants per meter, tillers per meter and yield. This revealed that environment (Zinc application) had higher effect on the above traits.

High heritability (> 0.8) was observed for days to maturity (0.95), test grain weight (0.88), days to heading (0.87).Therefore, all these traits were suitable for selecting wheat genotypes under similar environment. High heritability coupled with high genetic advance was observed for 1000 grain weight, days to heading, days to maturity etc.

Yield was found positive and significantly correlated with tillers per meter at Zn0 and Zn1.Path analysis revealed, positive and high direct effect for tillers per meter and days to heading under Zn0 & Zn2, while at Zn1 it was observed for plants per meter, plant height and days to maturity. The direct effect of zinc content in whole plant at CRI stage on yield was found positive and very high at Zn1 only. Zinc content in straw ant root at flowering stage had very high and positive direct effect on yield at Zn0. The residual effect was high in all the three levels of zinc application. This indicates that there may be some other factors which influenced yield more. Initial soil had low nitrogen, medium phosphorous, low potassium and medium zinc status. Uptake of nitrogen was found maximum at Zn2 followed by Zn1 while maximum uptake of phosphorous from soil was found at Zn0 followed by Zn1 and Zn2 which indicates positive interaction of zinc uptake by plant for soil nitrogen but negative interaction for soil phosphorous level. Uptake of K was found highest at Zn1 level which indicates that potassium has interaction with zinc content only at Zn1 (5 kg ZnSO4/ha). Uptake of zinc was found maximum at Zn2 followed by Zn1 which showed positive result for increased doses of zinc application in soil.

The genotypes like RAJ 4350, HD 2009, LBPY-2013-1, JS 6-1, RAJ 4443, LBPY-2011- 10, LBPY-2013-2, GW-2011-362, WSM-57-13 and RAJ 4441 were zinc efficient genotypes at Zn0 in terms of zinc content at CRI stage. While at Zn1and Zn2, genotypes like RAJ 4443, JS 6-1, RAJ 4350, LBPY-2011-10, HD 2009, RAJ 4441, LBPY-2013-1 gave only promising result indicating their consistent performance for the trait. Zinc content in root during flowering stage revealed that genotypes like RAJ 4350, HD 2009, JS 6-1, LBPY-2013-1, RAJ 4443, LBPY- 2013-2, GW -2011-362, LBPY-2011-10, RAJ 4393 and GW-2013-471 were having high zinc uptake at root level under Zn0 condition. Under Zn1and Zn2 condition, genotypes like RAJ 4350, JS 6-1, LBPY-2013-1, RAJ 4443, LBPY-2011-10 showed promising result only indicating stability of the performance under higher Zinc concentration too. The genotypes like RAJ 4350, JS-6-1, LBPY -2013-1, LBPY-2011-10, LBPY-2013-2, HD 2009, RAJ 4443, GW-2011-362, WSM-57-13 and GW -2013-471 were found most efficient at Zn0 condition in terms of high zinc content in straw at flowering stage. Under Zn1and Zn2 condition, genotypes like LBPY-2011-

10, LBPY -2013-1, HD 2009, JS-6-1, RAJ 4443 showed promising result indicating their stability of performance at all the three levels of zinc doses. RAJ 4350 and LBPY-2013-2, GW-2011-362 showed promising result only at Zn0 and Zn1 condition, indicating their high interaction with zinc doses.

The genotypes like LBPY-2013-1, NIAW 2844, LBPY-2014-11, LBPY-2014- 9, LBPY-2014-6, HD 2009, RAJ 4444, JS 6-4, GW- 2013-478 and LBPY- 2014-7 gave higher yields in zinc deficient soil (0 kg $ZnSO_4$/ha). So they can be considered as zinc efficient genotypes on the basis of yield performance. When the performance of these genotypes were compared at Zn1 and Zn2 level, it was found that consistent performance in terms of yield was shown by only few genotypes like LBPY-2013-1, NIAW 2844, LBPY-53 2014-6 etc. indicating high stability for the concerned trait. The genotypes like LBPY-2013-1 and HD 2009 show high yield along with high zinc uptake.

PERCEPTION ON EFFECT OF CLIMATE CHANGE ON FOREST AND ADAPTATION STRATEGIES OF FOREST DEPENDENT COMMUNITIES IN A HUMID TROPICAL FOOTHILL FOREST OF INDIAN EASTERN HIMALAYAS

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ABSTRACT

The present study documented perception of forest dependent community inhabiting in and around fringe villages of Chilapata Reserve Forest on climate change with its associated risk and coping strategies adopted. A total of 100 respondents not below the age of 40 through random sampling were selected for personal in-depth interview through close ended questionnaire schedule. Majority of the respondents were male, literates and farmers with land holding of 100-200 decimal (1 decimal = 33.33 m^2). The results show that forest dependent community of Chilapata Reserve Forest have considerable awareness and consistence on climate change and its effects on the weather, ecosystems, biodiversity and agriculture. These perceptions are consistent and conform to the past meteorological trend analysis from recorded climatic data of the region and scientific findings generated by modern science in different parts of the world. They perceived climate change and believed it as worldwide phenomena. Majority of them perceived increase in temperature as increase in day and night temperature, mildness in winter and warming of winds. Similarly they believed that monsoon is becoming unpredictable day by day with changed intensity and pattern but generally arriving late and withdrawing early over the past few decades along with decrease in cloudy and rainy days. Majority of these people also perceived negative impact of climate change on forest biotic and abiotic environment along with risk on their livelihood through increased misery, decreased income, increase susceptibility to serious diseases and decreased availability of food and water. Having perceived climate change the community is adopting knowledge-based adaptive measures to cope with it but with medium adaptive capacity. A total of 17 coping options were identified. Pre-monsoon dry-seeding, agroforestry, crop rotation, short duration crop varieties and use of organic products are popular. The study also revealed a need for scientists, government and non-government agents and other stakeholders to support efforts by farmers to adapt to effects of climate change through technological, policy and financial interventions with an aim of improving livelihoods and food security.

PHOSPHORUS MINERALIZATION POTENTIAL UNDER DIFFERENT ORGANIC FARMING SYSTEMS

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In the present investigation microbial potentiality in phosphorus mineralization under different organic production systems were assessed to understand the character and dimension of some microbiologically exploited organic phosphorus pools, extracted by different graded strength of basic EDTA. For such assessment, soils from different established and certified organic tea gardens (*viz.* Belseri, Chardwara, Mund) and conventional tea garden (Irrangmara Tea Estate) from Brahmaputra Valley and Jalinga, Kalachera, Dwarbund (organic tea gardens), Rose Candy (conventional tea garden) from Barak Valley of Assam were sampled and incubated in laboratory for 120 days to understand the mineralization potential of different organic P fractions. Out of this exercise, extractant which will extract most potentially mineralizable organic P fraction with faster mineralization rate (k) and shorter half-life (t1/2) as well as shorter turnover time/mean residence time (MRT) will be qualified as suitable extractant for estimation of most contributing organic P pool in organic production systems.

Organic phosphorus remains in soil in humic component as a very complex structure. Particularly, phytate, the lion share of soil organic phosphorus, makes a strong cationic bridge with Fe and Al in acid soils and Ca with alkaline soil. Due to this strong linkage, solubility decreases and the complexes become highly resistance to microbial mineralization. So, total organic phosphorus, extracted by conventional extarctants do not provide significant relationship with organic phosphorus mineralization and release of plant available phosphorus. EDTA in Basic EDTA developed by Bowman and Moir (1993) can chelate metal cations to eliminate the metal organic phosphorus bridge to increase the efficiency of SOM associated organic phosphorus solubilization by base used in the extractant. As the solubility of different fractions of organic phosphorus pool is not identical due their structural integrity, it is hypothesized that same strength of base cannot extract all fractions from soil. With this background graded strength of base starting from 0.125 (M) to 1 (M) were used with 0.05 (M) EDTA. As microbial mineralization of different fractions of organic phosphorus is subject to structural configuration, the proposed graded strength of basic EDTA will be good tools for studying the dynamics of P mineralization and subsequent identification of suitable extactant for tracking organic phosphorus fraction/s contributing phosphorus in plant nutrition under organic production system.

It was observed that initial soil of organically managed Jalinga Tea Garden retained diverse size of organic phosphorus fractions in organic P pool. It indicates the differential capacity of extarctants to draw different amount of organic phosphorus fractions from soil. Among the extracts 1 (M) NaOH + 0.05 (M) EDTA extracted significantly the highest magnitude of organic phosphorus followed by those of 0.5 (M) NaOH, 0.375 (M) NaOH, 0.75 (M) NaOH, 0.25 (M) NaOH , respectively, and least by 0.125 (M) NaOH. However, amount of organic phosphorus extracted by 0.5 (M) NaOH, 0.375 (M) NaOH, and 0.75 (M) NaOH did not differ significantly. 1 (M) NaOH + 0.05 (M) EDTA as it is relatively harsh; it extracted simple as well as comparatively resistant organic phosphorus fractions and, thus, gave higher initial stock. Dwarbund and Kalachera Tea Estate also exhibited higher retention of initial organic P stock while extracted by 1 (M) NaOH + 0.05 (M) EDTA. Interestingly, in spite of higher content of organic P, their changes over time did not follow higher rate of disappearance. Rather, 0.125 (M) NaOH + 0.05 (M) EDTA extractable organic P recorded the highest changes during 120 days of incubation in case of Dwarbund Tea Estate. While, 0.5 (M) NaOH + 0.05 (M) EDTA extractable organic P fraction showed the highest rate of mineralization of organic P in soils of Kalachera Tea Estate.

Tea gardens of Brahmaputra Valley exhibited differential levels of organic P fractions in initial soils. Nature of those fractions and their mineralization rate (% disappearance of organic P) were differentiated by using different extractant as discussed earlier. Though the dimension of 1 (M) NaOH + 0.05 (M) EDTA extractable organic P fraction were highest under all the gardens namely, Belseri, Mund and Chardwara Tea Estate as compared to conventionally managed tea garden Irrangmara, the mineralization rate , except Mund Tea Estate, did not follow the volume of the substrate. While, 0.5 (M)

NaOH + 0.05 (M) EDTA extractable organic P fraction showed the highest rate of mineralization of organic P in soils of Belseri Tea Estate; 0.375 (M) NaOH + 0.05 (M) EDTA extractable organic P fraction showed the highest rate of mineralization of organic P in soils of Chardwara Tea Estate. Results demonstrated that the organic P fractions are highly diversified under Tea gardens of Brahmaputra Valley as compared to those of Barrack Valley.

With the progress of incubation the concentration of different fractions of organic phosphorus extracted by different strength of basic EDTA declined gradually irrespective age and location of the gardens. Dynamics of organic phosphorus fraction mineralization across the incubation period varied even ignoring the initial stock of organic phosphorus. The highest stock of 1 (M) NaOH extractable organic phosphorus registered the lower change of 13.33 percent organic phosphorus. Whereas, the least amount of initial organic phosphorus fraction as extracted by 0.125 (M) NaOH recorded the highest disappearance of 16.07 percent of that fraction under Jalinga Tea Estate of Barrack Valley. Almost similar results were obtained from the gardens under Brahmaputra Valley. Dwarbund Tea Graden and Kalachera Tea Garden soil under same agro-ecological zone retained organic P fraction more or less similar in nature. It was also observed that same extractant drew less amount of different organic P fraction under conventionally managed tea garden Rose Candy and Irrangmara under Barrack Valley and Brahmaputra Valley, respectively. This indicates conventional tea gardens supported relatively higher resistant organic P fractions as they were not routinely applied with organic manures. By assessing disappearance of organic P fractions is not a rational approach to study organic p mineralization because of some lacunae associated with this method. To overcome the problem associated with currently adopted methodology for organic phosphorus mineralization study the concept of soil organic carbon (SOC) decomposition kinetics were tried with the assumption that decomposition of organic phosphorus also follows the rules of soil organic carbon decomposition. The model suggests that the potentially mineralizable phosphorus of a soil and its mineralization coefficient (k) can be estimated by incubating the soil at optimum temperature and moisture and measuring the P mineralized and the time of incubation. The main assumption is that the organic P mineralization at optimum temperature and moisture follows first order kinetics model as being widely seen in plant litter decomposition. Adopting first order kinetics model turnover rate, half life of and mean residence time of the organic P remained can be computed to identify the labile and most recalcitrant organic P fraction with potential turnover rate.

Perusal of turnover rate (k) data shows that among the tea gardens under Barak valley, Kalachera registered the highest turnover rates of different fractions of organic P extracted by graded strength of basic EDTA. On an average, the turnover rate of different organic fractions under Jalinga Tea Garden was very poor in spite of having higher organic carbon content. Among the extarctants, 0.5 (M) NaOH + 0.05 (M) EDTA extractable organic P fraction recorded the fastest mineralization rate of 0.072mg P/kg soil in Kalachera Tea Estate. Whereas, under Jalinga and Dwarbund Tea estate 0.125 (M) NaOH + 0.05 (M) EDTA extractable organic P fraction recorded significantly speediest mineralization rate. In general, Conventional tea garden Rose Candy exhibited the lowest mineralization rate. Turnover rate (k) data shows that among the tea gardens under Brahmaputra Valley Chardwara Tea Estate registered the highest turnover rates of different fractions of organic P extracted by graded strength of basic EDTA. This was followed by Mund Tea estate and least turnover rates was recorded under Belseri Tea Estate. Turnover rates of different fractions of organic P under conventional tea garden Irrangmara were relatively poor as was observed under conventional tea garden Rose Candy.

Half-life of existing stock of organic P under different gardens under Barak Valley varied from 9.62 days to 21.65 days. Among the tea gardens managed organically under Barak Valley, half-life of different reserves of organic P under Jalinga Tea Estate were very high followed by Dwarbund and Kalachera, respectively. Lowest half-life observed in 0.5 (M) NaOH + 0.05 (M) EDTA extractable organic P fraction under Kalachera Tea Estate. In general, higher half-life of all the fractions of organic P in organic P pool was under conventionally managed tea garden, Rose Candy. Half-life(t1/2) data shows that among the tea gardens under Brahmaputra Valley Chardwara Tea Estate registered the lowest half-life of different fractions of organic P extracted by graded strength of basic EDTA. This was followed by Mund Tea estate and highest half-life was recorded under Belseri Tea Estate. Lowest half-life of about 9.24 days was observed in case of 0.375 (M) NaOH + 0.05 (M) EDTA extractable organic P

fraction under Chardwara Tea Estate. Half-life period of different fractions of organic P under conventional tea garden Irrangmara were relatively high as was observed under conventional tea garden Rose Candy.

Comparison of MRT values of different fractions of organic P in organic P pool estimated by simple first-order modeling revealed a wide range of MRTs of 1666 days to 3870 days in organically and conventionally managed tea gardens Kalachera and Rose candy under Barrack Valley, respectively. Among the tea gardens managed organically, MRTs of different fractions extracted by different extractants under Jalinga Tea Estate were higher as compared to other gardens. A wide range of MRTs of 1600 days to 3000 days in organically and conventionally managed tea gardens Mund and Irrangmara under Brahmaputra Valley, respectively. Higher MRTs of different fractions under conventionally managed tea garden of Irrangmara was due to higher content of relatively resistant organic P with longer turnover time

In order to assess and compare the organic phosphorus mineralization process under organic and conventional tea gardens in Assam, activities of battery of enzymes like acid phosphatase, alkaline phosphatase and phytase activity were worked out. Results showed that acid phosphatase, alkaline phosphates as well as phytase activity were significantly increased under organic tea husbandry over conventional tea gardens in all the locations. On an average, 25.1 to 60 % increased level of phytase activity were recorded under organic tea production systems over conventional one. The activity of the enzyme reduced while the gardens and other production systems were brought under conventional system.

It was demonstrated that predicted mineralized P was higher in organically managed tea gardens irrespective of location and management practices adopted as compared to conventionally managed tea gardens. Among the organic tea gardens under Barak Valley least amount of mineralized P was recorded under Jalinga Tea Estate and the highest under Kalachera Tea Estate with a moderate mineralized P under Dwarbund Tea Estate. Mineralizated P from different fractions under Jalinga Tea Estate though could not differentiated statistically yet fraction extracted by 1 (M) NaOH + 0.05 (M) EDTA contributed the highest amount of mineralized P although the incubation period. Similarly, in case of Dwarbund and Kalachera Tea Estate mineralized P accumulated can hardly be differentiated statistically. However, 0.125 (M) NaOH + 0.05 (M) EDTA and 1 (M) NaOH + 0.05 (M) EDTA extractable organic P fractions provided statistically identical amount of mineralized P. Among the organic tea gardens under Brahmaputra Valley least amount of mineralized P was contributed by Belseri Tea Estate and the highest by Chardwara Tea Estate with a moderate mineralized P by Mund Tea Estate. With the progress of incubation the content of mineralized P declined progressively irrespective of location of garden and the management practices adopted.

The first order model well described the mineralization of different fractions of organic phosphorus extracted by basic EDTA extractant. By computing turnover rate from first order kinetic graph, half–life and mean residence time/turnover time were worked out for identifying and quantifying the individual P fraction of different organically and conventionally managed tea gardens. Overall results showed that in few cases 0.125(M) NaOH+ 0.05 (M) EDTA extractable organic p was identified as most contributing P pool but in other cases 0.5 (M) NaOH+ 0.05 (M) EDTA extractable organic p was identified as most potential. But in most of the cases, 1 (M) NaOH + 0.05 (M) EDTA extractable organic P was qualified as potential contributor as measured by predicted mineralized P. Thus, this extractant may putatively be selected as suitable extractant for potential P estimation under organic production systems. However, discrepancy stated above should be addressed to identify the best suitable extarctants for soil testing of P under organic system. More aged organic farms from diverse agro ecosystems along with unfertilized forest soil may be attempt to fine tuning the research. Moreover, soil test P should be correlated with crop response under organic production systems.

INNOVATIONS IN MARKETING OF FRUITS IN ASSAM: A STUDY OF NORTH EASTERN REGIONAL AGRICULTURAL MARKETING CORPORATION LIMITED (NERAMAC).

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2014

There is gradual growing commercialization of agriculture and increasing dominance of supply chains characterized by the requirement of rigid adherence to strict grades and standards. Small farmers in India, especially in backward regions like in North Eastern India, facing both an opportunity for access to valuable markets and also the risk that they will be excluded from them. There has been a big concern in the recent years regarding the efficiency of marketing of fruits and vegetables, and that is leading to high and fluctuating consumer prices and resulting to that only a small share of the consumer rupee reaching the producer farmers.

The present study was conducted to analyze the innovations in marketing of fruits in Assam with giving special focus to "North Eastern Regional Agricultural Marketing Corporation Limited (NERAMAC)". The study was conducted in two districts of Assam namely "Dhubri" and "Karimganj". The total of 80 NERAMAC beneficiaries and 40 non beneficiaries with the entire available field functionaries of NERAMAC were interviewed. Structured and semi structured interview schedules were used to collect the data from respondents of the study. The organizational and functional innovations by NERAMAC, the backward and forward linkages provided by it to the fruit growers, the factors influencing the market decisions of beneficiaries and non beneficiaries and the constraints in marketing of fruits as perceived by fruit growers and NERAMAC were analyzed.

The main problem that the farmers in this North Eastern region are facing is the marketing problem. Considering the problems at all levels of organization and farmer, the objectives were taken for research and the results are as follows.

Results:

The organizational and functional innovations by NERAMAC.

Documentation and analysis of specific innovations in respect of organizational structure, hierarchy and functional mechanism has been taken. NEARMAC research wing has invented different innovative useful technologies for the farmers. It is having innovative organizational and functional mechanism. For better working of the organization it has a provision of training of officials, regular information flow through seminars, conferences and use of leaflets. They follows bottom up planning of work where the services are provided to the farmers according to their conveniences. For procurement of produces, it has their own collection centres and for selling also they have made provision of specific outlets and auction centres for produces. In the organization, there is a provision of assigning the right activities to right persons which is a special criterion for effective organizing in a organization.NERAMAC also take care of the career planning of their members. In order to provide input and service to farmers, NERAMAC has made alliance with different input companies and channelized their products along with NERAMAC products through NERAMAC outlets. Agricultural advisory and Complaint Management are done for on field diagnosis of various problems faced in crop cultivation by the farmers.The increasing annual turnover of NERAMACs indicates its growth which indirectly indicates farmers' preference and adoption. The findings about personal characteristics of NERAMAC members i.e. high economic motivation, high marketing orientation, and social participation are well matched with company's desirable selection criteria.

Backward and forward linkages provided by NERAMAC to the fruit growers.

It was found that 86.2 per cent farmers perceived that their needs were fulfilled with full satisfaction with regard to latest packages of practices and market information while 6.2 per cent farmers assumed that their needs were fulfilled with average satisfaction. About the latest technology in

allied sectors, 49.2 per cent farmers felt that their needs were fulfilled with full satisfaction and 37.5 per cent farmers assumed that their needs will be fulfilled in future. Forty two 52.5 per cent farmers observed that their needs were fulfilled with full satisfaction with regard to the advisory services while 28.8 per cent farmers were hoping that their needs will be fulfilled in future with the advisory services provided by the NERAMAC. While considering the crop protection services, 61.2 per cent farmers perceived that their needs were fulfilled with full satisfaction and 33.8 per cent farmers felt that the needs were fulfilled with average satisfaction. Forty eight 60 per cent farmers believed that their needs were fulfilled with average satisfaction in concern with the post harvest technology provided by while 50 per cent felt that their needs were fulfilled with full satisfaction NERAMAC .

It was found that 68. 75 percent farmers perceived that the latest package of practice and market information provided by NARAMAC was appropriate to their field situation and 30 percent farmers perceived it highly appropriate for their location. It also showed that 60 percent of the farmers felt that the information regarding the technology advisory was appropriate to their condition while 27.5 percent farmers felt it as highly appropriate for their situation. About training services, 51.2percent farmers believed that it was appropriate in their situation while 35.0percent farmers believed that it was highly appropriate in their condition. It illustrated that 52.5percent farmers perceived appropriate of the service for the Market support by the NERAMAC while 25percentfarmers perceived it as moderately appropriate to their field situation. 62.5 percent farmers experienced that the services for the post-harvest technology was moderately appropriate in their situation while 21.2percentfarmers experienced it as somewhat appropriate in their condition. It characterized that 71.25 percent farmers perceived that the processing services provided by NARAMAC was appropriate to their field situation and 27.5percentfarmers perceived it highly appropriate for their location..

It signified that most of the farmers 24, 30 per cent had very high (80per cent and above) increase in their production after the intervention of NERAMAC. There was high (61-80 per cent) increase in the production of 23.8 per cent of the total farmers. There was medium (41-60 per cent) increase in production for 20 per cent of the total farmers. Out of total farmers, 15per cent farmers had low (21-40 per cent) increase in their production. There was very low (0-20 per cent) increase in the production of 11.2 per cent farmers, out of the total farmers after the interference of NERAMAC in their locality. Overall increase in production was 66.29 per cent after the intervention of NERAMAC.

For the services of latest technologies on allied sectors, the mean score was 4.262, which imply that this service met their need with full satisfaction. The mean score for the services of post-harvest technology is 4.237. For the advisory services, the mean score was 4.1, which mean that their need fulfilled with full satisfaction. Latest package of practices and market information of agriculture with the mean score of 3.93 signified that the most of the farmers perceived that their needs were fulfilled with full satisfaction. The mean score of procurement services was 3.85. The coefficient of variation of all the parameters is low so there is high consistency among the farmers for their satisfaction.

Table 5.3 represented the frequency and percentage of response of the farmers to the timeliness of the services of the NERAMAC. It showed that 81.25 percent farmers perceived that information regarding the latest package of practices was provided in advance of the season while 6.25 percent framers perceived that it was provided far in advance of the cropping season. 70 percent farmers assumed that information regarding the practices of allied sectors was provided in advance while 15 percent farmers felt that it was provided far in advance.

In case of market support, 61.2 percent farmers felt that it was provided far in advance,while 37.8 percent farmers told that the advisory services were provided in advance of the season. Regarding the crop protection services, 67 percent farmers felt that the services were at the time of usage of technology in the cropping season and 37.8 percent farmers responded that the services are provided in advance. For the post-harvest technology, 40 percent farmers perceived that the services were provided when technology loses its objective newness and 51.2 percent farmers responded it was provided at the time of technology is to be used. The obtained score was divided into five equal groups ranging from low effective to high effective of the NERAMAC services. Table 5.12 revealed that 62.5 per cent of the total farmers perceived that the NERAMAC was highly effective as a mean of getting information in their situation. Out of the total farmers, 16.2 per cent farmers perceived it very high

effective in obtaining the information regarding their farming. There were 21.2 per cent farmers believed that it was medium effective to meet their needs.

Factors influencing the market decision of NERAMAC beneficiaries and non beneficiaries

The analysis of the factors which affect the market decision of NERAMAC members and non members showed that the members having 25.00 per cent high innovativeness and 60.00 per cent medium level of innovativeness are very significant in affecting market decision of the farmers. It was found that 60.66 per cent of members of NERAMAC having higher achievement motivation 60 per cent medium innovativeness, 48.33 per cent medium level of risk orientation and 48.33 per cent medium economic motivation.It was alsoobserved that the members were having better social participation compared to that of non-members. The cosmopoliteness of members was comparatively higher to that of non members. From the study it was implied that produce procurement costs (comprising communication cost, travel cost, transportation cost and unloading charge together) was found to be lower for members than non-members of NERAMAC. The results showed that the output transaction cost was lower for members compared to that of non-members. The difference in output transaction cost between members and non-members are found to be significant non-member.From the results of Logit analysis it was evident that land holding, monetary profit and market support under fruit crops were the major factors which affect the market decision of farmers with the odds ratio of 3.005, 12.345 and 14.087 respectively. Since these odds ratios are significant,it may be concluded that these factors explain the market decision of farmer.

Constraints in marketing of fruits as perceived by fruit crop growers and NERAMAC

In case of the organizational constraints the respondents ranked lack of co-ordination among the members as a first because there were less communication between the top officials and lower officials and between other agencies or organizations with less number of field functionaries. The result is similar with what Levinthal 2000; Christensen and Raynor, 2003 found in their study. This problem gets support from the disadvantage of geographical barriers of this region. There were less trained staff or skillful field functionaries for effective execution of the work. Lack of trained staff was ranked second. So capacity building on the problem in this case. Similar result described in *IFPRI* research report (2009*)*. The field functionaries get training in case of principle knowledge by the scientists but the training in extension approach was lacking. Lack of proper communication was ranked third because of their complex organizational structure.

The functional constraint like lack of cooperation from ground level organizationas per Garrett's score ranked first position. The finding was similar with AtchutaRaju et.al (2001). Lack of coordination was also a major problem among the organization at ground level. Farmers awareness and less intensity of advisory work was perceived as the next constraint by the farmers in consonance with AtchutaRaju et.al (2001). Less participation of farmers in village work ranked next due to poor communication with progressive farmers approach. Lastly, ground level, lack of government support was affecting the functions.

The beneficiaries of NERAMAC ranked less intensity of advisory services and storage problems the foremost major constraints in the order of importance. According to non-beneficiaries fluctuating market price and finding appropriate market price is ranked as the first and foremost major constraint in the order of importance followed by finding appropriate processing unit /juice factory. Finding proper transportation facilities also perceived as a serious constraint by non-beneficiaries as they lack market intelligence as compared to the beneficiaries of NERAMAC.

Implication and suggestions

It can be concluded that for reaching higher level of effectiveness and to accelerate the growth, the hindrance in the form of constraints which have emerged have to be minimized or removed. To remove organizational constraints the ratio of field level worker and farmer ratio have to be reduced by employing more agricultural graduate in the profession. Training in organizational coordination and work style has to be conducted. As the human resource is most important in an organization, so to increase their efficiency soft skill training has to be conducted. Training on leadership development is also necessary to carryout organizational activity effectively. Emphasis should be given for developing the

coordination with farmers to field staff. It is organization's responsibility to develop and maintain good organizational climate so that the field staff can work though internal motivation rather than to fulfill the target.

For functional effectiveness the most prioritized constraint have to be removed through work with in linkage with other agencies like ATMA for better ground level coordination. If possible the organization can take the policy to reduce the cost of the maintaining the same quality of services. More budgets should be allocated for successful demonstration and field days with farmers so that farmers can be motivated through "seeing is believing" and building confidence by working with the farmers "learning by doing". Since the study area is potential belt for export of fruit produces the major constraints faced by growers need to be addressed in a long term perspective. Appropriate storage and transportation are also severely affects its quality as well as export opportunity. So the efforts should be focused on viable research and policy solutions to the above said problem. There should be improved extension services to farmers through more government Support to NERAMAC. Also, government should support the farmers for improved planting material sand environmental friendly high external inputs for increased yield of fruit crops. The specialized management requirements for fruits cultivation and marketing require not only a high levelof knowledge and experience by the farmers but also a well-informed extension services. Closer collaboration between this services and researchers of universities and research stations is strongly recommended. Growers, whether large or small, need better access to information, specific skill training and more incentive to take responsibility for the quality of fruits they produce. Growers are relatively disempowered in the supply chain and would benefit from belonging to alliances for skills development, as well as through-chain commercial alliances. Improving product quality and reducing losses is the highest priority, requiring a multi-faceted strategy spanning pre-harvest and post harvest practices, training, R&D, and demonstration. The above mentioned situation calls for changes in policies of NERAMAC to enhance support to functionaries and clients in terms of technical knowledge, trained manpower along with support in terms of infrastructural facilities to maintain vigor of the organization.

The NERAMAC need to establish more contacts with the farmers and should approach the farmers through various communication media effectively. This will help the potential non member farmers to participate in membership programme.

Small and marginal farmers were less able to get membership and purchase the inputs from NERAMAC. The effectiveness of NEARMAC can further be increased through reducing the cost of inputs and making partnership with govt. and other agencies.

For functional effectiveness the most prioritized constraint have to be removed through working in linkage with other agencies like KVK, State development departments, NGOs, agricultural research institute and ATMA for better ground level coordination.

The policies of NEARMAC should be enriched to enhance support to functionaries and clients in terms of technical knowledge, trained manpower along with support in terms of infrastructural facilities to maintain the organization. In order to increase efficiency, reduce repetitions and for better utilization of scarce resources convergence and better linkage is the need of the hour.

It is suggested that NERAMAC may explore possibilities of marketing of fresh pineapple in North Indian markets, taking Delhi as a main center. Refrigerated wagon may be attached to Rajdhani Express from Guwahati. Freight for the same will be subsidized by the Govt. of India for the initial years. DEPI may provide some space to have a marketing office at New Delhi.

ANALYSING THE EFFECTIVENESS OF DIFFERENT WOMEN STAKEHOLDER SELECTION PROCEDURES TOWARDS ADOPTION IN COOCHBEHAR DISTRICT OF WEST BENGAL

Victor Sarkar

Uttar Banga Krishi Viswavidyalaya
2014

Upadhyaayan-dasacarya acarryanam satam pita; Sahasram tu pitrnmata gauraveratiricyate
(Manu Samhita ,Chapter II, Para 145)

"A Guru who teaches Veda is 10 times superior to an ordinary teacher and the father is 100 times more than a teacher, but the Mother is 1000 times more superior than the father". A woman is the nucleus of the family, particularly, in rural India. She not only collects water, fuelwood, fodder and food but also plays a significant role in preserving the culture, grooming the children and shaping their destiny. Unfortunately, in spite of their laudable and vulnerable roles, which cannot be substituted by machine or men, women have been neglected since generations. This is happening inspite of a woman being recognized by our ancient saints and culture as not merely a mother but as a superior scholarly Institution. Today women are the worst sufferers in the society due to drudgery, ill health, illiteracy, deprivation and humiliation. Backwardness of women is a sign of poverty and women are the worst sufferers during the period of scarcity and calamity. No wonder, India hosts over one-third of the poor in the world, as lack of empowerment of women is a significant cause of poverty. The changed global scenario arouses the ultimate requirement for fulfilling the need of grown up women empowerment strategy demand. This realization paves the way of appropriate selection of women beneficiaries for women development and empowerment as the traditional beneficiary selection method for any development activity is through panchayat, the local self government. The other appropriate selection procedures for woman beneficiaries may be selection through women self help group where in development can be ensured in a better and reasonable way, selection through women farm and home visit by the extension worker, where in the direct contact, access to extension services can be inculcated, selection through farmer's club, the grass root organisation for women empowerment and agricultural development.

In such a research climate, there is a need to explore the efficiency of different women stakeholder selection process (panchayat, farm and home visit, self help group and farmer club) with respect to adoption of innovation. Keeping all these in view, the present research study has delineated following specific objectives to reach the goal of the study:

1. To study the socio-economic, socio-personal and psychological attributes of the women stakeholders.
2. To identify the different women stakeholder selection procedures.
3. To compare the effectiveness of different women stakeholder selection procedures in case of adopting a new innovation.
4. To assess and compare the correlates of adoption of new innovation within different women stakeholder selection approach.
5. To identify various training needs among the women stakeholders selected through different women stakeholder selection procedures.

Purposive, multi-stage and random sampling procedures are followed in the present study. The district Cooch Behar, block Cooch Behar-II and Takargach-Rajarhat as well as Dhandhinguri Gram Panchayats are purposively selected. Out of the ten villages within the Takargach-Rajarhat Gram Panchayat, three villages viz., Jatrapur, Jibdharer Kuthi and Kaminir Ghat and out of thirteen villages within the Dhandhinguri Gram Panchayat two villages Raserkuthi, Khairatibari are randomly selected for the present study. The women stakeholders were selected with the help of four selection procedures namely through Panchayat, Farm and home visit, Farmers' club and Self Help Group. From the exhaustive list of 104 women trainees in azolla training almost complete enumeration is done for

selection of the respondents for the present study. Only 8 women trainees did not give their responses for the present study. So, the total number of women respondents for the present study is ninety six (96) for final data collection of which 23 women respondents are selected through Panchyat selection procedure and 28 women respondents are selected through Self

Help Group selection procedure from Takargach-Rajarhat Gram panchayat and 24 women respondents are selected through Farm and Home visit selection procedure and 21 women respondents are selected through Farmers' club selection procedure from Dhandhinguri Gram panchayat. In the present study The women stakeholders selection procedures namely through panchayat, self help group, farm and home visit and farmers' club as well as the adoption percentage and other attributes of the women stakeholders are systematically operationalised and measured with the help of the slightly modified pre-constructed scales. In the present study the adoption percentage is considered as the dependent, consequent and predicted variables. The other attributes of women stakeholders are considered as the independent, antecedent and predictor variables. The data are collected with the help of the structured schedule constructed for the study through personal interview method. The important statistical measures that are used to analyze the survey or research data are frequency, percentage, Range, mean, standard deviation, coefficient of variation, coefficient of correlation, multiple regression and t-test.

The result shows that except the variables farm size and expenditure all other variables depict medium to high level of consistency in their distribution for all types of selection processes.

The variable caste is negatively and significantly associated with the adoption percentage and the variables expenditure and knowledge about the technology are positively and significantly associated with the adoption percentage at 5% level of significance in case of the women stakeholders selected through panchayat.

The variable education is positively and significantly associated with the adoption percentage and the variable farm size is negatively and significantly associated with the adoption percentage at 13% level of significance in case of the women stakeholders selected by farm and home visit.

The variable knowledge about the technology is positively and significantly associated with the adoption percentage at 5% level of significance, the variable assessed training need is positively and significantly associated with the adoption percentage at 10% level of significance and variable attitude towards technology adoption is also positively and significantly associated with the adoption percentage at 13% level of significance but the variable education aspiration is negatively and significantly associated with the adoption percentage at 13% level of significance in case of the women stakeholders selected by farmers' club.

The multiple regression analysis of the adoption percentage with sixteen predictor variables of the women stakeholders selected by the panchayat reveals that the variable annual income is negatively and significantly contributing towards characterizing the adoption percentage at 13% level of significance. The R2 value being 0.719, it is to infer that the sixteen predictor variables put together have explained 71.90% variation embedded with the predicted variable adoption percentage. Still 29.10% variations embedded with predicted one are unexplained. Thus it would be suggested that inclusion of some more contextual variables possessing direct bearing on the adoption percentage could have increased the level of explicability.

The multiple regression analysis of the predicted variable i.e. adoption percentage with sixteen predictor variables of the women stakeholders selected by the farm and home visit depicts that the variable education is positively and significantly contributing towards characterizing the adoption percentage at 10% level of significance. The R2 value being 0.663, it is to infer that the sixteen predictor variables put together have explained 66.30% variation embedded with the predicted variable adoption percentage. Still 34.70% variations embedded with predicted one are unexplained. Thus it would be suggested that inclusion of some more contextual variables possessing direct bearing on the adoption percentage could have increased the level of explicability.

The multiple regression analysis of the predicted variable i.e. adoption percentage with sixteen predictor variables of the women stakeholders selected by the self help group explores that the variable

knowledge about the technology is positively and significantly contributing towards characterizing the adoption percentage at 1% level of significance and the variable family size is negatively and significantly contributing towards characterizing the adoption percentage at 13% level of significance. The R2 value being 0.564, it is to infer that the sixteen predictor variables put together have explained 56.40% variation embedded with the predicted variable adoption percentage. Still 44.60% variations embedded with predicted one are unexplained. Thus it would be suggested that inclusion of some more contextual variables possessing direct bearing on the decision making ability could have increased the level of explicability.

The multiple regression analysis of the predicted variable i.e. adoption percentage with sixteen predictor variables of the women stakeholders selected by the farmers' club reflects that the variable educational aspiration is negatively and significantly contributing towards characterizing the adoption percentage at 13% level of significance. The R2 value being 0.802, it is to infer that the sixteen predictor variables put together have explained 80.20% variation embedded with the predicted variable, adoption percentage. Still 20.80% variations embedded with predicted one are unexplained. Thus it would be suggested that inclusion of some more contextual variables possessing direct bearing on the adoption percentage could have increased the level of explicability.

From the mean difference analysis through t-test the mean differences are observed among the women stakeholders selected by the panchayat, the farm and home visit, self help group and farmers' club with respect to the women stakeholders' attributes namely age, education, caste, occupation, family size, farm size, annual income, house type, animal size, risk orientation, attitude towards technology adoption, assessed training need and adoption percentage.

It is also found that the women stakeholders selected through the self help group is much more effective than other selection procedures through farmers' club and farm and home visit in case of adopting an innovation. The selection of women stakeholders through panchayat is not a very sound procedure for making the women stakeholder effective in case of adopting an innovation.

In search of the training need of the women stakeholders, the most of the women stakeholders are very fond of undergoing training on scientific orchard management followed by the training need on floriculture, improved poultry and duckery breed rearing, cattle feed rearing, tailoring and pisciculture.

ANNEXURE

ANNEXURE

ABOUT COOCH BEHAR ASSOCIATION FOR CULTIVATION OF AGRICULTURAL SCIENCES (COBACAS)

COBACAS was registered on 1st February, 2013 under the West Bengal Society Registration Act, 1961 with a mission to promote, disseminate and mutual exchange of scientific information of Agricultural Science among the scientific diaspora and stakeholders. The members of the Association already organized a National Conference in 2014 and publish **'Journal of Agriculture and Technology'** biannually since its inception March, 2014.

Membership of the Society

The Governing Body may admit membership to any person of any caste, creed or sex who has attained the age of 18 years, posses Master Degree in Science and agreed in writing to be bound by the Memorandum of association and regulations of the Society and who in the opinion of the Governing Body will be interested in advancement of the objects of the Society.

Types of Members:

a) ***Honorary member:*** Any person whose connection with the society is deemed to be useful may with the consent of such person be elected as honorary member of the society. Such members shall not, however, be eligible to the member of the Governing Body nor shall be entitled to vote in any meeting.

b) ***Ordinary member*****:** Any person, qualified to be a member and paying prescribed ordinary membership fee may be admitted as ordinary members of the society.

c) ***Life Member*****:** Any person of the any caste, creed or sex who has attained the age of 18 years, posses Master Degree and agreed in writing to be bound by the Memorandum of Association and Regulations of the Society and paying prescribed ordinary membership fee may be admitted as Life Member of the Society.

d) ***Farmers' Life Member*****:** Any person of the any caste, creed or sex who has attained the age of 18 years, passed Higher Secondary and agreed in writing to be bound by the Memorandum of Association and Regulations of the Society and paying prescribed ordinary membership fee may be admitted as Life Member of the Society.

(Membership form attached at the end)

JOURNAL OF AGRICULTURE AND TECHNOLOGY

Journal of Agriculture and Technology **(JAT)** is a biannual double blind peer reviewed print and on line journal published by the Cooch Behar Association for Cultivation of Agricultural Sciences in English.

Aims and scope: This journal publishes the new results of completed, original studies on any aspect of agriculture and other related fields. We also accept descriptions of original methods and instruments opening novel possibilities for obtaining and analyzing experimental results. Papers outlining trends and hypotheses are accepted as well. Review articles, chronicles of congresses and conferences, and book reviews are published at the invitation of the Editorial Board as a rule.

Manuscript submission implies that the material has not been published before and is not under consideration for publication anywhere else.

Instructions for Contributors

Manuscript requirements: Manuscript length should not exceed 06 printed pages, including references, tables, and figures. The manuscript must be typed (Arial font, 12 pt, double-spacing throughout) in a single column on one side of white paper (A4, 210 × 297 mm) with left and top margins of 2.5 cm and a right margin of 1.5 cm and printed using a high-quality printer. All pages should be numbered consecutively. The soft copy along with at least two names of probable reviewer may be sent to Editor, Journal of Agriculture and Technology, Department of

Genetics and Plant Breeding, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar 736 165, West Bengal, INDIA or may be sent as e-mail attachment to editorjat2014@gmail.com

Please arrange your manuscript as follows:

Title: Title must be concise but informative. Capitalize the first letters in all nouns, pronouns, adjectives, verbs, adverbs, and subordinate conjunctions. Provide names of all authors and their postal addresses and telephone and fax numbers, as well as e-mail addresses, and indicate the corresponding author by '*'. Author affiliations include the department, institution, and complete address of each author.

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Key words: Not more than 05

Text: Research papers include three parts- **INTRODUCTION, MATERIALS AND METHODS, RESULTS AND DISCUSSION**. Sub-titles may be included as per the requirement of the article. Describe procedures in sufficient detail so that the work can be repeated. Review articles and short communications may be organized according to their specific requirements.

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Journal

Roy B, Mandal AB. 2005. Toward development of Al-toxicity tolerant lines in indica rice by exploiting somaclonal variation. Euphytica. 145(3): 221-227.

Roy B, Mandal AB. 2005. Anther culture in *indica* rice and variation in major agronomic characters in androclones of Karnal local. African J Biotechnol. 4(3): 235-240.

Books

Roy B. 2010. Synthetic Seed- A challenging technology for plant propagation, transportation and conservation. LAP Lambert Academic Publishing AG & Co. KG, Theodor-Heuss-Ring 26, 50668 Köln, Germany. pp. 1-230.

Articles or chapters in books

Roy B. Sarkar B. 2013. Achievement and let down in hybrid wheat. In: Breeding Biotechnology and Seed Production of Field Crops, Roy B, Basu AK, Mandal AB (eds). New India Publishing Agency, New Delhi, pp. 241-262.

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MEMBERSHIP FORM

Cooch Behar Association for Cultivation of Agricultural Sciences (COBACAS)

Name in block letter :

Designation/Position :

Affiliation :

Academic qualification :

Field of specialization :

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I/we hereby declare that the above statements are correct in all respects to the best of my knowledge and I abide the rules and regulations of the COBACAS. I am willing to take the membership of COBACAS in the following category (put √ mark).

Life Member/Annual Member/Farmer Member/Honorary Member

_____

Signature of the Application with date

Membership of COBACAS is open to all individuals/Institutions/Corporate interested in any aspects of agriculture and allied fields subjected to possession of required qualification as per the Memorandum of COBACAS. Members are entitled to voting privileges and receipts of publications of the COBACAS.

The membership fees are being given below. fees can be sent to the Organizing Secretary as per dates given either through Demand Draft of any national bank drawn in favour of the Cooch Behar Association for Cultivation of Agricultural Sciences, payable at Cooch Behar or may be directly transfer to the account No. 33026323337, SBI, R.R.N. Road, Cooch Behar IFS Code: SBIN0015950 (Prefix: 0523700006) and send the electronic receipt copy along with the registration form.

i) Life Member : Rs. 3000.00
ii) Annual/Ordinary Member : Rs. 500.00
iii) Farmer Life Member : Rs. 1000.00

Send the form to:

Secretary

Cooch Behar Association for Cultivation of Agricultural Sciences (COBACAS)

Department of Genetics and Plant Breeding, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar 736 165, West Bengal, INDIA or **mail to** cobacas2013@gmail.com