National Symposium
Climate Change, Plant Protection and Food Security Interface

17-19, December, 2009

Collaborator: **West Bengal Pollution Control Board**

ABSTRACT

Editors :

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Shantanu Jha
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Organised by

Association for Advancement in Plant Protection
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From the Editor's Desk:

The overwhelming response of the plant protection fraternity in the first National Symposium organized by us in 2007 on '*Plant Protection-Technology Interface'* encouraged us to go for another similar interactive platform – '***Climate Change, Crop Protection and Food Security Interface'.***

The issue that is shaking the World today is climate change or global warming that is impacted with all life forms on earth. As the Symposium goes on, the Copenhagen Summit on Climate Change will be taking major decisions regarding GHG emissions.

Given that predicted climate change will lead to a pole ward migration of crops, the cropping profile in any given geographical region is likely to change. Pest profile on such crops also most certainly will change, bringing in new challenges for their protection. On the otherhand, environmental concerns are at loggerheads with the present day over emphasis on the use of pesticides in agricultural pest management. The alternative of organic agriculture is being pushed aggressively to counter the use of pesticides and high dosage of fertilizers. Already the global food security is in doldrums. Will such organic culture on a large scale lead to sufficient produce output to meet the challenges of global food security? Even though food security issues are largely impacted with many social and economic issues other than productivity, the minimal productivity needs to be assured for a population burgeoning as a function of time. How do we go about it?

Since there is a significant amount of crop losses resulting from pest onslaught that are likely to be aggravated by a shift in regional biodiversity resulting from climate change, obviously plant protection strategies need to be revised to meet the new challenges posed by both climate change and food security issues.

The Symposium, divided into seven technical sessions and a plenary, will deliberate on various aspects related to plant protection that may need revised attention given its interface with the looming climate change and food security issues. The serendipitous availability of Scientists of the APN group (Asia-Pacific Network) along with a team of scientists from neighbouring Bangladesh for participation in this Symposium will most certainly enrich and enliven the deliberations.

We received a large number of papers – many of them befitting oral presentation – but only marginally related to the main theme of the Symposium. Many of them have been placed under the poster session. Nevertheless, these papers are important as they throw light on ways and means of pest management strategies. These are divided into two broad groups. Each poster will be rated and the best ones will be suitably provided with special citation at the end of the Plenary Session.

Compiling the huge number of Abstracts received till as late as December 10, 2009 was a daunting task given the mosaic of formatting styles in which they were forwarded. Any errors of omission or commission are ours. The printing and the production of the 'Book of Abstracts' is made largely possible through funds provided by NABARD which we thankfully acknowledge.

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Programme Summary(Technical)

Inaugural Session

Theme Lectures :

TL - 1 : Dr. R.N. Basu , Chairman, State Agriculture Commission
Ecologically sustainable holistic agriculture for food security of the nation

TL - 2 : Mr. Debal Ray, Chief Environment Officer, GoWB
Climate Change in 2050

Technical Session A : Relevance of plant protection in global food security (12.00 noon- 1.30p.m.)

Chairman : Shri P.K. Mazumdar
Co-Chairman : Dr. Satyabrata Maiti
Rappoteurs : Shri Prabir K. Ghosh, Dr. S.K. Mondal

LS-1 Satyabrata Maity, DMAPR,
Opportunities in plant protection for achieving global food security

LS-2 Pradip K Mazumdar, Chairman Crop Life India
Agrochemicals and Food Security

LS-3 B. S. Mahapatra, Director,CRIJAF(ICAR), Barrackpore, Kolkata
Organic farming perspectives

IL-1 A.K. Dikshit and Irani Mukherjee, IARI,ND
Pesticide: a global link in food chain, food security and residue management

Technical Session B : Biotechnological support for plant protection & food security (2.30 -5.30p.m.)

Chairman : Dr. Arun K. Chatterjee
Co-Chairman : Dr. Anil Sirohi
Rappoteurs : Dr. Sampa Das
Dr. Somnath Bhattacharyara

LS-1 Arun K. Chatterjee et.al, University of Missouri- 65211,U.S.A
Quenching of quorum sensing signal in the management of bacterial soft-rotting disease

LS-2 **Anil Sirohi and A.K.Ganguly,** IARI, New Delhi
RNAi: a promising technology for plant parasitic nematode management

IL-1 **Sumanti Gupta, Dipankar Chakraborti and Sampa Das,** Bose Institute
Study on interaction between Fusarium oxysporum f. sp. ciceris and chickpea a model to develop understanding of plant defense response reaction

IL-2 **Somnath Bhattacharyya et al.** Crop Research Unit, BCKV
Identification of molecular markers links with the bruchid (C*allosobruchus chinensis*) resistance from a wild progenitor of greengram(*Vigna radiate* var.Sublobata) collected from India

IL-3 **D. K. Chakrabarti et al.,**NDUA&T, Faizabad
Initial response of *Mangifera indica* to the infection of *Fusarium mangifera* in malformation disease

OP-1 **K.K.Biswas et. al** IARI, New Delhi
Spatial distribution, genetic diversity, genome organization, genetic recombination and transformation of citrus plant with CP gene of citrus tristeza virus in India

OP-2 **Amrita Banerjee et. al.** BCKV
Development of high yielding tungro resistant rice lines by transferring a transgene, conditioning resistance through RNAi

OP-3 **Subhadipa Sen Gupta and Sampa Das,**Bose Institute
Development of marker - free insect resistant transgenic rice plant type: A clean gene approach

Concurrent Poster Session I :Plant pest management using
(12.30 - 2.30 P.M.) pesticides or related products

Judges for evaluation : Prof. M.R. Ghosh, BCKV
Prof. N. Mukherjee,BCKV
Prof. A. Reghupathy, TNAU

PP-1 **Parveen Noor,**
Morphological changes of different castes of the subterranean termites (*Odontotermes proformosanus* Ahmad) in fungus combs of termitophiles

PP-2 **Manoj Kanti Debnath et al,**
A study of population dynamics of mango hopper, *Amritodus atkinsoni* Leth. at Jabalpur, Madhya Pradesh

PP-3 **A. Samanta and V.W. Dhote**
Effectiveness of different spray treatments against hopper and on yield of mango cv. Himasagar

PP-4 Kaushik Chakraborty and Debesh Chandra Deb,
Determination of ETL of yellow stem borer (*Scirpophaga incertulus*) by egg mass estimation in relation to seasonal variations

PP-5 M. Patnaik et al.
Field efficacy of some insecticides for management of whitefly infesting mulberry, *Morus alba* L.

PP-6 M. D. Maji et al.
Development of forecasting model of bacterial leaf spot disease of mulberry for Birbhum district of W.B.

PP-7 S. K. Dutta et al.
Rot disease of muga host plant, som (*Persea bonbycina*, King ex Hook. f., Kost) and its management

PP-8 S.K.Mukhopadhyay et al.
Weather based forewarning of root mealybug, *Paraputo sp.* (Pseudococcidae: Hemiptera) in Mulberry of Kalimpong hills

PP-9 Malay K. Bhowmick et al.
Integrated weed management in lentil (*Lens culinaris* Medikus)

PP-10 P.K. Ghosh and A. Chatterjee,
An intensive investigation on the effect of Pests on cotton plant (*Gossypium* sp.) and its control measures

PP-11 M.K.Bag et al.
Evaluation of fungitoxic effect of some commercially available agro chemicals against grain discoloration (GD) disease of rice in West Bengal

PP-12 Amalendu Ghosh et al.
Field evaluation of some new insecticides against brown plant hopper *Nelaparvata lugens* (Stal.) in rice

PP-13Babul Chandra Sarkar and M.A. Rahim,
Effect of paclobutrazol and management practices on extension of harvesting time, yield and quality of mango

PP-14 S.M. Qumruzzaman et al.
Incidence of nut weevil in *Zizyphus mauritiana* cv. Thaikul

PP-15 S.B. Das and O.P. Veda,
Prediction model for the occurrence of *Helicoverpa armigera* Hub. on medium maturing pigeonpea

.

PP-16 Manoj Debnath et al.
Analysis of variance for preference of different mango varieties by hopper, *Amritodus atkinsoni* Leth.at Jabalpur Madhya Pradesh

PP-17Srabani Debnath et al.
Field efficacy of fungicides against purple blotch (*Alternaria porii*) of onion

PP-18 N. Jonson Singh et al.
Occurrence of aphids in different traps on potato in Gangetic plains of West Bengal

PP-19 Niraj Sriwastaw et al.
Evaluation of different insecticidal treatments on rice yellow stem borer (*Scirpophaga incertulus* Walker) during boro season

PP-20 S.Kundu. et al.
Assessment of pest incidence of various rice cultivars under different tillage practices

PP-21 D.Mondal et al.
Efficacy of different spray schedules to control the late blight disease of potato

PP-22 Arunabha Chakraborty and Sudarshan Chakraborti,
Relative toxicity of some newer molecules against Rice moth [*Corcyra cephalonica* (St.)] under laboratory condition

PP-23 A.K. Senapati et al.
Bioefficacy of some new and novel insecticides against chilli fruit borer (*Spodoptera litura* H)

PP-24 K. C. Hembrom et al.
Field screening of gladiolus germplasms for resistance to *Pseudomonas gladioli* pv.*gladioli* causing bacterial wilt under New Alluvial Zone of West Bengal and its management

PP-25 S. Hembram et.al.
Interaction of bacterial pathogens of betelvine with *Phoma piperis -betle*

PP-26 Palash Mondal et al.
Efficacy of some chemical and bio pesticides against major insect pests of potato in West Bengal

PP-27 Manoj Kanti Debnath et al.
Some probability distribution for the study of mango hopper, *Amritodus atkinsoni* at Jabalpur, M.P.

PP-28S. K. Mukhopadhyay et al.
Relative susceptibility of two high yielding mulberry (*Morus alba* L.) cultivars to whitefly and thrips

PP-29 Manoj Kumar and J. Tarafdar
Complete nucleotide sequence of DNA segment A of sweet potato leaf curl virus isolate from West Bengal (SPLCV-BCKV) and its relationship with allied members of the begomoviruses

PP-30 Sinam Subharani Sunil S. Thorat et.al.
A database on parasitoid of insect pests of Manipur (North East India)

PP-31 D. Mondal et al.
Synoptic weather normality information for farmers' crop planning and decision making

PP-32B. K. Das
Incidence of *Alurocanthus* spp. (Aleyrodidae : Hemiptera) on betelvine (*Piper betel* L.) and their interaction with host plants

PP-33 Sushilkumar Landge et al.
Study on bioefficacy of newer chemicals against pigeonpea pod pest complex under late sown conditions

PP-34 M. A. Rahim et al.
Tropical and subtropical fruits in Bangladesh in areas of nutrition food security, economy, women participation, and poverty reduction

PP-35 M. A. Rahim et al.
Fruit tree improvement program (FTIP) a one stop service for fruit development, production, extension, food security and research

PP-36 M. G. Mustafa. et al.
Food security in Bangladesh: evaluation of cassava (*Manihot esculenta*) morphotypes based on hydrogen cyanide acid toxicity and protein content of tuber

Session C : Ecology and biological management of plant pests

Chairman : Dr, B. Ramanujam
Co-Chairman : Dr. (Mrs) Pratibha Sharma
Rappoteurs : Prof. S.K. Pan,
Prof. S.Das

LS-1 C. Chinnusamy et. al., DWSRC,TNAU
Tillage and weed management on weed population dynamics and weed control efficiency in different cropping system

LS-2 S.J. Rahaman, ANGARU
Changing role of biological control in IPM under present agricultural scenario

IL-1 Sudarshan Ganguly, IARI,ND
Biosystematics and biocontrol potential of Entomopathogenic nematodes for managing insect pests

IL-2 Pratibha Sharma, IARI,ND
Ecological behaviour of biocontrol agents against major soil borne and foliar pathogens

IL-3 B. Ramanujam et.al., NBAII(PDBC),Bangalore
Mass production, formulation, quality control and delivery of fungal antagonists for plant disease management

OP-1 Sitansu Pan and Amrita Das, BCKV, Kalyani
Evaluation of shelf life of some value added bio formulation of *Trichoderma harzianum*

Session D: Impact of key climate change parameters on pest scenario

Chairman: Dr. J.E. Luck
Co-Chairman: Prof. S.A.Khan
Rappoteurs: Dr. C. Chattopadhyay, Dr. Saon Banerjee

LS-1 Kep Coughlan, University of Western Sydney, Australia
Climate change and climate risk management- and Australian perspective

LS-2 J.E. Luck et al. Biosciences Research Division, Department of Primary Industries
An integrative approach to understanding the pest and disease threats to agricultural biosecurity under future climates

IL-1 Swadesh Mishra, Ex- Agri Meteorologist, W.B.
Climate change – a West Bengal scenario

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IL-2 Chirantan Chattopadhyaya and AKS,Huda, IIPR(ICAR), Kanpur
Changing climate forcing alteration in cropping pattern to trigger new disease scenario in oilseeds and pulses in Indian sub-continent

IL-3 A.Regupathy and R. Ayyasamy,Science Advisor, BRDC
Impact on climate change on insect pests and management options

OP-1 A. Mukherjee et al. University of Florida
Current and future climatic distribution of the invasive aquatic weed *Hygrophila polysperma* T. Anders

Session E: Pest Diagnostics

Chairman: **Prof. Salil K. Gupta**
Co-Chairman: Dr. (Mrs) V. G. Malathi
Rappoteurs: Dr.A.K.Das
Dr. S.Chakraborty

LS-1 Salil K. Gupta, DST USERS Project,Kolkata
Diversity and diagnosis of agricultural mites with their importance either as pests or as predators

LS-2 V. G Malathi, IARI, New Delhi
Diversity of Begomoviruses : a challenge to crop cultivation in India

IL-1 A.K. Das, NRCC, Nagpur
Recent developments in diagnosis of *Candidatus liberibacter asiaticus*, the bacterium causing citrus greening(Haunglongbing) disease

IL-2 S. Chakraborty et.al., JNU, New Delhi
Recent advances in geminivirus detection

OP-1 T. Kumar et. al., National Botanical Institute, Lucknow
Pathogenicity determination of a single complementary sense transcript of satellite DNA-ß associated with cotton leaf curl virus

OP-2 Matiyar Rahaman Khan et al., BCKV
Identification of *Meloidogyne* species infecting crops in West Bengal

Concurrent Poster Session I :Integrated pest management in modern agri-horticultural production system
(12.30 - 2.30 P.M.)
Jusges for evaluation : Prof. M.R. Ghosh, BCKV
Prof. N. Mukherjee, BCKV
Prof. A.K.S. Huda, Australia

PP-37 A. K. Chaubey and Satyendra Kumar,
Bio-management of root knot nematode and root rot disease by antagonistic fungi and rhizobacteria

PP-38 Y. V. Ingle and S.S. Mane
Performance of some carrier' formulations of *Nomuraea rileyi* against *Helicoverpa armigera*

PP-39 Y. V. Ingle, et al.
Evaluation of formulations of Nomuraea rileyi against *Helicoverpa armigera*

PP-40 R.W. Ingle et al.
Efficacy of plant growth promoting rhizobacteria against soil pathogen in cotton

PP-41 R .W. Ingle, et al.
Effect of agrochemicals on PGPR in cotton

PP-42 B. Adhikari et al.
Effect of arsenate on growth and yield attributing traits of rice in simulated condition

PP-43 J. Jayakumar
Effect of *Streptomyces avermitilis* as a boipesticides for the management of root knot nematode, *Meloidogyne incognita* in bhendi

PP-44 M .R. Khan and Sekhar Ghosh
Bioefficacy of pesticides against *Aphelenchoides besseyi* and sensitivity of tuberose bulbs to hot-water treatment

PP-45 Archana U Sing and Vijendra Singh
Effect of seed soaking of different doses of agroneem,carbofuran and neem cake against *Meloidogyne incognita* on okra crop cv. A4 hybrid

PP-46 Archana U Sing and Vijendra Singh
Effect of seed soaking of ozoneem trisul, agroneem, *Aspergillus terreus* , phorate and neem cake(soil application) against *Meloidogyne incognita* on pea crop

PP-47 Md Kamrul Hasan
Antifungal compound in mango sap provide natural protection to anthracnose disease in mango

PP-48 K. Karmakar
Utilization of Predatory mite, *Amblyseius longispinosus* Evans (Acari: Phytoseiidae) for management of spider mite, *Tetranychus urticae* Koch in pointed gourd ecosystem

PP-49 Honnur Basha et al.
Screening of chilli microflora and other biocontrol agents for their antagonistic effect of *Colletotrichum* sp. Infecting chillies

PP-50 Khandker Neshar Ahmed
Sudden outbreak of mealybug and armoured scale causing severe damage to economic crops in Bangladesh

PP-51 L. Saravanan and Vipin Chaudhary
Seasonal activity of spotted beetle, *Epilachna vigintioctopunctata* infesting ashwagandha (*Withania somnifera*) and it relation to weather factors

PP-52 T. Boopathi et al.
Seasonal incidence of major insect pests in okra under subtropical conditions

PP-53 M. Setua et al.
Comparative effect of some plant growth regulators on growth and quality leaf yield of mulberry (*Morus alba* L.)under low temperature stress during winter

PP-54 T. Sengupta et al.
Studies on the improved mulberry genotypes suitable for eastern and north eastern region of India

PP-55 Neerja Agrawal et al.
Survey and monitoring of pests, parasites and predators on pulses in central and eastern Uttar Pradesh

PP-56 Mujeebur Rahman Khan
Response of plants to pathogens under elevated levels of carbon dioxide

PP-57 T. Boopathi et al.
Seasonal incidence of major insect pests and their succession in broccoli under subtropical conditions

PP-58 O. P. Veda et al.
Studies on susceptibility of Indo-African pigeonpea derivatives of medium maturing pigeonpea against pod borer complex

PP-59 Sushilkumar Landge et al.
Screening of pigeonpea genotypes against pod pest complex under late sown condition

PP-60 Yogesh Patel and S. B. Das
Influence of weather factors on the population of *Coccinella septumpunctata* L. in cotton

PP-61 Amitava Konar et. al.
Impact of different dates of planting on the incidence pattern of important insect pests of potato in West Bengal

PP-62 Sahidur Rahman and Matiyar Rahaman Khan
Incidence of pests in jute (*Corchorus olitorius* L.) ecosystem and pest weather relationships in West Bengal India

PP-63 Bappaditya Chandra and Matiyar Rahaman Khan,
Dynamics of plant parasitic nematodes in vegetable based crop sequences in West Bengal, India

PP-64 M. K. Biswas
Natural incidence of *Alternaria* leaf blight of mustard caused by *Alternaria brassicae* in the lateritic zone of West Bengal

PP-65 M.K.Pandit et al.
Influence of sowing dates on flowering pattern and melon fruit fly infestation in snap melon (*Cucumis melo* var*. momordica*) genotypes

PP-66 Sanjib Bauri et al.
Use of various geotextile as soil conditioner to increase ground nut crop productivity under inceptisol soils in West Bengal

PP-67 Elvera Momin et al.
Studies on target spot of *Rauvolfia serpentine* caused by *Corynespora cassicola*

PP-68 D. P. Singh et al.
Multiple disease resistance in wheat and triticales and utilization of sources of resistance over past decade in India

PP-69 Sunita Mahapatra et al.
Effects of different levels of nitrogen under different fertility gradient soil on foliar disease severity of potato and yield were determined on field condition

PP-70 T.Murali Krishna et al.
Influence of weather parameters on pheromone trap catches of *Spodoptera litura* in groundnut ecosystem

PP-71 Ranjan Nath and Alok Kumar Mathato
Evaluation of phyto-extracts against *Rhizoctonia solani* Kuhn. inciting sheath blight of rice

PP-72 Md. S. Rahman et al.
Allamanda compounds are fungicidal to some important plant pathogens

PP-73 A.Somorjit Singh et al.
Effect of nutrition on the incidence of leaf curl virus disease of tomato (*Lycopersicon esculentum* Mill.)under field condition

PP-74Diptanjan Ghosh et al.
Downy mildew disease risk of cucurbits by using weather and biological data

PP-75S. A. Khan and S. Jha
Effect of dates of sowing and moisture regimes on incidences of aphid (*Lipaphis erysimi* (Kalt.) in rape and mustard

PP-76 S.P.Bhattacharyya et al.
Effect of Ramederma plus on growth of yield of chilli

PP-77 S. Satpathy et al.
Mealy bug infestation in jJute and Mesta crop- A case study

PP-78 B. N. Panja et al.
Fungicide tolerance of rice sheath blight pathogen, *Rhizoctonia solani* Kuhn, and its management

PP-79 Pranab Barma et al.
Population dynamics and varietal preference of mango fruit borer *Autocharis albizonalis* Hampson in New Alluvial Zone

PP-80 S. Dutta et al.
First report of a leaf blight disease of cabbage caused by *Colletotrichum capsici* in Eastern India

PP-81 N.Surmina Devi et al.
Effect of dates of sowing and inorganic nutrients on leaf blight severity on wheat caused by *Alternaria triticina* under field condition

PP-82 Ananya Nath et al.
Laboratory evaluation of some new chemicals against tobacco caterpillar (*Spodoptera litura* Fab.)

PP-83 A.K. Pandey et al.
Effect of climatic change on plant diseases

PP-84 S. K. Acharya et al.
The hunger, poverty and silence: The synergy of danger and destruction

PP - 85: K.K. Biswas et al.
Begomo, tospo and leaf crinkle disease complex in mungbean(*Phaseolus aureous* Roxb.): A threat of grain productivity in India

Session F: Integreted pest management in modern agri-horticultural production system

Chairman: Prof. M. Bahadur Meah
Co-Chairman: Roberlt Spooner-Hart
Rappoteur: Dr. D.P. Singh

LS-1 M. Bahdur Meah, BAU, Bangladesh
IPM for organic agriculture in Bangladesh

LS-2 Robert Spooner-Hart , University of Western Sydney
Integrated pest and disease management (IPDM)-based horticultural food production in Australia and possible impacts of climate change

OP-1 D. P. Singh et. al.,DWR, Karnal
Status of leaf blight of wheat caused (*Alternaria triticina*)over past one decade in India

OP-2 M. A. Rahim et. al., BAU, Bangladesh
Integrated crop management for controlling fruits pest and diseases

OP-3 A.K. Bhattacherjee and B.K. Pandey, CISH (ICAR), Lucknow
Dissipation of carbendazim in mango (cv.chausa) after pre and post harvesting treatments

Session G: IT interface with climate change and plant protection

Chairman: Prof. D.K. Bagchi
Co-Chairman: Dr. P. Krishna Reddy
Rappoteur: Dr. Saon Bannerjee

LS-1 P. Krishna Reddy et. al., IIIT, Hyderabad
Development of eSagu system: experiences and future plan

LS-2 S. K. Paradhan and Anupam Deb, IFMED,Kolkata
Application of information and communication technology in IPM

Session Planery:

Chairman: Dr. Satyabrata Maity
Co-Chairman: Dr. Avedesh Narain
Rappoteurs: Dr. Subrata Dutta, Dr.K.K.Biswas

Presidential Address:

Agricultural Sustainability: Issues related to Agro-Ecology and Socio-Economic Indicators

Dipak Kumar Bagchi, President, AAPP & Former Vice-Chancellor, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India, **E-mail**: dk_bagchi@yahoo.com

Present International and National scenario suggest that agricultural sustainability is facing challenges both in respect to food security and ecological vulnerability All over the world record food prices have been noted during 2007 and 2008 although production does not seem to be so dismally low. This brings out the issues of sustainability covering both agro-ecological and socio-economic indicators. First of the eight Millennium Development Goals (MDG) by the International Community to halve the number of hungry people by 2015 is destined to be upset as presently hungry world, showing no signs of reduction, is having about one billion people. Our national intense effort to boost up production through green revolution (GR) and chemical farming could not keep pace with population growth since mid- nineties due to decelerated/stagnated crop yield Also technologies, it seems, failed to combat degradation in natural and bio-resources .Again in spite of Kyoto Protocol(1997) and IPCC Report (2006) as also currently held Copenhagen Conference the planet is passing through the worst environmental crisis caused presumably by greenhouse gas emissions reflected mainly by global warming and frequently occurring drought/flood /typhoons/natural disasters etc. Since initiation of scientific recording of meteorological data in 1850 the first decade of 21st. Century have been noted to be the warmest one .Trials have already confirmed that rise of 1ÚÙ C. above normal would reduce wheat yield by about 4-5 quintals per hectare while national loss thus estimated will be 7 million tonnes output reduction. Another example may be cited about indifferent rainfall pattern noted for the last few years in different regions resulting into drastic yield reduction effects on rainfed crops. This year, India receiving 22% less kharif rain is estimated to yield 15 million tonnes less paddy compared to last year. All these added together are the prime factors of present crisis as reflected through non accessibility and non affordability of food and nutrition affecting quality of life of poor people. Besides skyrocketing prices of production components with uncertainty of assured yield have made agriculture mostly non remunerative and recent NSS data have shown that 40% of Indian farmers, on the probability of getting alternate livelihood option, will leave this profession.

The central thematic issue thus indicating sustainability should address agronomical productivity, ecological harmony, social acceptability and economic stability. Plant protection being the key factor in agricultural productivity sustainable policies of research and development on agriculture, while outlining the roadmap in this sector should emphasize “Business as usual is not an option”. Parliamentary Committee report’s estimation about 5 years ago pointed out an annual loss of nearly Rs 90,000 through disease and pest infestation. Stress on chemical use to get rid of this problem could not bring relief. Instead hazards of chemical use could be felt though ill effects on soil health, biodiversity and serious human health and environmental problems.. On the pretext of maximum reduction/abolition of chemical pesticides genetically modified organism (GMOs) particularly Bt (toxic gene) food crops are at the doorstep of commercial cultivation. Being hailed as the answer to anti-nature pesticides as also cost reduction technologies, proponents of GMOs/Bt technologies are forcefully arguing in its favour while overwhelming opposition, equipped with studies/findings is also seen questioning

long term sustainability, biodiversity , health, biosafety and ethical issues. Undue haste to introduce, particularly Bt food crops by specially the business corporates and multinationals will certainly raise eye-brows where best way to resolve is further research to satisfactorily establish the merits and demerits of this technology before granting permission for commercial cultivation.

With the objective of achieving sustainability, UN sponsored Johannesburg meeting held in2002 and attended by all the national governments, FAO, World Bank, Business houses, NGOs and others decided to outline roadmap for future world agriculture. Follow up work involving 400 scientists, after a thorough studies over 3-4 years submitted the report entitled "International Assessment of Agricultural Science and Technology for Development"(IAASTD)in 2008.The report through assessment of present status outlined the future planning and strategies on the basis of all the important factors influencing agriculture while giving special attention to improve the livelihood of small and marginal farmers. Interestingly most of the countries including India were signatories in its favour (2500pagesreport) whereas the multinationals and 3 important nations like Australia, Canada and U.S having disagreement opted out after submitting dissent notes.The report can be accessed through www:agassessment.org. The Central message of IAASTD has focused that food production is an activity with a wide range of impacts, some of which are potentially damaging to the environment. Equally important is the report's demand for substantially more public investment in agricultural research. It has observed that interested donors have tended to reduce emphasis in this area after arguing that the task of meeting demand for food can be safely left to the private sector. The price of this policy is being felt in rapidly rising food prices. It has correctly assessed that modern agriculture, caught between more and affordable food on one hand and meeting the demands in a way that is environmentally sustainable and socially equitable on the other. This report needs wide circulation and intense debates are utmost necessary, specially in the developing countries for outlining planning and strategies having strong productivity components with perfect ecological niches. On plant protection components examples may be cited of Integrated Pest Management (IPM) thought to be rather unsuccessful as mostly chemicals could not be reduced while sustainable management technologies were largely ignored indicating weakness in our participatory development approaches. It is heartening to note that few states specially Andhra Pradesh has made significant progress in non pesticide management, a significant step forward. To summarize, future approaches need to include low cost, eco-friendly, resource conserving and participatory technologies in crop production, protection, processing distribution and marketing

I would like to conclude by quoting a part of the lecture of UN President at the GENERAL Assembly on 25 September, 2009 "The essential purpose of food which is to nourish people has been subordinated to the economics of handful of multinational companies that monopolize all aspects of food production from seed to all major components to nearly all distributing chains and they have been the prime beneficiaries of world crisis". Research conducted by UNEP suggested that organic scale farming can deliver the increased, thought to the preserve of Industrial farming, without environmental damage I am confident that through intense debates and discussion on papers covering appropriate themes in this national symposium will be able to meaningfully contribute in matters of food security and environmental sustainability while emphasizing eco-friendly crop production and protection technologies.

Inaugural Session

Theme Lectures:

- **Prof. R.N. Basu**
- **Sri Debal Ray**

TL - 1 : Ecologically sustainable holistic agriculture for food security of the nation

R.N. Basu, Chairman, State Agriculture Commission, Government of West Bengal.

The plateauing of agricultural production and even significant decline in productivity in many situations have raised serious concerns regarding food security in the country greatly aggravated in the recent times by global climatic changes and aberrations, more so in the tropical and sub-tropical developing countries. Unfortunately conventional energy and chemical intensive agriculture itself is making a large contribution to anthropogenic green house gas emissions. The ground breaking report of the International Assessment of Agricultural Science and Technology for Development (IAASTD) has deliberated in details (2500 page full report) the overall consequences of global climatic changes.

Only pronature policies and practices can enable us to face the impending challenges to long term sustainability of agriculture in general and rural livelihood in particular as the country cannot prosper keeping the majority of its people deprived of basic necessities of life. Their food and nutritional security is being increasingly impacted adversely by serious degradation of natural resources — land, air, water and biodiversity primarily due to wrong agricultural policies, deliberately pursued by global corporates with the active support of people involved in vital decision making processes. They basically follow a top-down approach to suit their economic interests, sacrificing in the process all vital norms of ecology and environment. It is high time to immediately turn to much more ecofriendly systems of agriculture that will make the farmers free from the clutches of the agribusiness lobby and enable them to make their own decisions on all aspects of agriculture right from choice of inputs, cultural practices and subsequent processes. What the agricultural scientists, sociologists, economists and others, specifically the agricultural field level scientists can do is to suggest the most suitable options depending on the circumstances and perspectives. It has to be a total welfare oriented partnership, with the state providing the much needed financial help and necessary infrastructural frame work. In view of the degradation and shortage of natural resources the underlying motto of all activities would be resource conservation that includes all abiotic and biotic resources. Ensuring availability of adequate quantity of water and preservation of its quality, conservation of soil and its nutrients, conservation of all forms of biodiversity, the unique creations of nature that once lost would be absolutely irreplaceable, and most efficient recycling of wastes through innovative technologies, and researching economically viable renewable energy sources that would be readily available to the rural people.

The options for our predominantly small and marginal farmers could be as follows : (i) rain water harvesting through all possible ways such as building surface storage structures, tanks, dugwells, etc., contour bunding, gully plugging in case of undulated terrains, in particular, (ii) land shaping for rainwater harvesting in ponds and elevation of low lands to different levels with the excavated soil for growing different types of crops, bunds on all sides of plots to prevent run-offs, etc. checking ingression

of salt water in coastal regions, (iii) cultural and biological control of insects, pests and diseases, (iv) developing area-specific crop-livestock integrated farming systems using multiple crops and maximizing the synergy between the different components of the integrated system, (v) development of most efficient systems of recycling of wastes, implying in the long run zero waste generation, (vi) encouraging localized food systems through a cluster, group or cooperative approach to cut down energy costs in long distance transport, distribution and marketing, (vii) involving at all levels appropriate self help groups preferably women self help groups in making vermicomposts, botanical preparations for pest control, and in processing, post-harvest value addition and all such activities that would economically benefit women, in particular.

Even at the level of the average small holder, food security, – the assured year-round availability of nutritious food in adequate quantity and food sovereignty, – the full freedom and authority in all decision-making processes, are ensured in the biodiversity based built-in safety mechanisms of the integrated organic farming systems.

There is little time to lose and utmost urgency is imperative.

TL - 2 : Climate Change in 2050

Debal Ray, Chief Environment Officer, Department of Environment, Government of West Bengal, **E-mail:** raydebal@gmail.com.

Recently conducted five independent studies show that Green House Gas (GHG) emission of India by 2030 will be 4 to 7.3 billion tons of CO_2e. The per capita emission, even then, will range between 2.77 to 5.0 tons of CO_2 e which would be lower than the current per capita emission of the developed world.

The GHG concentration of the globe at 2050 will determine to a very large extent the temperature on earth. This will again follow from the SRES scenario that the countries adopt in their developmental pathway. Thus, depending on SRES scenarios, India may experience a rise of temperature of 2.23 to 2.27 ^{0}C over preindustrial period (Lal, 2001). This rise in temperature will be almost monotonously uniform over India. But the rise in winter is expected to be of greater magnitude (2.54 ^{0}C to 3.18 ^{0}C). The projected annual rainfall for 2050 shows 5.36% to 9.34% increase while the projected winter rainfall shows 9.33% to 3.82% decrease. A separate study finds that that the rainfall intensity will increase significantly only after 2040. Both rise in winter temperature and decline in winter precipitation is likely to have adverse effect on crop production in India. Rainfall over northwest India is projected experience high (30%) increase in monsoon rainfall while rainfall over peninsular India may not change much. Increase in water vapour due to warming could be more decisive in bringing about rainfall than sea-land temperature gradient. One study predicts wakening of Indian monsoon.

Indian Himalayas, with nearly 9575 glaciers, cover an area of 38000 km^2 snowfield. Using conceptual snowmelt models (SNOWMOD) for Himalayas, it has been shown that for a temperature rise of 2 ^{0}C, summer melt runoff will decrease by about 10% and annual runoff by about 5%. Study of Geological Survey of India has revealed that Himalayan glaciers are receding at an alarming rate viz. Gangotri (17.5 m/yr), Dokriani (17.5 m/yr), Milam (13.3 m/yr), Pindari (23.5 m/yr) and Zemu (13.2 m/yr). However, more recent works (Raina 2009) questions the simple cause and effect relationship between retreat of glaciers and climate change.

Sea Level Rise record along major tide gauge stations indicate rise in the range of 1 to 2 mm per year. The only exception is Diamond Harbour in West Bengal which record 5.74 mm rise per year. Simulation results of HADRM2 for 2050 shows that there is no significant change in number of tropical cyclones , but the number of intense events in the Bay of Bengal will rise. The storm surges are also expected to rise in the Bay of Bengal.

Productivity of most crops will decrease only marginally by 2020 but substantially (10 to 40%) by 2100. There will be 10 to 20% rise in production of rice, wheat, oilseeds etc. under 550 ppm CO_2e. This will be primarily due to CO_2 fertilization effect till the nitrogen supply becomes limiting. Some improvement in yield of chickpea, rabi maize, sorghum, millets and coconut (along west coast) are also expected.

Major forestry species like sal, teak and pine show different response under climate change scenario. Sal is relatively resilient and its response will not change much over the years. It, thus, constitutes one potential species for regeneration plans. Pine will be most severely affected even at modest level of climate change and this

response is unlikely to change much over the years. Teak stand is expected to be affected only modestly (10%) in by 2025 but more and more stands will be the middle and end of the century. IBIS and BIOME4 models indicate that 52% of forest grids of India will be affected by climate change. The modeling results indicate that future climate will not be very conducive for the present biodiversity. The species that are categorized as critically endangered are likely to be extinct. Most of the species will move along latitudinal or altitudinal gradients to stay within the tolerable climatic envelope. However, for most of the species the rate of climate change will be faster than migration rates of species. As a result, individual components of an ecosystem will move at a differential rate resulting in new assemblages. IPCC AR4 (2007) predicts that due to 2.2^{0}C temperature rise globally 15-37% [mean 24%] species would be committed to extinction.

Transmission window of the malaria vectors will also be affected by changes in temperature and relative humidity. Gonotrophic cycle and Longevity for sporogony reduced at higher temperature. Modelling exercise shows that by 2080 increase in transmission windows in Northern and NE states, reduction in Orissa, Andhra Pradesh and Tamil Nadu is expected. Transmission window of West Bengal will remain unchanged.

Technical Session A: Relevance of plant protection in global food security

- **Chairman : Shri P.K. Mazumdar**
- **Co-Chairman : Dr. Satyabrata Maiti**
- **Rappoteurs : Shri Prabir K. Ghosh**
  Prof. S. K. Mondal

Lead speaker: 03

Invited Lecture: 01

LS - 1 : Opportunities in plant protection for achieving global food security

Satyabrata Maiti, Director, Directorate of Medicinal & Aromatic Plants Reseach, Boriavi, Anand, Gujarat,PIN 387 310, **E - mail:** satyabratamaiti@gmail.com

LS - 2 : Agrochemicals and Food Security

Pradip K. Mazumdar, Chairman of Agrochemicals Policy Group, and CEO & Director of Crop Life India **E - mail:** pradip.croplife@gmail.com

The world population by the year 2050 is projected to be over 9.4 billion. Both land and water resources are already under stress and this definitely is going to worsen. A projection is that by the year 2050 the area per head for food production will be reduced to 1400 sq.mts from its present 2200 sq.mts. In other words production has to be almost doubled. Will that be possible? This does not appear to be possible, at the present growth rate of agriculture production.

The situation for India is gloomier. Population growth - likely to reach 120 Crores by 2011-12 with:

- Stagnant Resource base
- Diminishing and deteriorating water and land resource
- Loss of bio diversity
- Decline in Factor Productivity
- Globalization and liberalization
- Slow pace of mechanization

The present area under cultivation in India is 141.2 million hectares. Of this in 2007, about 123 million hectares was under food grains with a yield average of 18 qtls. There is no further scope of area under cultivation increasing. It is more likely to decrease because of stagnation in yields despite increasing cost, increasing pest problems, farmers moving away from cultivation; increasing urbanization etc. The net result: to meet our food requirements in the coming years our yield per hectare has to be raised to about 23 qtls per hectare - an increase of ca 27 %. It does seem unlikely but efforts have to be made.

Therefore, the need for protecting what we are producing (from Pests) is 'Paramount'. Official records showed a staggering loss of Rs. 90,000 Crores of agriculture produce in the year 2003. *Extrapolations at 2007 production & prices, stretch the figure at 1,40,000 Crores*. Just a 30% saving of crop losses, will give the Country a saving of Rs.30 - 42000 Crores- easily, satisfying the food requirements of > 25% BPL families. This is feasible by just extending the Crop Protection measures over mere 50% of the area under cultivation.

The present pesticide use scenario is as follows:

- Hardly one fourth of the cropped area is protected against Pests.
- Current Level of Pesticides Use is very low – less than 500 gm/ha.
- Crop Protection largely limited to irrigated crops. 90% of the rain-fed areas receive no Crop Protection measure.
- Newer and safer molecules replacing older products.
- Spurious Products – Estimated market Rs. 1500 crore.

Strategy for the Future

- Current pesticides consumption is valued at Rs. 5,000 crores per annum and covers hardly 20% of the cultivated area of India.

- Contribution of agriculture to GDP is suffering and the one immediate possibility to improving this, will be to target the reduction of losses due to pests by - Rs. 30,000 crores.

- This additional cover will result in Rs. 30,000 crores worth of additional crop savings.

- This Rs. 30,000 crores on the agriculture output shall have a material impact on our agriculture, **food security** and rural economy and GDP.

LS - 3 : Organic farming - Perspectives

B.S. Mahapatra, Director, CRIJAF(ICAR), Nilganj, Barrackpore, Kolkata
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IL - 1 : Pesticides: A global link in food chain, food security and residue management

A.K.Dikshit and Irani Mukherjee, Division of Agricultural Chemicals, Indian Agricultural Research Institute, New Delhi-110012, **E-mail**: anandkd_kk49@yahoo.co.in.

Chemical-free agriculture is gaining support but it is still not able to respond to the need for producing massive amounts of food. The use of agrochemicals, including pesticides still remains a common practice especially in tropical regions and developing countries. developed countries, but still popular in developing countries for domestic pest control. Coordinated efforts are needed to increase the production of food with a view to enhance food quality, food safety and in controlling residues of persistent pesticides in the environment. Globally shared food safety risks include microbial pathogens, pesticide residues, or mycotoxins.

Potentially, all pesticides pose some risk to non-target organisms and environmental concentration estimates are critical in estimating ecological risk. Data developed on the environmental fate of a pesticide, along with use information as stated in the proposed pesticide labeling, are used to generate a value known as an Estimated Environmental Concentration (EEC). The EEC is an estimate of how much of a pesticide might reach non-target areas, potentially exposing wildlife, bees, worms, aquatic animals, and plants. Food safety hazards can arise at any stage of the food chain from primary production, protection and consumption. Climate changes have implications for food production and protection, food security and food safety. Alternate ways of pest control has to be explored in the present scenario.

“Food safety” generally refers to the content of various chemical and microbiological elements in food. A “holistic food chain approach” would recognize that responsibility for supplying safe and nutritious food lies with all the stake holders involved in food production /protection and residue free commodities from farm to fork. The risk assessment process is a critical component of pesticide product development and regulatory review. Ministry of agriculture, the authority to register pesticides; to require appropriate chemical, toxicological, and environmental studies; and to prescribe labeling use restrictions aimed to prevent unreasonable adverse effects on human health and the environment. Pesticides that come into contact with food and animal feed are regulated under by Ministry of Health and Welfare, which gives Government the authority to establish tolerances (maximum pesticide residues allowed) in food and feed. Regulations for pesticide registration specify data requirements, methods for conducting studies, procedures for risk assessment, and labeling content. National authorities use these as tools to determine whether a pesticide can be used without unreasonable effects on human and environmental health. Recently, there have been many changes in pesticide products and registration requirements. What was acceptable risk, yesterday, may not be, today. Policies and decisions on acceptable risk change, over time; and as public awareness and concerns over pesticide risk increase, so do registration requirements.

Session B: Biotechnological support for plant protection & food security

- **Chairman : Dr. Arun K. Chatterjee**
- **Co-Chairman : Dr. Anil Sirohi**
- **Rappoteurs : Dr. Sampa Das**
  Dr. Somnath Bhattacharyara

Lead Lecture : 02
Invited Lectures : 03
Oral Presentation : 03

LS -1 :Quenching of quorum sensing signal in the management of bacterial soft-rotting disease

Arun K. Chatterjee, Yaya Cui and Asita Chatterjee, Division of Plant Sciences, University of Missouri at Columbia, Columbia, Missouri 65211, U. S. A.
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Erwinia carotovora ssp. *carotovora* (Ecc) causes soft-rotting disease on a wide variety of plants or plant organs worldwide. A consortium of plant cell wall degrading extracellular enzymes comprising pectate lyase (Pel), polygalacturonase (Peh), protease (Prt) and cellulase (Cel) contribute to its plant virulence. Among those, Pel and Peh play a crucial role in tissue maceration and cell death. An assortment of secondary factors including motility and some effectors secreted through the type III secretion system augment virulence of Ecc. The regulation of the extracellular enzymes and proteins including harpin, the elicitor of the HR (hypersensitive response) in Ecc has been extensively studied and many regulatory genes and factors have been identified. These extracellular proteins and motility are co-regulated by quorum sensing (QS) signal as well as by an assortment of transcriptional factors and post-transcriptional factors including the RsmA-rsmB system (Rsm= regulator of secondary metabolite production). Of these regulators, the post-transcriptional regulators, RsmA and non-coding rsmB sRNA are absolutely critical in the expression of exoprotein genes. RsmA, a small RNA binding protein, promotes RNA decay and thus behaves as a negative regulator. rsmB specifies a regulatory sRNA that binds RsmA and neutralizes its negative regulatory effect. The expression of rsmA and rsmB in Ecc is subject to multi-factorial regulation.

N-acyl homoserine lactone (AHL) and its analogs are diffusible metabolites of bacterial origin that function as cell density (quorum) sensing signals. AHLs are typified by N-(3-oxohexanoyl)-L-homoserine lactone, produced by Ecc as well as other bacteria. AHLs are synthesized by AHL synthases, encoded by luxI homologs. In most bacteria, there are cognate regulatory factors, usually transcriptional activators called the LuxR homologs. Generally, LuxR homologs bind AHL, and such complexes activate the AHL-regulated genes as well as luxI homologs (see below for an exception). Homologs of the LuxR and LuxI pair control diverse phenotypes including bacteria-microbe and bacteria-plant/animal interactions, bioluminescence, production of secreted proteins, extracellular polysaccharides, antibiotics, pigments and other secondary metabolites.

The QS system of *E. carotovora* is required for its virulence as well as for the production of extracellular proteins and the antibiotic, carbapenem (Car). The signaling system is unusual in many respects. (1) These bacteria possess several species of AHL-receptors: ExpR1, ExpR2 and CarR. (2) ExpR1 and ExpR2 activate rsmA transcription, whereas CarR regulates the Car biosynthetic genes. (3) The ExpR proteins differ in their ligand (AHL)-binding specificity. (4) The activator function of ExpR species is ameliorated upon AHL-binding. By contrast, CarR-AHL complex, but not CarR, activates expression of the car genes. (5) The AHL receptors do not regulate transcription of AHL synthase gene, ahlI, and thus differ from the classical auto-inducer (LUX) paradigm. The current model of AHL-mediated regulation of

extracellular proteins postulates that AHL production is constitutive and AHL molecules accumulate as the cell density increases. In the absence of AHL or when AHL levels are relatively low as during early growth stage, the AHL receptors (ExpR proteins) activate rsmA transcription. Under these conditions free RsmA accumulates promoting decay of RNA species, including those of exoprotein genes and some of their regulators. As the cell density increases AHL levels rise and produce ExpR-ligand complex. These complexes do not activate rsmA transcription. Moreover, activation of rsmB RNA production at this juncture results in sequestering of free RsmA by the formation of RsmA-rsmB RNA complex. The consequent reduction in the pool of free RsmA stimulates extracellular protein production resulting in tissue maceration and cell death.

As described above, a primary function of AHL in Ecc in the context of extracellular protein production and virulence is to modulate the levels of RsmA. It then follows that in the absence of AHL, RsmA levels will remain high inhibiting extracellular protein production and consequently rendering the bacterium non-pathogenic. Enzymes (AHL-lactonase and AHL-acylase) that degrade AHL analogs have been discovered. The cognate genes are widespread in many bacterial species including several plant pathogens. The AHL-lactonase gene aiiA from a *Bacillus* species has been cloned and transgenic plants expressing the gene have been developed. These plants or their organs are resistant to soft rotting disease as little or no bacterial maceration occurs. Thus, this system illustrates the merits of exploiting fundamental knowledge of virulence factors and their regulation in plant disease management.

LS - 2 : RNAi : A promising technology for plant parasitic nematode management

Anil Sirohi and A.K. Ganguly, Division of Nematology, Indian Agricultural Research Institute, New Delhi - 110 012, **E-mail:** anilsirohi@yahoo.com.

Plant-parasitic nematodes cause losses of about $157 billion annually to global agriculture.Chemical nematicides are the most reliable means of controlling nematodes, but owing to toxicity they are a concern to human as well as environmental health. The insufficiency of current control measures provides an opportunity for transgenic approaches to make an important contribution to nematode management. Resistance in crop plants against plant parasitic nematodes has been demonstrated by incorporating cloned resistance genes, protease inhibitor genes or toxin producing genes but with partial success. An exciting and emerging strategy could be the use of RNAi(RNA interference) technology for target identification in the nematode-plant interaction which could also be the basis for transgenic resistance.

RNAi refers to the introduction of homologous double stranded RNA (dsRNA) to specifically target a gene's product, resulting in null or hypomorphic phenotypes. Host plant producing dsRNA targeted at silencing specific nematode gene(s) and accessible for ingestion by nematode is an interesting strategy for developing resistant plants. The most interesting aspects of RNAi are that it is highly specific, remarkably potent (only a few dsRNA molecules per cell are required for effective interference) and the interfering activity can cause interference in cells and tissues

far removed from the site of introduction. This presentation reviews the current developments in this area as well as the potential of using RNAi technology for nematode management.

IL - 1 : Study on interaction between *Fusarium oxysporum* f. sp. *ciceris* and chickpea-a model to develop understanding of plant defense response reaction

Sumanti Gupta, Dipankar Chakraborti and Sampa Das, Bose Institute,Centenary Campus, Kolkata, **E-mail :** sampa@bic.boseinst.ernet.in.

Wilt disease of chickpea caused by *Fusarium oxysporum* f. sp. *ciceris* (FOC) is one of the most destructive diseases of chickpea throughout the world. Variation in patho-varieties of F. *oxysporum* f.sp.*ciceris* which leads to the breakdown of natural resistance is the main obstacle towards developing resistant plants by applying conventional resistant breeding strategies. Additionally, lack of information of potential resistant genes (R genes) limits gene-transfer technology. A thorough understanding of *Fusarium*.–chickpea interaction at a cellular and molecular level is therefore essential for isolation of potential genes involved in counteracting disease progression. Experiments were designed to induce the pathogen-challenged disease responses in both susceptible and resistant plants and monitor the expression of stress induced genes/gene fragments at the transcript level. cDNA-amplified fragment length polymorphism (cDNA-AFLP) followed by homology search helped in differentiating and analyzing the up- and downregulated gene fragments. Several detected DNA fragments appeared to have relevance with pathogen-mediated host defense. Some of the important transcript-derived fragments (TDFs) were homologous to genes for sugar metabolism, isoflavonoid biosynthesis, kinases, cystatins, arginases and so on. Reverse-transcriptase polymerase chain reaction (RT-PCR) followed by real time PCR (qPCR) performed with samples collected at different time points post-infection confirmed a similar type of differential expression pattern. Based on these results, interacting pathways of cellular processes were generated that highlighted the early recognition of the pathogen by the host. Besides, it also showed that the primary metabolism of the host was the prime target of the fungal pathogen. This study has relevance towards functional identification of significant genes involved in wilt resistance.

IL - 2 : Identification of molecular markers linked with the bruchid (*Callosobruchus chinensis*) resistance from a wild progenitor of greengram (*Vigna radiata* var. Sublobata) collected from India

Somnath Bhattacharyya, Sutanu Sarkar, Swagata Ghosh, Mitali Chatterjee, Padminee Das, Triparna Lahari, Nirmal Mondal, Kanti Kumar Pradhan, Crop Research Unit, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, WB, PIN-741252, **E-mail:** somnathbhat@yahoo.com.

The wild relatives and the primitive cultivars of grain legumes in general and Vigna in particular, constitute a reservoir of gene pool. Genetic resistance to bruchid (*Callosobruchus chinensis*) was identified in Sub2, an Indian collection of *V. radiata* var. *sublobata*, the progenitor of mungbean. Bruchid resistance assay of each seed lot collected from 349 F_2 plants revealed that 'bruchid resistance' is a dominant character which is governed by a major gene with a few modifier genes. On the basis of insect feeding assay, homozygous resistant and susceptible seed lots were identified. Twelve pairs of SSR primer of V. radiata, forty two pairs of SSR primer of *Vigna angularis*, two pairs of common bean SSR primer and two pairs of STS primer were employed to assess the polymorphism between the selected parents. STS 1 amplified 225 bp fragment from the resistant parent Sub-2 and all 85 resistant segregants where as the same fragment was absent in susceptible cultivar B-1 and 25 susceptible segregants. A SSR primer pair of *V. angularis* also showed linkage (4.15 CM) with the bruchid resistance character and inherited co-dominantly. Both the dominant and co-dominant markers identified in this study may be useful for generating superior genotypes with durable bruchid resistance by marker assisted selection in relatively shorter time span with accuracy.

IL - 3 : Initial response of *Mangifera indica* to the infection of *Fusarium mangifera* in malformation disease

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Defense related biochemical changes in mango (*Mangifera indica*) by elicitor from mycelial walls of mango malformation pathogen, *Fusarium moniliforme* Sheld. var. subglutinans Wollenweb and Reinking (*F. mangiferae*), at an early stage of infection in a compatible host - pathogen interaction were investigated. In response to application of elicitor (EL) over vegetative buds of susceptible cv. Amrapali, amounts of â-1,3,glucanase (PR-protein), that causes lysis of hyphae, increased by many folds. Considerable increase was also recorded with salicyclic acid (SA) and F. mangiferae-inoculation (Fm). H_2O_2 content, responsible for hypersensitive cell death in host, was reduced in all the treatments. EL reduces SA content while in treatments with SA and Fm it was marginally increased. In susceptible host low activity of SA that affects scavenger activity of catalase (CA) failed to prevent degradation of

H_2O_2. CA activity was moderately reduced by the treatments but it was not sufficient to check degradation of H_2O_2 in host cells. Mangiferin (anti-fusarial host metabolite) content was increased substantially while total protein content was reduced by all the treatments. Thus, signal transduction system involving H_2O_2 and SA remains non-functional and enough defense chemicals could not be synthesized. However, defense genes that produce mangiferin and â-1,3,glucanase became activated and saved the plant. Apparently mangiferin that occurred in malformed buds in huge amount totally inhibited the activity of cellulase (C_x) while drastically reduced that of polygalacturonase (PG). However, in malformed mango buds activity of protease was very high and pectin methyl esterase (PME) activity was moderate. Due to down regulated activities of C_x secondary cell wall of of mango buds remain unaffected. Low activity of pectic enzymes failed to macerate the primary cell wall and middle lamella. However, their structural protein components were degraded by high protease activity and cell wall permeability was damaged. The regulated activity of cell wall degrading enzymes of the pathogen that remains as an endemic parasite only created small gaps in between adjacent cells through which the fungal hyphae move without causing much structural disturbance in host.

OP - 1 : Spatial distribution, genetic diversity, genome organization, genetic recombination, and transformation of citrus plant with CP gene, of Citrus tristeza virus in India

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Citrus tristeza virus (CTV) is a major limiting factor in cultivation of citrus worldwide causing death of million of trees. CTV is long flexuous virion of 2000 x 11 nm under genus Closterovirus. It is primarily dispersed by propagation of infected buds and is then locally spread by aphid (*Toxoptera citricidus*). The single stranded positive sense CTV genomic RNA is of 19.2-19.3 kb nucleotides with 12 open reading frames (ORFs) encoding at least 19 proteins.
Citrus is cultivated almost in all the four geographical regions of India; northeast, northwest, central and south, covering a area of 8.43 lakh ha with 75.7 lakh tones

fruit production per annum. CTV is known to be widely distributed in the entire citrus growing region with the incidence estimated from 16-90%. CTV is a century old problem in India by killing more than one million citrus trees till to day. It infects almost all the citrus spp. and their relatives with symptoms like vein flecking, corking, seedling yellow, stem-pitting, decline etc. Various diagnostic methods have been applied in India.However, studies on genetic diversity and distribution of CTV variants in India; Full length genome and genomic organization, which are essential to develop effective management strategy for Indian CTV are few and far between.

In the present study, we examined genetic variability of CTV using 73 Indian isolates (35 from Darjeeling hills, five from Bangalore, 15 from Delhi and 18 from Vidarbha), and generated phylogenetic relationships with international CTV isolates by analyzing sequences of two genomic region (5´ORF1a fragment and CP gene). Based on CP gene, Indian isolates generated five phylogenetic clades sharing 88-99% nt identity, while based on 5´ORF1a fragment they formed eight phylogenetic clades sharing 82-99% identity among them, indicating a high degree of genetic diversity in CTV population in India. Incongruent phylogenetic relationships in both the genomic regions suggested recombination events.

About the full length genome (c 20 kb) of a CTV isolate, K22 of the Darjeeling hills was sequenced, and all the 12 ORFs were characterized. The length of ORFs varied from 156 nt (shortest ORF 3) to 9439 nt (largest ORF1a) similar to other seven international CTV isolates. The ORFs of K 22 showed sharing 82 to 92% nt identity with respective ORFs of other international isolates. Comparative analysis of ORFs and about full length genome of Indian CTV indicates K22 to be a different and divergent entity.

Viral CP gene mediated transgenic resistance has been proved to be an effective method to control virus diseases in many crops. In present study, gene constructs using entire CP genes of six Indian CTV isolates representing the major phylogenetic clades, in pBinAR in sense and antisense orientation were made. Epicotyl-explant of acid lime (Citrus aurantifolia) seedlings was co-cultivated with Agrobacterium strain EHA 105 harbouring CP gene construct. Several acid lime plants were regenerated in MS_0 supplemented with BAP @ 2mg/lit. Multiplex PCR using specific primers designed from tetA gene (out of T-DNA) and CP gene of CTV was developed to eliminate false transformants i.e., contamination of Agrobacterium plasmid. Maximum number of false transformants was detected. The PCR positive transformants to be confirmed by southern hybridization were kept for hardening in greenhouse.

OP - 2 : Development of high yielding tungro resistant rice lines by transferring a transgene, conditioning resistance through RNAi

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A transgene conditioning resistance against rice tungro bacilliform virus (RTBV) has been transferred into two high yielding tungro susceptible rice varieties (IET 4094 and IET 4786) of West Bengal through back crossing. The transgenic Pusa Basmati 1 lines expressing DNA encoding ORFIV of RTBV, both in sense and antisense orientation, resulting in the formation of double-stranded (ds) RNA, were used as donor. Thirty BC_2F_1 plants of each recurrent parent have been raised and scored for the presence of the transgene and the selectable marker hygromycine phosphotransferase (hpt). Backcrossed progenies were also tested for the expression of transgene by using reverse transcription PCR (RT-PCR) and also for the resistance against rice tungro disease. Plants were inoculated with the viruses via green leafhopper mediated artificial transmission. The resistance against the disease was scored following standard procedure developed by IRRI, Philippines. The progenies showed increased resistance to tungro as evidenced through less reduction in plant height and very mild leaf yellowing over respective controls (the parents and susceptible check TN1). The transfer of a transgene construct, conditioning disease resistance via RNAi, through conventional backcross breeding has been done first time with respect to rice or any other crops.

OP - 3 : Development of marker free insect resistant transgenic rice plant type: A clean gene approach

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Rice, the major food crop of world is severely affected by homopteran sucking pests. We introduced coding sequence of *Allium sativum* leaf agglutinin, *ASAL*, in rice cultivar IR64 to develop sustainable resistance against sap sucking planthoppers as well as eliminated the selectable antibiotic resistant marker gene *hygromycin phosphotransferase II* (*hptII*) exploiting cre/lox site specific recombination system. To expedite consumer acceptance of GM crops, removal of antibiotic resistant selectable markers from the transgenic lines has now become mandatory. For the development of complete marker free insect resistant transgenic rice lines, cre/lox site specific recombination system of bacteriophage P1 was exploited in the present study. An expression vector was constructed containing the coding sequence of *ASAL*, a mannose specific 25 KDa lectin, proved to be a potent controlling agent against green leafhoppers

(GLH, *Nephotettix virescens*) and brown planthopper (BPH, *Nilaparvata lugens*). The selectable marker (*hptII*) gene cassette was cloned within two *lox* sites of the same vector. Alongside, another vector was developed with chimeric *cre* recombinase gene cassette. Six reciprocal crosses were performed with each of the single copy T_0 *ASAL* lox-*hptII*-lox transformed lines and T_0 *cre-bar* transformed lines. Marker gene excisions were detected in T_1 hybrids through hygromycin sensitivity assay followed by the molecular analysis that exhibited 27.4 % efficiency of cre/lox recombination in rice. T_2 progenies of L03C04(1) hybrid parent showed 25% *cre* negative *ASAL* expressing lines. Northern blot, western blot and ELISA showed significant level of ASAL expression in five marker free T_2 lines. *In planta* bioassay of GLH and BPH performed on these T_2 lines exhibited significant reduction in survivability and fecundity compared to the untransformed control plants. Finally, marker free homozygous rice lines were established in T_3 generation conferring significant resistance against homopteran sucking pests as well as promises to be the more acceptable genetically modified clean plants.

Concurrent Poster Session I : Plant pest management using pesticides or related products

- **Judges for Evaluation :**

Prof. M.R. Ghosh, BCKV

Prof. N.Mukherjee, BCKV

Prof. A.Reghupathy, TNAU

PP - 1 :Morphological changes of different castes of the subterranean termites (*Odontotermes proformosanus* Ahmad) in fungus combs of termitophiles

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Termitidae is the largest family of termites. The workers of the subfamily Macrotermitinae have the extra-ordinary phenomena of making fungus combs inside the termitophiles. So, considering the consistency of fungus-bed in the termitophiles, an attempt has been made to observe the morphological changes of nymphs while they stayed within the fungus comb. Biological attributes indicated that *Odontotermes proformosanus* are polymorphic in nature and have exopterygote post-metamorphic development. During the period of study, eggs and nymphs were collected in different seasons from the fungus combs of termite mounds. Eggs of Odontotermes proformosanus were found profusely in fungus comb in the months of March, May, September and October. Average lengths of the eggs were (0.66 ± 0.09) width (0.04 ± 0.07) mm and egg shape ratio is 0.53 . Eggs were mostly of broad type. Distinct quiescent period was also observed. The workers and soldiers of O. proformosanus were dimorphic. Morphological changes completed within 1st to 5th stages. The 1st stage ranged from 0.8-1.5 mm. Terminal form of workers and soldiers were attained at the 5th stage (4.1- 4.5 mm in body length). Morphological changes and differentiation were found to be associated with changes in the total length, head length and capsule widths of the nymphs.

PP - 2 : A study of population dynamics of mango hopper, *Amritodus atkinsoni* Leth. at Jabalpur, Madhya Pradesh

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This paper deals with the population dynamics of mango hopper, Amritodus atkinsoni Leth. at Jabalpur. The data were recorded from an experiment which was conducted in the experimental field at Jabalpur during *rabi* season 2008-09. The weekly data on temperature (maximum and minimum) relative (morning and evening), sunshine hours, rainfall, wind speed, vapour pressure (morning and evening) and evaporation were recoded and correlations between mango hopper and meteorological parameters were computed.The results reveal that maximum and minimum temperature morning and evening relative humidity, wind speed, sunshine and evaporation have played an important role favouring the increase in the population of mango hopper on mango plant. Paired sample t-test was also used to find out the difference of mean of mango hopper population on different sites of mango plant.

PP - 3 : Effectiveness of different spray treatments against mango hopper and on yield of mango cv. Himasagar

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Field experiment was conducted at Horticultural Research Farm, Mondouri, B.C.K.V. (West Bengal) during 20007-08 and 2008-09 to evaluate the effectiveness of different spray treatments viz.T_1:spraying of imidacloprid(0.005%) at panicle emergence, T_2:T_1+spraying of endosufan(0.07%) 21 days after spray of imidacloprid(0.005%) spray, T_3:T_2+spraying of endosulfan (0.07%) 15 days after Ist spray of endosulfan (0.07%) along with untreated check against mango hopper. All insecticidal treatments were found significantly superior in reducing the hopper population as well as increase in fruit yield over untreated check. But among these treatments, the treatment of triple spray (T_3) was found to be most effective, which recorded lowest hopper population (5.475) as well as highest fruit yield both at marble stage (197.62/100 panicles) and mature stage (96.4kg/plant) and avoidable fruit loss (82.9%) followed by T_2 and T_1 respectively.

PP-4:Determination of ETL of yellow stem borer (*Scirpophaga incertulus*) by egg mass estimation in relation to seasonal variations

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Yellow stem borer (YSB), a major paddy pest, causing more than 10% grain loss depending on the agro ecological situation in India. Adoption and subsequent execution of the pest control methodology in the modern IPM system are fundamentally guided by the specification of ETL which requires continuous periodic field assessment of the available total YSB's egg masses in relation to the growth stages of paddy. Such monitoring system, presently in practice, disregards the variety under consideration and seasonality of cultivation. Field observation of YSB egg masses broadly represents two categories, active and inactive. Eggs were inactivated either by parasitization or by season induced sterilization. The active egg masses are viable hence influence the subsequent pest intensity. Present study indicates that the number of active eggs is only responsible for the subsequent crop damage. So the collective consideration of total egg masses often give overstated erroneous result regarding the subsequent field pest level. As the viability of the YSB egg masses is season specific, determination of the dynamics of relative abundance of egg masses in relation to the climatic conditions in the present investigation enables to formulate a more specific, reliable and judicious pest control strategy for a particular locality.

PP - 5 :Field efficacy of some insecticides for management of whitefly infesting mulberry, *Morus alba* L.

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Whitefly, *Dialeupora decempuncta* Quaintance & Baker (Homoptera: Aleurodidae) is a polyphagous pest started causing severe damage to mulberry *Morus alba* L since 1994. They suck leaf sap causing chlorosis, dryness of leaves , leaf curl and sooty mould disease and results in culminating loss in yield of leaf to the tune of 10-24% especially during major silkworm cocoon crop seasons. Though several insecticides were recommended earlier for the control of whitefly in mulberry, the continuous reliance on chemical insecticides for control of whitefly in other agricultural crops has caused several problems like development of pesticide resistance and environmental pollution leading to health hazards also. So efforts were made to avoid the environmental pollution by adopting some newer insecticides which are less toxic, economic, biodegradable and easily available viz thiamethoxam (Actara 25% WG), diafenthiuron (Pegasus 50%WP) and clothianidin (Dantap 50% WDG). The LC90 values of these three insecticides were worked out as 0.0131%, 0.0635% and 0.0046% respectively . Hence it was felt necessary to study the field efficacy of these three insecticides which in turn will cause no adverse effect on environment.

The post treatment population was recorded after 1stday,3rd day,5th day, 7th day and 14th day of spray. Among these three insecticides tested, the field efficacy of thiamethoxam at 0.015% reduced the population by 99.81% followed by diafenthiuron at 0.0633% by 99.62% & 99.19% , clothianidin at 0.0047% by 99.07% in 1st and 3$^{rd\ day}$ of spray respectively. On 5th day after spray clothianidin at 0.005% reduced the population by 98.59% followed by thiamethoxam at 0.015%, by 96.82% , diafenthiuron at 0.070% by 96.70%. The data of 7th day after spray revealed that diafenthiuron at 0.0633 % reduced the population by 97.47% followed by clothianidin at 0.0047% by 96.83%, thiamethoxam at 0.015% by 96.82 %. Based on this field efficacy studies the biosafety of these insecticides on silkworm rearing will be evaluated for finally adopting them at farmers' level for effective management of whitefly.

PP - 6 :Development of forecasting model of bacterial leaf spot disease of mulberry for Birbhum district of West Bengal

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Forecasting of disease is one of the important tools to forewarn the farmers well in advance for taking up timely preventive / control measures against the diseases so as to manage / minimizes the leaf yield / quality loss. Mulberry (*Morus* sp.)The sole food plant of silkworm (*Bombyx mori*) gets affected with several diseases, which not only reduce leaf yield (10-30%) but also considerably impair quality. Feeding of diseased leaves to the silkworm reduces cocoon yield to the tune of 15-20% and also its quality. In order to identify the major diseases affecting mulberry in the Birbhum district of West Bengal and to develop forecasting models of the diseases, weekly disease severity data were recorded from nine farmers' field for four years. Daily meteorological data viz. max. temperature (x_1) and relative humidity (x_3), min. temperature (x_2) and relative humidity (x_4), rainfall (x_5) and numbers of rainy days (x_6) were also recorded. Bacterial leaf spot (BLS) caused by *Xanthomonas campestris* pv. *mori* was found as one of the major diseases of mulberry from May to September. Incidence of other diseases viz. Myrothecium leaf spot (*Myrothecium roridum*), Pseudocercospora leaf spot (Pseudocercospora mori) and Powdery mildew (*Phyllactinia corylea*) were observed to be below economic threshold level. It was observed that BLS regularly appeared in 3rd week of May and continued up to September with maximum severity (16.65 - 28.95PDI) in August and September. The correlation coefficient between disease severity and meteorological parameters revealed that BLS has significant positive correlation with max & min. temperatures, min. relative humidity, rainfall and number of rainy days with average of preceding seven days. Stepdown multiple regression analysis revealed that prediction of bacterial leaf spot could best be done with combination of meteorological factors viz. min. temp, min. relative humidity and number of rainy days. The regression equation developed for prediction of BLS is $Y = -28.12 + 1.093x_2 + 0.677x_5 + 0.215x_4$ ($R^2=0.58$, $P=1.975x10^{-18}$).

PP - 7 :Rot disease of muga host plant, Som (*Persea bonbycina*, King ex Hook. f., Kost) and its management

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Som, the primary food plant of muga silkworm, (*Antheraea assamensis,* Helfer) grows mainly in North Eastern region and Uttaranchal State in India. India is unique in producing the golden muga silk and has monopoly in global silk market. Som plant grows up to 20-25 meters and survive for 18-20 years. Pollarding of Som plant at 6 ft. height is a common practice in North Eastern region of India for controlled rearing (outdoor) of muga silkworm. It was observes that stems of som plant (specifically the pollarded plants) are generally infected with rot disease when it grows older. *Phellinus contigus* (under Polyporaceae), a white rot fungus, causes heart rot disease and Biscogniauxia medeterranea (= *Hypoxylon medeterran*ea) (under Xylariaceae) causes canker rot disease of Som plant. A survey was conducted to study the infection of rot disease on Som plants maintained at Regional Muga Research Station, Boko, Assam with 3 m x 3 m spacing, during 2004-06. Data recorded on infection of rot disease revealed that the disease incidence (DI %) caused by *B. medeterranea* was 12% while *P.contigus* showed 20% infection. Considering the age of Som plants into three age groups, such as, up to 5 years, 5 to 10 years and more than 10 years, rot disease infection was found maximum in the plants of more than 10 years and gradually the entire plant decays. For muga silkworm rearing, ten years' old Som plants/ trees are preferred as the plants / trees produced highest leaf of around 14 mt/ha/year. For controlling rot disease, use of cowdung smear on the cut ends of the pollarded plants is the traditional practice. However, to control rot disease in Som, Chaubattia paste (copper carbonate and red lead @ 800 g each to be dissolved in 1.0 litre of linseed oil) may be applied, as recommended by Forest Research Institute, Dehradun.

PP - 8 : Weather based forewarning of root mealy bug, *Paraputo* sp. (Pseudococcidae: Hemiptera) in mulberry of Kalimpong Hills

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Mulberry (*Morus* sp.) is grown for its foliage in the Kalimpong hills of Darjeeling district due to prevalance of quite conductive climate to rear bivoltine silkworm (*Bombyx mori* L.) . The infestation of root mealy bug paraputo sp. Was noticed in the last decade is now causing a serious concern. The pest remains in the underground stem and roots up to 20 cm depth, sucks up , secrets honey dew , thereby inviting occurrance of fungus. It ultimately leads to stunted growth; inerior quality leaves and fially plant die. It is more prevalent in the nursery beds. Several chemcl insecticides were recommended but their use in hills is difficult/non-permissible due to the pollution of surface water sources and toxicity of chemicals to the silkworms in a ixed cropping schedule.

Considering this, an attmpt was undertaken to forewarn seriulturists about the incidence of root mealy bug to remain in preparedness and to reduce the use of excess chemical. Root mealy bug incidence was recorded a weekly intervals at RSRS, three farms (Barabat, Hill nursery and FRSS) and in three farmers plot in Kalimpong hills for last three (2005-08) years. Meteorological factors viz. maximum temp. minimum temp, maximum RH, minimum RH and rainfall were recorded on daily basis. A definite incidence pattern was observed. Population was almost nil during January and February after which it started growing and attended maximum sometimes during June and Octobr. While developing a prediction model of incidence from the meteorological factors the most precise multiple regression equation (R^2 = 0.394) was found to be $Y = -46.201 + 1.000x_1 + 0.929 x_2 + 0.102x_3 + 0.211x_4 + 0.103x^5$ where x_1, x_2, x_3, x_4, x_5 are the above five meteorological factors averagd over a period of 19-22 days, 24-29 days, 19-25 days and 29-31 days prior to the day of incidence. It was also found that almost the same level of prediction (R^2 = 0.365) could be made from the minimum temperature averaged over the same period using regression equation $Y = -21.130 + 2.320 x_2$. The study/trends of observation paves the way to develop the full proof prediction/forewarning model.

PP - 8 : Integrated weed management in lentil (*Lens culinaris* Medikus)

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Weeds cause heavy loss to the lentil crop as they rob the soil of its nutrients and moisture. The crop competes poorly with many weed species because of its weak stem, short stature, slow initial growth and long duration. Though manual weeding is effective, it has certain limitations such as non-availability of sufficient manpower during peak periods and/or high labour wages. Under these circumstances, use of herbicides becomes necessary to avert losses due to weeds. Furthermore, integrated weed management involving both chemical and other agronomic manipulation may be a good offer. Keeping this background in view, a two-year field trial was conducted during rabi, 2003-04 and 2004-05 at the Pulses and Oilseeds Research Sub-station, Beldanga, Murshidabad, West Bengal to identify a sound integrated weed management practice in lentil. The treatments, including one hand weeding (HW) at 30 days after sowing (DAS), 25% higher seed rate, pendimethalin 30 EC as pre-emergence (1.0 kg ha^{-1}) and their suitable combinations were tested against weedy and weed free checks. Major weed flora in the experimental site consisted of *Cyperus rotundus, Anagallis arvensis, Chenopodium album, Solanum nigrum* and *Vicia sativa*. Though weed free treatment recorded the highest seed yield (1004.50 kg ha^{-1}) along with its attributes, it was closely followed by HW at 30 DAS + 25% higher seed rate (899.63 kg ha^{-1}), pendimethalin at 0.75 kg ha^{-1} + HW at 40 DAS (872.75 kg ha^{-1}) and pendimethalin at 1.0 kg ha^{-1} (832.50 kg ha^{-1}). Higher yields under these treatments might be due to effective suppression of weed growth till crop harvest. Season-long crop-weed competition caused an average yield reduction of 49.77% as compared to weed free condition.

PP - 10 :An intensive investigation on the effect of pests on cotton plant (*Gossypium* sp.) and it's control measures

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An intensive investigation showed that cotton (*Gossypium* sp.) suffers from insect ravages throughout its growth period At germination, termites and other soil pests nibble the germinating seeds and seedlings. As the plants grow, sucking pests like jassid(*Amrisca devastans* D.),aphid (*Aphis gossypii* (Glover),white fly (*Bemisia tabaci* L.) and thrips (*Thrips tabaci* Lind) make their appearance and by sucking the sap, cause the plants to turn yellow and crinkled and severe attack by these insects lead to complete withering of the plants. During the peak period of growth leaf eating insects viz. leaf roller (*Sylepta derogata* Fab.) and semi-lopper (*Anomises flava* Fab.) at times , take a very heavy toll of the crop and at the square and boll formation stage ,the crop is attacked by cotton bollworms viz.,the American Bollworm(Heliothis armigera Hub.) and spotted bollworm (*Earias* sp.) which bore into squares and bolls causing lot of shedding. Besides these major pests there are a number of minor pests like stem weevil,cotton stem borer,red cotton bug dusky cotton bug, surface grasshopper etc. Sucking pests can be easily controlled by Dimecron,100-60-80 ml,rogar 30EC,thiodan 35EC 250-300ml per acre,leaf eating larval pests by thiodon 35EC 600 ml/acre, bollworms sprayed with DDT 25 EC 3000ml/acre,thiiodon 4% at the rate of 8-10 kg/acre. The object of the present investigation was to protect crop loss by detection of insect pest problems and adoption of appropriate control methods at the proper time is one of the modern methods of increasing the yields of cotton and many of our agricultural and horticultural crops.

PP - 11 :Evaluation of fungitoxic effect of some commercially available agrochemicals against grain discoloration (GD) disease of rice in West Bengal

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Grain discoloration is one of the major emerging rice diseases Sc name of the pattogen should be given as is being reported from all the rice growing areas. This disease has adverse effect both on quality and yield of rice. The degree of grain discoloration depends according to environmental condition particularly from booting to maturity stages of the crop. Among various causes fungal infection is one of the major reasons of grain discoloration. Infected seeds are not normally preferred as a good quality seed and pose a serious problem in seed certification. Attempt has been taken to manage or reduce the disease by applying commercially available agrochemicals. Six agrochemicals belong to different groups and different site of actions were taken for evaluating their fungitoxic effect upon the disease. All the agrochemicals were found significantly superior over untreated check in reducing the disease and increasing yield of rice. Among six agrochemicals 'Carbendazim 64% + Mancozeb 8% 75 WP and Carbendazim 50 WP were found at par in reducing panicle infection (20.1 – 20.4%), spikelet infection (28.9-33%) and increasing grain yield (46.3-47.9%) over untreated check. Though Tebuconazole 250 EW was found the third best chemical but was found at par with the first two agrochemicals. Therefore any of the three agrochemicals can be included in the spray schedule for management of grain discoloration.

PP - 12 : Field evaluation of some new insecticides against brown plant hopper, *Nilaparvata lugens* (Stal.) in rice

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Seven insecticidal treatments (buprofezin 25 SC, two doses of imidacloprid 17.8 SL, thiamethoxam 25 WDG, acetamiprid 20 SP, acephate 75 SP and imidacloprid 1.8%+ acephate 50% at 200; 50 & 25; 40; 40; 400 and 518 g a.i./ha, respectively) were evaluated in the field against rice brown plant hopper Nilaparvata lugens Stal. (BPH), during kharif, 2007 and 2008 at 'Sahebganj' village (Block- Bhatar, District- Burdwan, West Bengal). The results revealed that out of seven insecticides evaluated buprofezin 25 SC @ 200 g a.i./ha and imidacloprid 17.8 SL @ 50 g a.i./ha registered superiority over other insecticides evaluated in suppressing BPH population to the tune of 99.13 - 94.97% over control during both the seasons of evaluation at 14 DAS.

PP - 13 : Effect of paclobutrazol and management practices on extension of harveting time, yield and quality of mango

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The flowering in mango usually takes place during January to March with a short harvesting period from May to June. So, the duration of availability of mango is very short which needs to be extended either before or after the normal harvesting season (May - June). But such types of studies under Bangladesh condition are meager. To extend the period of availability of fresh mango fruits beyond the normal fruiting season (May - June), increasing yield and quality and for uniform bearing in each year a series of experiments on deblossoming, manuring and use of paclobutrazol and other chemicals including the variety Amrapali were conducted during the period from January 2005 to June 2007. Whole-tree and 75 % deblossoming in March after completion of flowering resulted early flowering and fruiting in the Amrapali variety. Use of manures and fertilizers in three installments had the highest yield, best quality and delay in harvesting. The flowering and fruiting in mango (cv. Amrapali) were advanced by the use of paclobutrazol (2500 ppm, 5000 ppm, 7500 ppm and 10,000 ppm) as compared to control. Paclobutrazol at 7500 ppm was found to be the best treatment which promoted earlier flowering than normal as well as increased yield and quality of mango. KNO_3 is an effective flower inducer which at 4 % and 8 % produced profuse flower and good quality fruits in Amrapali.

PP - 14 : Incidence of nut weevil in *Zizyphus mauritiana* cv. Thai kul

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In the northwestern part of Bangladesh cultivation has been since last few years with BAU KUL, Thai KUL, Apple Kul etc. Last year (2007) it was found that in each and every fruits of Thai Kul in Modern Horticulture Center and in the North Western areas was infeted by a new nut weevil.This nut want seriously infested the young and developing nuts that caused premature shedding and malformed nuts resulted in poor yield. This pest may cause an epidemic in kul cultivation. In other parts of the country this nut weevil was not found. Till now all over the country, the BAU Kul, Apple KUL, BARI Kul found to be free from this serious pest. This might have come from its original home (Thailand).

PP - 15 : Prediction model for the occurrence of *Helicoverpa armigera* Hub. on medium maturing pigeonpea

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During kharif 2006-09 studies on population dynamics of *Helicoverpa armigera* Hub. (Lepidoptera : Noctuidae) immature stages and adult moths were carried out on pigeonpea crop (cv. JKM-7) in the experimental field at Jabalpur.
H. armigera eggs were counted on 30 cm twig on 25 random twigs whereas larval population were counted plant on 25 random plants. The observations were initiated from the first appearance of the pest and continued upto their availability. The observations were recorded twice in a standard week. Further, *H. armigera* moth catches were recorded daily, male moths in pheromone traps and both sexes of adult moths in light traps. A record of meteorological data was also maintained of the study period. Data were subjected to statistical analysis.First appearance of the eggs was observed on 17th December 2008 and it remained active throughout the cropping season and was available upto 15th February 2009 and attained a conspicuous peak in the 4th SW (22nd – 28th January). Correlation studies revealed that all the weather factors included in the study did not exhibit any significant effect on *H. armigera* egg population.
First appearance of the larvae was observed on 28th December, 2008 and it remained active throughout the cropping season and was available upto 13th March 2009 and attained distinct peaks in the 9th SW (28th February - 4th March) and 10th SW (5th – 11th March),respectively. Correlation studies revealed that weather factors- maximum and minimum temperature and evaporation rate exhibited a significant positive correlation, whereas morning and evening relative humidity exhibited a significant negative correlation with *H. armigera* larval population while the remaining weather factors included in the study did not exhibit any significant effect on *H. armigera* larval population.
Light trap catches revealed that the pest was active throughout the period of study and four distinct peaks were observed, first during the 1st SW (1st - 7th January) and the 2nd during the 5th SW (29th January- 4th February). The 3rd and 4th peaks were observed during 8th SW (19th – 25th February) and 12th SW (19th – 25th March) respectively.
Pheromone trap catches revealed that the pest was active throughout the period of study and five distinct peaks were observed, first during the 1st SW (1st - 7th January) and the 2nd during the 4th SW (22nd - 28th January). The 3rd, 4th and 5th peaks were observed during 8th SW (19th – 25th February), 10th SW (5th – 11th March) and 12th SW (19th – 25th March) respectively. Correlation studies revealed that weather factors – minimum temperature, sunshine, wind speed and evaporation exhibited a significant positive correlation while morning and evening RH, evening vapour pressure exhibited a significant negative correlation with pheromone trap male moth catches.

PP - 16 : Analysis of variance for preference of different mango varieties by hopper, *Amritodus atkinsoni* Leth. at Jabalpur, Madhya Pradesh

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Analysis of variance for the study of different varieties of mango with respect to occurrence of the hoppers on trunks, primary, secondary and tertiary branches revealed that there was a significant difference among the varieties with respect to hopper on trunks, primary, secondary and tertiary branches respectively. Newman Quel test was applied to investigate all possible pairs of means in a sequential order: primary branches (4.903), panicles (4.206), leaves (3.545), trunks (2.0763), tertiary branches (1.500), secondary branches (1.499) with CD at 5% (1.3114). From the above mean value, it is possible to argue that primary branches differ significantly from all others except panicle with respect to mango hopper population in different sites. Further, panicle differs significantly from trunks, tertiary and secondary branches and there is no significant difference among trunk, tertiary and secondary branches. Hence, it is possible to mention that primary branches, panicle and leaf are the most preferred sites for mango hopper. ANOVA table also shows that there was no significant difference among the treatments for the occurrence of mango hopper on mango plant with respect to direction at 5% level of significance.

PP - 17 : Field efficacy of fungicides against purple blotch (*Alternaria porii*) of onion

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An experiment was conducted to find out the field efficacy of fungicides against purple blotch of onion during the two consecutive year of 2007 – 08 and 2008 – 09 at the University farm, BCKV, Kalyani, Nadia. Tebuconazole 250 EC, Hexaconazole 5 EC and Propiconazole 25 EC with different doses were applied over the crop to control purple blotch of onion. Spraying was done as son as the disease appeared in the field, followed by another two spraying at ten days interval of the first spraying. All the fungicides with different doses were found significantly superior control. Lowest disease incidence and severity and highest fruit yield was found when Tebuconazole 250 EC @ 187.5 g ai/ha was sprayed over the crop. It was statistically at par with Tebuconazole 250 EC @ 156.25 g ai/ha.

PP - 18 : Occurrence of aphids in different traps on potato in gangetic plains of West Bengal

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A field experiment was conducted during rabi season of 2006-07 and 2007-08 at Adisaptagram Block Seed Farm, Hooghly, West Bengal to evaluate the population dynamics of aphids with the help of yellow pan trap and yellow sticky trap. Two sticky traps were used for the present experiment, which is placed in potato field with its top about 1.2 m above the ground. Similarly, two yellow traps were placed at a height of crop canopy level. The caught aphids in both types of traps were collected at one-day interval and number was counted periodically. The meteorological data was recorded with a view to determine the relationship between the aphid population and abiotic factors. The population of aphid catches was quite lower in yellow pan trap than yellow sticky trap. Aphids were first observed in traps during third week of December and the population of pests was gradually increasing to reach the peak in second week of February in the first year of study (2006-07) while in second year of study (2007-08) the aphid population appeared in second week of December and attained its peak by the end of February. It was observed that the climatic conditions during their nymphal stage of pest were mainly influenced the population build up of aphids in traps. The abiotic factors viz., temperature (maximum & minimum), relative humidity (minimum & mean) and bright sunshine hour had significant effect on aphid population. The same abiotic factor, were quite different between the first and second year. This was due to the fact that the climatic conditions in second year distinctly varied from the first year.

PP - 19 : Evaluation of different insecticidal treatments on rice yellow stem borer (*Scirpophaga incertulas* Walker) Infestation during *boro* season

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Experiment was conducted during boro season in 2008 and 2009 at Jaguli Instructional Farm of Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal in order to determine the comparative efficacy of different insecticides viz. fipronil (Regent 0.3G), cartap hydrochloride (Kritap 4G), imidacloprid 0.3G, phorate (Thimet 10G), carbofuran (Furadan 3G), lambda-cyhalothrin (Karate 5EC), mixed formulation of chlorpyrifos+cypermethrin (Hamla 55EC), profenofos+cypermethrin (Polytrin 44EC), and triazophos+deltamethrin (Spark 36EC) at 60; 1000; 45; 1000; 750; 20; 350; 350; & 350 gm a.i./ha, respectively, against yellow stem borer, *Scirpophaga incertulas*

Walker in rice. Result showed that all the treatments were significantly effective in checking stem borer infestation lead to decrease in dead heart and white ear head number as well as increase in yield. Pooled data revealed that carbofuran at 750 gm a.i./ha was the most effective to check the dead heart (1.70%) followed by cartap hydrochloride at 1000gm a.i./ha (1.85%) and fipronil at 60 gm a.i./ha (1.91%). During this period, mean number of dead heart was 8.65% in control plot. In terms of mean percentage of white ear head, fipronil showed excellent performance in reducing white ear head (2.12%) followed by carbofuran (2.20%), phorate (2.45%), cartap hydrochloride (2.45%) and imidacloprid (2.67%). In control plot percentage of white ear head was 10.70%. The highest mean yield (45.2 q/ha) were recorded in carbofuran treated plot followed by phorate and fipronil with yield of 45.1 and 44.7 q/ha, respectively, whereas in control plot the mean yield was 34.7 q/ha.

PP - 20 : Assessment of pest incidence of various rice cultivars under different tillage practices

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A field experiment was conducted to study the assessment of pest incidence of four (4) rice cultivars (NK 3325, Ariz 6444, NK Sahyadri, IET 15847) under three (3) different tillage practices (Zero Tillage Direct sowing using Zero Tillage Machine, Zero Tillage Direct sowing using Punch Planter and Conventional Transplanting) at the farm of Uttar Dinajpur Krishi Vigyan Kendra, Chopra, Uttar Dinajpur, West Bengal under Mahananda Flood Plain farming situation of Terai zone during the kharif season of 2008 and 2009. The experiment was laid out in a Randomized Block Design with twelve (12) treatments in three (3) replicates. Experimental results revealed that among the different tillage operations the intensity and severity of Bacterial Leaf Blight (BLB) [c.o. - *Xanthomonas oryzae* pv. *oryzae*], Leaf folder attack and Gundhi bug infestation were higher in direct seeded conditions (both in zero tillage machine and punch planter) as compared to conventional tillage whereas the yellow stem borer [*Scirpophaga incertulas*] attack was least. IET 15847 (HYV) recorded the highest intensity (30.54 %) and severity (1.32) of BLB when sown using zero tillage machine which were statistically at par with the punch planter. Whereas the least intensity (10.18 %) and severity (0.73) of BLB was associated with NK 3325 (Hybrid) grown under conventional tillage practice. Perusal of data on the percentage of dead heart and white head revealed that NK 3325 when grown under conventional tillage condition recorded the highest (9.46 %). The number of folded leaves m^{-2} due to Leaf folder (*Cnaphalocrocis medinalis*) followed the same trend as of BLB infestation where IET 15847 sown using zero tillage recorded the highest (19.26 m^{-2}). The percentage of punctured grains $panicle^{-1}$ due to Gundhi Bug (*Leptocorisa acuta)* was least in NK Sahyadri (4.89 %) grown under conventional tillage and recorded the highest with the treatment in IET 15847 with Zero Tillage machine (18.56 %).

PP - 21: Efficacy of different spray schedules to control the late blight disease of potato

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Late Blight [c.o.- *Phytophthora infestans* (Mont.)] is one of the serious diseases of potato (Solanum tuberrosum L.) specially under North Bengal condition as high humidity and foggy weather prevails throughout its vegetative growth period. A field experiment was conducted during the rabi season of 2007-08 and 2008-09 to study the efficacy of different spray schedules to management the late blight disease of potato (var. Khufri Joyti) at Uttar Dinajpur Krishi Vigyan Kendra's farm, Chopra, Uttar Dinajpur, West Bengal in RBD with seven treatments in three (3) replicates. The treatment details were : Maximum routine practice (T_1), Minimum routine practice-I (T_2), Minimum routine practice-II (T_3), New spray schedule-I (T_4), New spray schedule-II (T_5), Farmers practice-I (T_6), Farmers practice-II (T_7) using 5, 5, 5, 6, 4, 4, 3 number of different chemicals with the frequency of 8, 5, 6, 7, 6, 7, 10 times spraying, respectively.

Experimental results revealed the fact that the highest intensity of late blight in potato (LBP) was associated with T_7 (37.42%) at 70 DAP, whereas, the mean intensity was highest in T_7 (23.12%) and T_1 (14.46%) recorded the least. As far as the severity was concerned New spray schedule-I [T_4 : Copper oxy chloride '! Mancozeb '! Metiram '! (Cymoxanil+Mancozeb) '! Metiram '! Propiconazole '! Dimethomorph] recorded the minimum and Farmers practice – II (T_7) recorded the maximum. The maximum yield of potato was observed in T_4 (27.22 t ha^{-1}) which was higher to the tune of 11.3%, 9.4 – 15.0% and 11.5 – 16.0 % than Maximum routine practice (T_1), Minimum routine practices (T_2 and T_3) and Frarmer's practices (T_6 and T_7), respectively. The benefit /cost ratio was recorded to be the highest (1.94) in New spray schedule-I (T_4), whereas, the least in T_7 (1.65) which was closely associated with T_1 (Maximum routine practice). This investigation revealed that among the different disease management modules T_4 was the best which can be recommended for late blight management.

PP - 22: Relative toxicity of some newer molecules against rice moth, *Corcyra cephalonica* (St.) under laboratory condition

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Three newer molecules, i.e., Indoxacarb 14.5% SC, Abamectin 1.9% W/W EC and Neemacin (Az 10,000 ppm), tested against 3rd instar larvae of *Corcyra cephalonica* (St.), were found to be toxic to the larvae in laboratory experiment. Three different chemicals, along with their three different concentrations were applied to laboratory reared rice moth larvae and mortality percentages were observed at 24 hours, 48 hours and 72 hours after application. From corrected mortality percentage LC_{50} values for particular chemicals at certain points of time were calculated by probit analysis. Relative toxicity of Abamectin 1.9% W/W EC has been found highest with LC_{50} 144.30 ppm, 47.80 ppm, 6.61 ppm at 24 hours, 48 hours and 72 hours respectively, followed by Indoxacarb 14.5% SC and Neemacin (Az 10,000 ppm). Due to highest acute toxicity (24 hours), Abamectin 1.9% W/W EC was most efficient (LC_{50} value 144.30 ppm) against 3rd inster larvae of *C cephalonica* (St.) during the course of investigation, the next best insecticide was Indoxacarb 14.5% SC (1087.81 ppm) according to the descending order of relative toxicity. Whereas, Neemacin showed lowest acute toxic effect with highest LC_{50} value (5681.99 ppm).

PP -23: Bioefficacy of some new and novel insecticides against chilli fruit borer (*Spodopter litura* H)

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During the past three decades, efforts have been made to reduce the risk of human exposure to pesticides specially insecticides. There is a great demand for safer and more selective insecticides that spare natural enemies and non target organisms. Consequently new types of insecticides have been developed by agrochemical companies. Although they are mostly synthetic but they are more selective than conventional insecticides. The limited number of target sites exploited by conventional insecticides has created problems with resistance to these insecticides.

The present investigations were conducted to test the effectiveness of some new chemicals viz. phthalic acid diamide (flubendiamide), microbial pesticides (Spinosad, emamectin benzoate, Bacillus thuringiensis & chlorfenapyr) and IGRs (novaluron, lufenuron & methoxyfenozide) in comparison with one traditional insecticide

(chlorpyriphos + cypermethrin) in controlling two important lepidopteran pests, i.e., *Spodoptera litura* on chilli and *Putella xylostella* on cabbage. The field experiments were conducted for two consecutive years during 2007 and 2008. In field experiment, each insecticide was tested with the recommended dose and the experiment was laid out in Randomised Block Design with nine insecticides. The total number of treatments were ten including control. For all the experiments on chilli and cabbage, damage incidence and yield were determined and compared at the end.
In the field experiments, overall good performance was found in case of flubendiamide, spinosad, emamectin benzoate and chlorfenapyr in reducing damage caused by fruit borer on chilli and diamond-back moth on cabbage and led to increases in yield. Among the IGRs, novaluron performed well against all the insects, but lufenuron and methoxyfenozide expressed comparatively lower performance than other selected insecticides. Bacillus thuringiensis performed moderately well against the insect pests. It was also evident from the field observations that all the chemicals except mixed formulation of chlorpyriphos and cypermethrin were comparatively safer to natural enemies – spider, Menochillus, Chrysoperla and Cotesia on chilli and cabbage. The chemicals used in the experiment are highly vulnerable to lepidopteron pest with their new mode of action and high selectivity. They are very safe to non target organisms and quickly degraded to non toxic products and have potential use in Integrated Pest Management (IPM) systems.

PP - 24: Varietal screening and option for management against Bacterial wilt of gladiolus (*Pseudomon gladioli* pv *gladioli*) under new alluvial zone of West Bengal

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Gladiolus is a potential flower crop and mostly popular as cut flowers. Cultivated area of gladiolus in hills as well in plains of West Bengal is increasing not only for its export potentiality but also of its domestic market value in recent years. Bacterial wilt disease caused by Pseudomonas gladioli pv. Gladioli in recent years was found to be a major threatening problem causing considerable loss during its cultivation. Keeping this view the present experiments were carried out at Instructional Farm, Jaguli, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal during 2002-3 and 2003-04. Percent Incidence of bacterial wilt were recorded among fifteen gladiolus varieties under field condition and results obtained from two years (2002-02004) observation revealed that none of the variety was found free (i.e. Highly Resistant =HR) from this malady and results were statistically significant. Variety Friendship showed least wilt incidence (3.52%) followed by Appolose (4.75%) and marked as Resistant (R) while Candium (8.26%), American Beauty (9.20%) and Tropic Sea (9.86%) were found as Moderately Resistant (MR) group. Varieties Morola, Sabnam, Interpaid ,Rippling Water, Green Bag and Agewander exhibited a range of wilt incidence (11.85% -14.80%) which were categorized as Moderately

Susceptible (MS) and Rapetears and Hermojonty (16.87% &16.37%) as Susceptible (S) group. Maximum wilt incidence were recorded on Silva (24.36%) followed by Tiger Flame (20.55%) and designated as Highly Susceptible (HS) varieties based on field evaluation in pathogen conducive soils.

Trials on management against the pathogen were made through corm treatment in artificially inoculated field condition on susceptible variety "Silva" with a number of antibacterial compounds and bio agents (chloramphenicol, strepcycline, bacteriomycin, kribac, bleaching powder, Oxy-tetracycline hydrochloride, Tricoderma viride, Bacillus sp. and Pseudomonas fluorescens) including control . Results (Pool, 2002-04) indicated that all the treatments reduced the wilt incidence at their respective concentration over control and were statistically significant. Among the treatments Kribac @ 2000ppm (9.09%) performed best in reducing the wilt incidence followed by chloramphenicol @ 200ppm (10.91%) and streptocycline @ 200 ppm (12.05%). Among bio agents wilt incidence were found 20.82% in *Tricoderma viride* treated corm followed by *Pseudomonas fluorescens* (21.34%) and *Bacillus* sp. (24.50%) over control (42.88%) and results among themselves were statistically at par.

PP - 25: Interaction of bacterial pathogens of betelvine with *Phoma piperis -betle*

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Betelvine (*Piper betle* L.) is the most important cash crop grown almost all over the state of West Bengal covering 19,000 ha area in comparison to 55,000 ha in India. The most important betelvine growing districts in West Bengal are Midnapore (East), Howrah, Hooghly, 24-Parganas (South) and Nadia. Besides the above districts, cultivation has now been extended to 24-Parganas (North), Birbhum, Bankura, West Dinajpur and Murshidabad districts too. It is affected by a large number of diseases, which reduces yield and quality of betelvine leaves. Bacterial leaf spot and stem rot disease caused by *Xanthomonas axonopodis* pv. *betlicola* and *Pseudomonas betel*, respectively are gradually become important in West Bengal. *Phoma piperis-betle* is also prevalent in the state. The joint inoculation of *X.axonopodis* pv. *betlicola* and *Ps. betel* in same leaf produced relatively larger size of lesion as compared to the lesion produced by the individual bacterium. Simultaneous inoculation of *X. axonopodis* pv. *betlicola*, *Ps. betel* and *Phoma piperis-betle* did not have pronounced effect in respect to lesion size in the leaves. While inoculation of bacteria, 48 hours after inoculation of P. piperis-betle showed synergistic effect in respect of lesion size.

PP - 26: Efficacy of some chemical and biopesticides against major insect pests of potato in West Bengal

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Bioefficacy of four molecules comprising of both chemicals and non-chemical insecticides against major insect pests of potato were evaluated during rabi season of 2006-07 and 2007-08 at Adisaptagram Block Seed Farm, Hooghly, West Bengal. The potato (cv. Kufri Jyoti) was planted by the end of November at 60×20 cm spacing. Four different insecticidal schedules including control were assessed against the important pests of potato in a Randomized Block Design and each schedule was replicated four times. Observations were recorded on the occurrence of the important pests of potato on standing crop. All the treatments viz.,T_1, T_2, T_3 and T_4 were superior to control T_5. The minimum population of aphid, whitefly and epilachna beetle were observed in the treatment T_1 which received soil application of phorate at planting followed by spraying of chlorpyriphos, imadichloprid and cartap hydrochlodide at 40, 55 and 70 days after planting (DAP) than other treatment including untreated control. However, the tuber treated with chlorpyriphos before planting and foliar spray of acephate, imidacloprid and chlorpyriphos + cypermethrin at 40, 55 and 70 DAP were recorded maximum yield of healthy potato tubers (T2). Viral disease incidence was found least in T_3 (consisting of soil application of phorate at planting followed by foliar spray with chlorpyriphos, azadirachtin and *Bacillus thuringiensis* var *kurstaki* at 40, 55 and 70 DAP). Among the other treatment schedules, T4 (soil application of phorate at 40 DAP, followed by foliar spray with imidacloprid and chlorpyriphos + cypermethrin at 55 and 70 DAP, respectively) gave quite satisfactory result in controlling the pests on potato.

PP - 27: Some probability distribution for the study of mango hopper, *Amritodus atkinsoni* Leth. at Jabalpur, Madhya Pradesh

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In the present paper, an attempt has been made to propose some probability distribution for the study of mango hopper on mango under four sites, each of trunks, primary, secondary and tertiary branches. The data were recorded from an experiment which was conducted in the experimental field at Jabalpur during *rabi* season 2008-09.There were nine varieties and eight insecticidal treatments with three replications for screening and evaluation respectively against the mango hopper. It may be suggested that Poisson, binomial and negative binomial distribution describe the pattern of mango hopper for trunks, primary, secondary and tertiary branches. The parameters of the distributions were estimated by method of moments, method of proportion of zeroth cell and maximum likelihood. The distributions describe the data well.

PP - 28: Relative susceptibility of two high yielding mulberry (*Morus alba* L.) cultivars to whitefly and thrips

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Mulberry is grown in more than 1.92 lakh ha in India for its foliage to feed silkworm (*Bombyx mori* L.) for production of silk of which >0.3 lakh ha is in Eastern and northeastern India. To augment the production of silk high yielding mulberry cultivars were developed and released. During 60's S1 and in the late 90's S1635 were developed with a yield potential of > 28 and > 40 mt $ha^{-1}yr^{-1}$ respectively and these are well established and popular in the eastern and northeastern India especially in indo-gangetic plains. Due to prevalence of hot and humid conditions in this area insect pest is a serious predicament for the production of mulberry during March to October. To study the relative susceptibility of two cultivars (S1 and S1635) incidence of pests like thrips and whitefly were recorded in three consecutive years (2005—08) on weekly intervals in the plots maintained with recommended package of practices, routine cultural operations except plant protection measures at CSR&TI, Berhampore, West Bengal. It was observed that though the average pest population, of both whitefly and thrips, was slightly higher in S1635 than S1, the difference between those was not significant.

PP - 29: Complete nucleotide sequence of DNA segment A of sweet potato leaf curl virus isolate from West Bengal (SPLCV-BCKV) and its relationship with allied members of the Begomoviruses

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In the present study, the sweet potato infecting Gemini virus isolated from the plants of the experimental field of All India Coordinated Research Project on Tuber Crops, Bidhan Chandra Krishi Viswavidyalaya (BCKV), West Bengal was detected by polymerase chain reaction (PCR). PCR products amplified from DNA-A were cloned and sequenced. The DNA-A had two ORFs (AV1 and AV2) in the virion sense and four ORFs (AC1, AC2, AC3, and AC4) in the complementary sense, separated by an intergenic region (IR) containing a conserved stem-loop motif. Sequence comparisons showed that the DNA-A sequence of SPLCV-BCKV (gene bank accession No. FN432356) was closely related to those of strains of China, USA, Georgia and Spain with nucleotide sequence identity ranging from 83% to 95%. The individual nucleic acid sequence of coat protein (AV1), precoat protein (AV2) on the virion-

sense strand, replication initiation protein (AC1), transactivator protein (AC2) and replication enhancer protein (AC3) and AC4 protein on the complementary-sense strand of SPLCV-BCKV was compared with other SPLV isolates showed that AC2 and AC3 genes shared amino acid similarities with 84-92% and 88-90% respectively and SPLCV-BCKV isolate showed major sorts of insertion and deletion of amino acids. The comparison also revealed that AV1 and AV2 of SPLV-BCKV isolate highest identity with other isolates. Multiple nucleotide sequence alignment of the common region of the isolate of Sweet potato gemini virus (SPLCV-BCKV) compared with other SPLCV isolates for ancestor analysis.

PP - 30: A database on parasitoid of insect pests of Manipur (North East India)

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Parasitoids, the agents used in biological control possess the potential to be effectively employed in the integrated pest management programme owing to their parasitic nature, high reproductive potential resulting to easy mass multiplication and seasonal synchrony with their insect host. In Manipur (NE India), crops are extensively grown throughout the year due to presence of favorable climatic conditions. To protect these crops from pests devastation we have been solely depending on chemical pesticides, the side effects of which have come to fore so candidly that there is a serious concern for finding alternative methods of crop protection. The concept of integrated pest management has received a greater acceptance in the present scenario of environment degradation and food contamination. Hence, propagation of parasitoids as a means for controlling insect pest is necessary for providing a successful integrated pest management program. Taking into consideration the importance of conservation and augmentation of parasitoid bioresource, documentation of the useful information was undertaken to design a database of parasitoids infesting insect crop pests of Manipur.

The database was designed by using MS-Access. The database is for academic purpose which includes the taxonomic details of the parasitoid, host insect, host plant, morphological characters, geographical distribution, period of activity, parasitoid behavior and its biology. Image of the parasitoid species are also available which will help in easy identification of the species.

At present this parasitoid database contains 46 records which were gathered by conducting a systematic survey of parasitoids on insect pests of crops in different localities of Manipur varying in altitude and seasons. Parasitoid database provides a user friendly interface to the scientists, research scholars, students and the farmers of the region to retrieve information easily with less time and effort for their attempt to enhance the conservation and augmentation of the parasitoids. Updating the data further with more records and making it available on the World Wide Web for public access will be our future work.

PP - 31: Synoptic weather normality information for farmer's crop planning and decision making

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Climate is the most significant factors being largely responsible for the success or failure of a particular crop in a given area. Growth and development phases are greatly influenced by environmental temperature in rice, groundnut, potato and wheat. A field experiment was conducted at a farmer's field in the village Senkapur, Birbhum (23^{0}362 532 2† N latitude, 87^{0}372 592 2† E longitude with an average altitude of 46 Above mean sea level (AMSL), as per GIS) located on the bank of Ajay in a flood–prone but earth-embanked area during 2002-2005 to study the effect of temperature on crop growth stage for decision making for crop planning. Optimum temperature required for cultivation 20-35 ^{o}C, 20-30 ^{o}C, 16-22 ^{o}C and 15-25 ^{o}C which were correspondent to mean temperature observed 29.57 ^{o}C, 29.32 ^{o}C, 20.12 ^{o}C and 20.24 ^{o}C in rice, groundnut, potato and wheat respectively in the experimental area during cropping seasons. Average maximum, minimum and mean air temperature from germination to maturity stage was associated with the optimum temperature required. Mean temperature is required around 22 ^{o}C for the entire growing period of rice which was not matched in the kharif seasons in the experimental area but it may be matched in the summer seasons i.e. first fortnight of January appears to the optimum time for transplanting of boro rice. Predictable (± 1 SD) temperature both in maximum and minimum in standard weeks matched in case of groundnut in vegetative growth to maximum pod growth; whereas predictable (± 1 SD) temperature matched in the early stage of crop growth in Max. T and Min. T; but Min T dose not matched in the later stage of crop growth in potato and wheat.

PP - 32: Incidence of *Aleurocanthus* spp. (Aleyrodidae: Hemiptera) on betelvine (*Piper betle* L.) and their interaction with host plants

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Betelvine (*Piper betle* L.) is a perennial dioecious evergreen creeper grown in shady condition with high humidity. In India, it is commercially cultivated over 50,000 ha as an important cash crop and is one of the least land- intensive and highly labour-intensive crops. In spite of the tremendous potentially of the crop, cultivation of betelvine is highly risky and returns are uncertain because of its proneness to several pests and diseases, aggravated by the moist and humid conditions of the plantation. A good number of hemipteran insect pests occur in betelvine ecosystem

which causes substantial damage to betelvine. Among these, aleyrodid flies (Hemiptera: Aleurodidae) are major pests of betelvine. During the faunastic survey in betelvine in West Bengal, a polyphagus species, *Aleurocanthus rugosa* Singh (commonly known as betelvine blackfly), was found to occur along with *Singhiella pallida* (Singh) (known as betelvine whitefly) in the betelvine conservatories (borojas) of West Bengal causing severe damage to the foliage of betelvine. Besides this, a new species of Aleurocanthus (yet to be described) has been recorded here on betelvine and as well as on Piper longum L. Another species, A. nubilance (Buckton) which was once recorded on betelvine in Bangladesh in 1900, was not found in this area. Detection of host resistance against insect pests is very relevant for genetic improvement programmes. Till date there is no information on the source of resistance if any against betelvine blackfly, *A. rugosa* .The reaction of some betelvine cultivars to *A. rugosa* was tested in the boroja where varietal collections from different parts of India were maintained. None of the entries under observation was completely free from infestation. A few cultivars [CARI- 2 (AN), CARI-6(AN) and Bilhari] showed moderate resistance reaction against *A. rugosa*. Awani Pan (*Piper hamiltonii*) showed resistant reaction.

PP - 33: Study on bioefficacy of newer chemicals against pigeonpea pest complex under late sown conditions

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In Madhya Pradesh, the low yields of pigeonpea crop are due to pod borer complex and physiological shriveling. Studies were carried out on reaction of pigeonpea genotypes against pod borer complex under late sown conditions. Twenty two genotypes of medium maturing group were sown on 28th August, 2008 under unprotected conditions in three replications in the experimental field at Jabalpur during kharif season 2008-09. Pod infesting insect pests recorded were pod fly, *M. obtusa*, gram pod borer, *H. armigera*, pod bug ,*C. gibbosa* and plume moth, *E. atomosa*. Out of the four pests, *M. obtusa* established as the most important pest on the basis of pod and grain damage, followed by *E. atomosa*, *H. armigera* and *C. gibbosa* respectively. Perusal of the data revealed that no genotype was found to be free from any one of the pod infesting pest complex. Pod damage due to pod fly, gram pod borer, plume moth and pod bug significantly ranged from54.68 to 84.69%, upto 12.27 %, upto 29.84 % and upto 7.87 % respectively. Whereas grain damage due to pod fly, gram pod borer, plume moth and pod bug significantly ranged from28.63 to 63.38 %, upto 4.38 %, 13.1% and 3.09 % respectively.The pod and grain damage due to physiological disorder varied from 14.71% to 52.42% and 6.20% to 25.97% respectively. Out of the 22 genotypes screened against pod borer complex, no genotype was found to be free from damage from pod fly, whereas genotype BDN-2 was free from pigeonpea plume moth infestation.Further genotypes JKT-240 and JKM-8 were found to be least susceptible against insect pest's viz. plume moth, pod bug and pod borer respectively. In addition they were least damage due to physiological disorder.

PP - 34: Tropical and subtropical fruits in Bangladesh-in areas of nutrition food security, economy, women participation and proverty reduction

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Bangladesh economy is predominantly dependent on agriculture. So, the importance of horticulture in the National economy has been well justified. The Horticultural crops, particularly fruits is playing a vital role in crop diversification, nutrition, economy, environment, with an ultimate goal of balanced diet, food self-sufficiency and poverty alleviation. Our Government has paid much emphasis on fruits, vegetables, spices and flowers production as our diet is rice based. Although there has been considerable success in variety development and technology generation but their application are not adequate. Improved varieties of fruit like mango, guava, jackfruit, litchi, pineapple and banana are available in Bangladesh. The paper deals with mainly achievements, constraints and opportunities of horticultural crops (fruits) in Bangladesh. The paper also deals with the present status of production of temperate fruits in Bangladesh-a strictly tropical country. However, a number of temperate fruits are now growing in Bangladesh. They are also contributing in nutrition and poverty alleviation of our land scarce, malnutrition affected poor people. Bangladesh Agricultural University established the largest fruit repository including a number of temperate fruits here in Mymensingh. Export and import situation are also addressed in the paper. In Bangladesh, lots of underutilized fruits grown largely in the homestead, fallow, forest areas, as well as, in the road/rail sides with less care. Those fruits are well adapted to the local climate, highly nutritious and contributing in the poverty reduction and household food security of rural peoples. Huge number of tribal people are also dependant on the underutilized fruits. Underutilized fruits also contributing significantly in herbal medicine. Underutilized fruits trees like river ebony, velvet apple, Garcinia cowa, ber contribute to protect natural disaster and balancing the coastal ecosystem. Contribution of the fruits in the nutrition of poor people and to alleviate poverty in coastal, hunger prone (monga) and flood affected areas also addressed. Plantation of underutilized fruit ber (Jujube) cv. BAU Kul 1 tremendously contributes in the poverty reduction and natural soil reclamation from saline to non-saline condition. Almost every year Bangladesh facing serious flood and other natural disaster in about one third of the area where serious food shortage, nutrition problems and poverty enhancement happened. Similarly, in the extreme northern part of the country (about one tenth of the country area) periodic serious food crisis due to shortage of employment, no crops harvest in that time causes disaster which is popularly called as Monga (hunger prone). In all these areas underutilized fruits contribute a lot as risk buffers, ensure household food security. The paper mainly deals the contribution of underutilized fruits for food, nutrition, rural employment, women participation and risk managements. In the fruit orchards, BAU developed garlic and onion are growing as understory crop. Carrot also grown very well as multistory crops. Finally, the paper focuses on the future policy of the managements of fruits in Bangladesh for economy, nutrition, food and sustainable development.

PP - 35: Fruit tree improvement programme (FTIP)-A one stop service for fruit development, production, extension, food security and research

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Fruit tree improvement project (FTIP)- The largest depository/germplasm centre of fruits, medicinal plants and agroforestry in Bangladesh. Initially the project was established on 1 acre of land in 1991 funded by Swiss Agency for Development and Cooperation (SDC) whose mission was to establish of a seed bank and extension of technologies among the farmers. Over the past 16 years FTIP has developed a vast array of improved and conserve resources and science based appropriate technology for fruit tree propagation. Currently it is operative on 21 acres of land with the objectives i) to maintain the germplasm centre (GPC) as a facility for education, research and training ii) to conserve the germplasm resources (fruit tree, medicinal plants and associated agroforestry sp. iii) to supply quality planting materials to various organization (DAE, BRAC, Proshika, World Vision Bangladesh, BADC, etc.). FTIP possesses 163 varieties of mango, 39 varieties of guava, 25 varieties of litchi, 48 varieties of citrus, 94 accession of Jackfruit, 67 species of minor fruits, 31 species of exotic fruits collected from 19 countries including 97 species of medicinal plants. FTIP has released total 32 varieties of fruits. Recent achievement at FTIP is development of 'BAU KUL (*Ziziphus mauritiana*)' which is in great demand all over the country. Another achievement is development of polyembrayonic sapling of mango by which we can get easily authentic quality planting material (QPM) without vegetative propagation. Different systematic approach like sapling distribution, exchange visit, motivational tour, demonstrations are performed for implementation of the project. In total 60 MS and 8 Ph.D. students have completed their courses and presently 12 Ph.D and 25 MS students are doing research here from different discipline. FTIP helps in education, research, propagation and disseminating improved germplasm and other technologies country wide through extension GOs, NGOs and private sectors that will help the farmers to improve their economic condition as well as whole country. International organizations may exchange germplasm of fruits from this program.

PP - 36:Food security in Bangladesh: evaluation of cassava (*Manihot esculenta*) Morphotypes based on hydrogen cyanide acid toxicity and protein content of tuber

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Cassava is a perennial shrub and its underground tubers contain approximately 30% starch. Cassava starch is widely used as staple, and raw material in the food, feed and pharmaceutical industry. The whole Cassava plants contain cyanogenic glucosides which releases hydrogen cyanic acid (HCN) due to enzymatic reactions during harvesting and processing. In spite of the presence of the potentially toxic cyanogens, Cassava has many desirable agronomic properties including very high yield (fresh tuber yield up to 71 t/ha/yr); drought, diseases and pest tolerance; ability to grow on poor and unutilized high lands like 'ails' of rice field, homestead and hill slopes; therefore no competition with rice lands; and providing food security under changed climate. Determination of HCN level in tuber of the available germplasms of Bangladesh is urgently needed before consumption/ utilization. Five Cassava Morphotypes were collected from different regions of Bangladesh and their tubers were analysed for hydrogen cyanide (HCN) toxicity level and protein content. The edible tuber was analysed for HCN at fresh and boiled (100^{0}C for 1hr) conditions. The flesh of fresh tubers of all the Morphotypes had higher level of HCN (102.36 to 121.49 mg HCN/kg fresh tuber). The safe level of HCN for human consumption is less than 50 mg/average body weight. Boiled tuber of two Morphotypes, 'Comilla' and 'Khagrachari', had safer level of HCN (<50mg HCN/kg boiled tuber) and the other two Morphotypes, 'Sagordege' and 'White' contained higher level of HCN (>50 up to 250mg HCN/kg boiled tuber) unsuitable for consumption but can be utilized in the industry. Comilla Morphotypes also possessed higher tuber protein content (2.53%) than in the others (average of 2.05%). We apparently recommend Comilla and Khagrachari Morphotypes for human consumption as staple. However for validity repeated analyses are being carried out toward final recommendation. Use of cassava and cassava product like cassava flour would supplement cereal, like rice and wheat, to a great extent under changed climatic condition in Bangladesh.

Session C: Ecology and biological management of plant pests

- **Chairman : Dr. B. Ramanujam**
- **Co-Chairman : Dr. (Mrs) Pratibha Sharma**
- **Rappoteurs : Prof. S.K. Pan**
  Prof. S. Das

Lead Lecture :	**02**
Invited Lectures :	**03**
Oral Presentation :	**01**

LS - 1: Tillage and weed management on weed population dynamics and weed control efficiency in different cropping systems

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Tillage or soil surface manipulation to obtain desired seedbed is a major input in agricultural production. Among the total production losses, weeds alone contribute 33% share. The optimum tillage practices combined with effective weed control method is to be identified for efficient weed management in different cropping systems.

Hence, field experiments were conducted in different AICRP-WC centres of India to develop information on weed population dynamics in different cropping systems as influenced by tillage and weed management methods under irrigated condition. Experiments include two different tillage methods viz., Zero and Conventional tillages in all possible combinations integration of manual, herbicidal and herbicide + manual methods of weed management for both the crops in a cropping system. Studies were carried out in four major cropping systems like rice, maize, pearl millet and pulses based cropping systems in different regions of our country.

Results revealed that major weed flora, weed population dynamics and yields were influenced by different treatments under four major cropping systems. Major weed flora of the rice based cropping systems are, *Panicum repens, Echinochloa crusgalli, Echinochloa colona* and *Marselia quadrifolia*. In maize based cropping systems *Chloris barbata, Cynodon dactylon, Dactyloctenium aegyptium, Cyperus rotundus Acalypha indica, Amaranthus polygamus, Amaranthus viridis, Trianthema portulacastrum are the major weeds. Cyperus rotundus, Cynodon dactylon, Commelina benghalensis, Phyllanthus niruri, Chenopodium album* and *Cynodon dactylon* were the dominant weeds in pearl millet based cropping system. Whereas, *Cynodon dactylon, Cyperus rotundus, Acalypa indica, Portulata oleracea, Convolvulus arvensis, Chenopodium album, Digera arvensis* are the major weeds observed in pulse based cropping system.

Weed density and weed dry weight in rice based cropping system, the lowest weed dry weight was obtained in CT-ZT as compared to ZT-ZT, ZT-CT and CT-CT. Among the weed control treatments, application of recommended herbicide recorded the lowest weed density and dry weight. Under maize based cropping system ZT-CT and hand weeding twice recorded lower weed density in both tillage and weed management practices. Lower weed dry weight was recorded with conventional – conventional tillage combined with hand weeding. In pearl millet based system ZT-CT recorded significantly lower weed density. Tillage treatments did not influence the weed dry weight. Hand weeding twice recorded significantly lower weed dry weight. Higher weed control efficiency was observed in HW followed by PE herbicides. With respect to pulse based cropping system CT-CT recorded the lowest weed dry weight and HW twice recorded minimum weed dry weight. Integration of conventional tillage with zero or conventional tillage in combination with hand weeding or herbicide + HW was found to be efficient in reducing the weed density and dry weight and increasing the productivity of different cropping systems.

LS - 2: Changing role of biological control in IPM under present agricultural scenario

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In the present WTO regime, quality of the agricultural produce has gained importance apart from quantity produced. Globalization of agriculture necessitated the Indian farmer to follow Good Agricultural Practices (GAP) in crop protection through Integrated Pest Management (IPM). Globalized competition led the farmer to adopt sustainable agricultural approaches to improve the quality of the produce without chemical/ pesticidal residues. Till the last decade, pesticidal applications considered to be the prime measures for insect pest and disease control in major crops. However, due to indiscriminate use of pesticides, several of the non-target beneficial organisms like natural enemies, honeybees and other such useful fauna are adversely affected causing ecological imbalance resulting into unaccountable amounts of deleterious effects on "Mother Nature". Several non-insecticidal methods of pest control such as Biological Control, use of Pheromones, Cultural Control and use of botanical insecticides started gaining importance in IPM programmes in different important crops. Among various alternative approaches adopted in pest control, Biological control based Bio Intensive Pest Management (BIPM) of crop pests is found to be the most important and practically feasible in the present scenario of Indian agriculture.

Parasitoids, predators and microbial organisms as Bio Pesticides are the core components of BIPM being advocated against important pests in major crops. *Trichogramma* egg parasitoid against gram pod borer, rice stem borer, diamond back moth in cabbage and castor semilooper; *Bracon hebetor* against insect pests of coconut and sugarcane; *Brachymeria* against the pupae of several pests of plantation crops are some of the successful examples of using parasitoids in pest management while *Chrysoperla* sps against aphids and leaf hoppers, Ladybird beetle against soft bodied insects;; *Cryptolaemus montrouzeirii* against mealy bugs are the noteworthy predators to be mentioned under BIPM. As far as microbial based Bio Pesticides are concerned, Insect specific Nucleopolyhedrosis virus (NPV) is effective against lepidopteran insects like *Helicoverpa armigera, Spodoptera litura* and *Achaeae janata* in different crops. Bacterial Bio pesticide, *Bacillus thuringiensis* is available in commercial formulations such as Dipel, Delfin, Halt, Spicturin, Biolep, BioAsp etc. Entomopathogenic fungi, *Beauveria bassiana*, *Metarhizlum anisopliae* and *Verticillium lecanii* are used against important pests like gram pod borer, tobacco cater pillar and sucking pests like thrips, aphids and mealy bugs. *Trichoderma viride, Pseudomonas fluorescens* are other plant growth promoting antagonistic organisms used for the control of many plant diseases. Entomopathogenic nematodes like *Heterorhabditis* sp, *Steimernema* sp. are also employed in insect control operations in tobacco, chick pea, pigeon pea etc.

Biological control of the weeds through biotic agents is also gaining momentum in the recent years. *Zygogramma bicolorata* against *Parthenium hysterophorus, Neochitina bruchi* (weevil) and *Orthogalumna terebrantia* (mite) against water

hyacinth; *Puccinia spegazzinii* against *Mikania micrantha* are being exploited for the purpose.

Despite several advantages, certain constraints in the application of Biological Control need to be addressed for effective implementation. Availability of bio products; quality and shelf-life concerns; proper formulation technology; lack of awareness among the farmers about the right way of their usage; competition from the chemical pesticides are some of the problems crippling the real success of these eco-friendly products. Solutions for all these have been discussed herewith. Scientific community has come out with mass production techniques for several parasitoids, predators and bio pesticides standardized for commercial scale production. Several Government programs are in progress highlighting importance of Bio control. Similarly, failure of certain insecticides to control insects in some occasions compelled the farmers to turn to Biological Control. Research efforts to expand the killing spectrum and improve the environmental stability of microbial bio agents have yielded fruitful results. Modification of entomopathogens to grow on artificial media and also to propagated host tissues to be used as media is being actively worked out to bring down the cost of mass production of these organisms.

With the growing awareness about alternate protection technologies among farming community and with positive initiative from Government machinery, days are not far when biological control and other eco friendly approaches can offer an effective substitute to chemical pesticides. This is evident from the fact that several Multinational companies have already entered bio pesticides production business.

The scope of these bio-rational methods of pest management as an integral part of sustainable agriculture is evident from the fact that they are practically being used as an effective component of IPM in several major crops grown in India and can be effectively incorporated as an effective tool in sustainable agriculture.

IL - 1: Biosystematics and biocontrol potential of entomopathogenic nematodes for managing insect pests

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Global demand for organic agri-products, serious environmental concerns and pesticidal bio-magnification, have led to search for ecofriendly non-chemical pest control strategies. Biological control is one of the means among multifaceted strategies, under which entomopathogenic nematodes have emerged as excellent candidates for managing a wide range of insect pests. These nematodes are soil dwelling beneficial organisms which can kill the insect host within 24-48 hours. These nematodes carry symbiotic bacteria, belonging to the family Enterobacteriacae, which are released in the insect hemocoel, where bacteria multiply and kill the host due to septicaemia. The nematodes in turn feed on the bacteria and degraded tissues, complete 2 –3 generations, and then emerge en masse as 3rd stage infective juveniles ready to seek another host. These nematodes are grouped under the families Steinernematidae and Heterorhabditidae of the order Rhabditida. Till to date, there are two known genera (*Steinernema* and *Neosteinernema*) under Steinernematidae, and only one (*Heterorhabditis*) under Heterorhabditidae. The type species of *Steinernema* is *S. kraussei* and more than 56 other species. The genus, *Neosteinernema* is monotypic with type and the only species, *N. longicurvicaudatum*. There are 10 valid species of *Heterorhabditis* with its type species *H. bacteriophora*. The steinernematids and heterorhabditids can easily be differentiated on the basis of morphological characters of their infective juveniles, females and males. Besides, there are distinct differences in their biology especially the type of adults formed in the first generation after invading the insect hemocoel. Steinernematids produce amphimictic females and males in all the generations, while heterorhabditids produce only hermaphroditic females in the 1st generation and amphimictic adults in the 2nd generation. Taxonomy of these nematodes is quite tedious and complex involving morphological data of infective juveniles and adults of two generations, tests for reproductive isolation and molecular characterization with respect to RFLPs and sequencing of ribosomal DNA. Recently, differences in ITS (Internal Transcribing Spacer) region of r DNA has been found to be of great value not only in species identification but also in deducing their phylogenetic relationships. The differences in ITS region of ribosomal DNA also serve as a useful tool for differentiating the species of symbiotic bacteria.

These nematodes are ecofriendly efficient biocontrol agents having the capability to recycle in the environment, and at the same time quite safe for the human health, environment and the non-target organisms, and therefore exempted from registration in many parts of the world. These are compatible with most of the pesticides as well as other bioagents like Bacillus thuringiensis, and can be easily applied in the soil or sprayed on the foliage depending upon the target insect, requiring no special equipments. These are already being exploited against insect pests in many developed nations. Presently, in USA, Europe and Australia, more than hundred companies are mass-producing, formulating and marketing these

nematodes for their widespread use against insect pests in home gardens, orchards, turf grass and mushrooms gnats.

In India, much of the earlier work (1965-1985) on EPNs was carried out on the exotic strains, but that did not have any practical relevance since the exotic strains could not establish in local agroclimatic conditions. Resultantly, several indigenous strains of EPNs have now been isolated, of which only two have been described as new species – Heterorhabditis indica by Poinar et al, 1992 from Tamil Nadu and *Steinernema thermophilum* by Ganguly & Singh, 2000 from New Delhi. Besides, a few of them have been identified as *S. carpocapsae, S. feltiae, S. bicornutum, S. glaseri, S. riobrave, S. siamkayai, S. tami, H. bacteriophora* and *H. indica*, while a large number of strains are yet to be identified. Their increasing importance in integrated pest management demands precise identification of species and their strains for not only pursuing further research on them but also for patenting and regulatory purposes, which require a sound biosystematics base.

In depth studies on *S. thermophilum* had shown it to be heat tolerant, having very wide host range and wide range of moisture requirement, and capability to access the host located on the soil surface as well as at a depth of 10 cm. It can effectively kill several insect species of agricultural importance and household pests, belonging to the orders Lepidoptera (cabbage butterfly, tussock caterpillar, bihar hairy caterpillar, diamond back moth, american boll worm, tobacco caterpillar, beet army worm, greater wax moth), Orthoptera (rice grasshopper, field cricket, house cricket, desert locust), Hemiptera (red cotton bug and plant lice), Homoptera (aphids, mealy bugs, whitefly), Isoptera (termite), Coleoptera (seven spotted lady bird), and even some of the noxious veterinary pests (ticks).

Recently, formulations of *S. thermophilum* (Pusa NemaGel and Pusa NemaPearl) with significantly enhanced shelf life even at temperatures upto 40^0C, have been developed and are in the process of commercialization. Soil application of Pusa NemaGel, has already shown promising results for managing termite infestation on maize and Diamond Backmoth on cabbage at IARI fields. These biopesticidal formulations may prove to be useful for incorporating in the IPM schedules not only in India, but also in other tropical and subtropical parts of the world.

There is now urgent need to explore the indigenous strains, identify them, characterise them ecologically before testing them under field conditions. The efforts should also be made to explore the possibility of insect toxins and insect toxic genes present in the symbiotic bacteria for developing the biopesticides as well as developing the transgenic plants resistant to insects.

IL - 2: Ecological behaviour of biocontrol agents against major soil-borne and foliar pathogens

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Research interest in dissecting the complexity of the interactions that take place in vitro conditions and utilizing specific antagonistic microorganisms or agricultural practices so as to purposefully recreate a pathogen-suppressive microbial environment has increased in recent years.Rhizosphere colonization ,Competitive saprophytic ability (CSA) are the parameters of the ecological behaviour of a biocontrol agent (BCA) under varied climatic conditions. CSA can be tested by the colonization potential of the BCA of the organic matter available in the rhizosphere. The major antagonist's viz., *Trichoderma harzianum, T.viride, Pseudomonas florescence* are the common microbes dealt widely in India for biocontrol which required to be dealt ecologically.

Several mechanisms operating alone or in combination are known to be involved in antagonist interactions in the phyllosphere. Nutrient competition, antibiosis, and mycoparasitism are the major mechanism operating in the soil or rhizosphere. Additional mechanisms such as induced resistance, production of biosurfectants, interference with pathogen related enzymes and undoubtedly a number of still unknown mechanisms may compete the microbial arsenal.

A potential fungal strain *Trichoderma harzianum* (Th3), *Aspergillus niger* (AN 27), *Pythium oligandrum* and *Pythium lycopersicum* identified to be effective against soil and foliar in lab were evaluated for ecological parameters. The basic survival structures are spores, conidia, chlamydospores, oospores etc. The associations of the different antagonists with the root cortex, rhizoplane, and rhizosphere were measured with different crop species. Attempts on detoxification of the metabolites of *Alternaria* spp. by *Trichoderma* was also deployed to understand the biocontrol mechanism. Some of the answers are known to the scientists working with the microorganisms but again we still need to explore some of the basic questions. The efficacy is still sometimes being questioned. The powdered formulations are tested for the colonies of the active antagonist. Are they able to effectively multiply, the conditions required for effective multiplication, effective medium.What is the long term ecological impact of these bioformulations. The release of bioformulation in the soil and foliage is very important because it is the potential of the formulation for the success of bioagent. All components of the bioformulation are important.Many aspects of biocontrol agent production and development represent new areas. To develop new products different from traditional products, biocontrol agents must not only be produced in high yield but must also meet the following quality criteria: high (near 100%) retention of cell viability with maintenance of crop compatibility and bioefficacy during several months of storage. Once biocontrol agents are har-vested from culture, they must be stored (preferably in a dry, nonrefrigerated state) until time for field application. Even after storage, the liquid culture- produced cells must remain not only viable but also active enough to rapidly colonize and establish plant disease protection. The biocontrol application may retain beneficial natural antibiotics, but must be free of metabolites that are phyto-toxic and may have a detrimental effect on the crop. This latter quality is especially pertinent to

biocontrol agents applied and stored as seed treatments. Seed treatments are an efficient and economical means of application because they target the emerging root for colonization by the protective strains, but they run the risk of impacting seed physiology and germination.Therefore, ecological behaviour of all need to be given prime importance.

IL - 3: Mass production, formulation, quality control and delivery of fungal antagonists for plant disease management

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Among the fungal antagonists, species of *Trichoderma* and *Gliocladium* have gained maximum popularity as biocontrol agents due to the fact that they are effective against a large number of soil-borne plant pathogenic fungi without adversely affecting beneficial microbes like *Rhizobium*, their high degree of effectiveness, capable of showing growth promotion on certain crops and ability to suppress root knot nematodes. The major aspects of successful biological control technologies include the establishment of production, formulation and delivery system for microorganisms that results in disease control. With increasing interest in developing alternatives to chemical fungicides, mass production of microorganisms has become a focus of industrial research and development. There are two major methods of inoculum production of fungal biocontrol agents viz., Solid state fermentation and Liquid state fermentation. In solid fermentation the fungus is grown on various cheap cereal grains (sorghum, ragi), agriculture wastes and byproducts (Wheat bran-saw dust, rice bran, Tapioca refuse, Press mud, Coffee-berry husk, Spent tea leaf waste, coconut coir pith, Groundnut shell and poultry manure). This type of fermentation results in a product that is generally used as it is rather than being formulated further. The solid state production is highly labour intensive and fit for cottage industry. These products are likely to obstruct agricultural machinery and thus are probably not feasible for commercial use. These products are used mainly for direct soil application or along with FYM in nurseries / main fields to suppress the soil-borne inoculum. Deep tank fermentation in inexpensive media like molasses and yeast medium is the technological approach most likely to be adopted on industrial scale. Large scale production of *Glocladium virens, Trichoderma harzianum, T. viride* and *T. hamatum* by liquid fermentation in large fermenters has been reported in several countries including India. The system simulated industrial conditions by utilizing commercially available ingredients. Fermentor biomass of *Trichoderma* and *Gliocladium* consisted mainly of chlamydospores with some amount of conidia and mycelial fragments. Air dried mats were ground and mixed (10, 25 or 50% w/w) with a commercially available pyrophyllite carrier. The formulation, thus developed, contained 10^7 propagules/g when mixed in Pyrex (10% by weight). In India, talc is used as a carrier and is mixed with fermentor biomass in 1:2 ratio to prepare talc-based formulation of *Trichoderma*. Fermentor biomass of *Trichoderma*

and *Gliocladium* has been used in a pelletized form or as a dry powder. Pelletized formulations of *T. viride* and *G. virens* have also been developed by using 1% sodium alginate, 10% Pyrex and conidial suspension.

Inconsistent and erratic field performance of microbial biocontrol agents (BCAs) are responsible for failure of successful commercialization. Various quality factors influence the field performance of the microbial BCAs. Among these, the most important ones are strain variations and formulation characters. One of the critical obstacles in commercialization of a microbial-based preparation is the loss of viability of the biocontrol agents in a short period. Most popularly used antagonists in India viz., *T. viride,* and *T. harzianum* in talc formulations have a maximum shelf life of only four months. Shelf life depends not only on strain but also on formulation characters like, quantity and quality of active ingredient (cfu/g or ml and type of propagule, aerial/ submerged conidia, chlamydospore/ mycelia), contamination levels, moisture, nutritional status of formulation etc. The present need is to intensify research on improving shelf life of BCA products, besides regulation and imposition of strict quality control aspects by the government agencies which will help in bringing out better BCA products that can change the image of these agents. At NBAII, Bangalore work on increasing shelf life of talc formulations of Trichoderma using various ingredients (chitin and glycerol) in production medium and heat shock at the end of log phase of fermentation was carried out which can extend the shelf of talc formulation of *Trichoderma* up to one year. An invert-emulsion formulation of *T. harzianum* has been developed with 8 months of shelf life and good field efficacy against root rot of ground nut. To ensure that the products of microbial BCAs do not affect the environment, human beings and other living organisms adversely and to prevent the sale of poor quality products to the farmers, the Central Insecticide Board (CIB) of the Government of India has made Registration of microbial biopesticides mandatory before commercial production/ import/ sale. Guidelines and Data requirements for registration of microbial pesticides (Data on Biological, Physical, Chemical properties and Bioefficacy to the target pest/ pathogen, Effect on non-target organisms, Toxicological reports on laboratory animals, Eco-toxicity, Manufacturing process, Packing and labeling) have been provided in the Annexure of Insecticide Act.

OP - 1: Evaluation of shelf life of some value added bioformulation of *Trichoderma harzianum*

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Shelf life of *Trichoderma harzianum* was studied during 2007-08 in some organic formulations like vermicompost, leaf mold, rice bran and FYM and also their combinations with two oil cakes like neem and mustard cake. The growth was estimated in terms of colony forming unit (c.f.u.) up to 120 days at 30 days interval. In all organic products or their amendment with oil cakes c.f.u. increased up to 60 days and then gradually declined. Among the four organic media, vermicompost retained 2.13 x 10^8 c.f.u. /g at 120 days where as leaf mold, FYM and rice bran retained 2.01 x 10^8 c.f.u. /g, 1.73 x 10^8 c.f.u. /g and 1.51 x 10^8c.f.u. /g of substrate respectively at 120 days of incubation. When oil cake was amended with organic material, vermicompost + mustard cake producedhigh population of the antagonist upto 60 days.

Session D : Impact of key climate change parameters on pest seenario

- **Chairman : Dr. J.E. Luck**
- **Co-Chairman : Prof. S.A. Khan**
- **Rappoteurs : Dr. C. Chattopadhyay**
  Dr. Saon Banerjee

Lead Lecture :	**02**
Invited Lectures :	**03**
Oral Presentation :	**01**

LS - 1: Climate change and climate risk management-an Australian perspective

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This presentation considers both the technical and political environment in which Australia's response to Climate Change is developing. Since the science is, by its very nature, uncertain, any acceptable response both in terms of mitigation and adaptation must manage technical, political and social issues.
Australia has a very variable climate, and has been subject to periodic changes in climate over historical times, and in the recent past. An example of an historical change in climate is given.
Computer simulation models of future climates predict warmer temperatures and, in the main, reductions in rainfall. Discussion of technical issues will concentrate on risk management strategies in an uncertain environment, such as geographic diversification and management of large properties. The presentation also includes an analysis of the management of Drought or "Exceptional Circumstances

LS - 2: An integrative approach to understanding the pest and disease threats to agricultural biosecurity under future climates

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Despite increasing knowledge of the predicted impacts of climate change, the potential threats to agricultural biosecurity remain uncertain. In this study, models have been developed to better predict the responses of pest and disease threats to our changing climate. By coupling host-plant physiology, virus and vector population growth and climatic data with projected climate change conditions, we are able to predict individual species responses and shifts to historic geographic ranges. Strengthened by empirical data, these models are intended to be incorporated into plant biosecurity management and contingency planning, forming the basis of integrated scenario-based decision support systems for emergency

pest and pathogen management. Current work focuses on developing an innovative spatial modelling environment using the bird cherry-oat aphid (*Rhopalosiphum padi*) which vectors Barley yellow dwarf virus (BYDV). The effect of climate change on aphid feeding behaviour, flight time and synchrony with the crop, virus acquisition and transmission rates and wheat phenology changes and physiological responses are being incorporated. Experiments in the Australian Grains Free Air Carbon dioxide Enrichment (Ag FACE) research facility have enabled field based investigations of the effects of elevated (e) CO_2 on wheat pathosystems. Wheat stripe rust (*Puccinia striiformis*) and crown rot (*Fusarium pseudograminearum*) severity, latent period, fecundity and host resistance was assessed under ambient and 550ppm CO_2. While no effects of the treatment were observed with *P. striiformis* over two seasons, an increase in *F. pseudograminearum* biomass under eCO_2 has been observed in 2008. Our integrated modelling and field-based approach to resolving the likely effects of climate change to plant biosecurity will be presented.

IL - 1: Climate Change – A West Bengal Scenario

Swadesh Mishra, Ex- Agricultural Meteorologist & Rainfall Registration Authority of West Bengal, **Email:** swadesh97@ymail.com.

To day Climate change is neither a fantasy nor a story prepared by wishful thinking of a group of scientists, rather a hard reality. Agriculture and food security are the major casualties of climate change in India. To identify the risks posed by climate change and development of adaptation strategies in West Bengal specially in the field of agriculture the following steps are to be followed in a systematic manner.

1. Area or location specific quantification of change including behavioural change of different elements of weather and climate along with trends of important events or weather phenomena. 2. Assessment or evaluation of its impact on different aspects of agriculture i.e, crops and varieties in different seasons over different areas. 3. Estimation of projected change for the coming years. 4. Area or location and time specific suggestions for adaptation for different crops and varieties.

In the present study attempts have been made to find out trends of two major weather and climate elements i.e, rainfall and temperature of 7 – 10 meteorological stations located in different geographical regions of the state from the Himalayas to the Bay of Bengal covering a period of almost 120 years in phases.

It has also been tried to correlate the trend with the frequency of storms and depressions and onset of monsoon in this part of the country. Incidences of drought and floods in the state have also been analysed in brief.

Behavioural change of weather during last three decades which have specific relevance to agriculture of the state have also been listed. The scenario of changing / reducing winter in the state have also been studied using last 30 years temperature data ending in 2009.

Broad outline of adaptation strategies in the background of the changing scenario have been suggested for making best and efficient management of weather- the ' no cost input of nature ' with a view to maximise and stabilise production and productivity.

IL - 2: Changing climate forcing alteration in cropping pattern to trigger new disease scenario in oilseeds and pulses in Indian sub-continent

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The Indian sub-continent has witnessed a shift in cropping pattern in pulses in the last three decades. Several pulse crops viz., chickpea have shifted from highly productive irrigated conditions in northern India to less productive rainfed areas in central and southern India. This has made diseases viz., Ascochyta blight, Botrytis gray mold less frequent with wilts, root and collar rots, pod borer and pigeonpea sterility mosaic becoming important in newer niches. Stemphylium blight, first reported from Bangladesh in 1987 on chickpea is posing danger to lentil and chickpea in Nepal and India. Pigeonpea has moved to higher reaches of Uttarakhand and is now grown in a large part of north Indian plains. This has brought about increase in nematode infestation both in rice and pigeonpea crops. Diseases of the major oilseed crop Indian mustard (*Brassica juncea*), hitherto unknown in farmers' fields viz., rots caused by *Erwinia carotovora* pv. *carotovora*, *Fusarium*, *Rhizoctonia solani* and *Sclerotium rolfsii* are being observed for the past few years in the north-western India. The aforesaid pathogens are known primarily as tropical ones and generally not reported from *B. juncea* cropping system. Some isolates of existing important pathogens of B. juncea viz., *Alternaria brassicae*, *Sclerotinia sclerotiorum* have been found to grow and sporulate well under higher temperature (>30-35^{o}C) and relative humidity (100%) conditions.

Recent changes, towards warmer winters and hotter, drier summers, are in line with current projections for future climate change. Seasonal fluctuations in the severity of diseases will continue under climate change scenarios. Changes in climate will not only affect development of pathogen epidemics but also will affect development of the crop. Drought or water-logging will affect crop growth, yield and heavy precipitation may physically damage crops, prevent spraying operations. Both crop and disease development is driven by growing degree days. However the degree of response is different, so changes in temperature may result in changes in the degree of synchronicity between the susceptibility of the crop and the peak dispersal, infection phases of the pathogen. These indirect effects of climate change on diseases will make risk prediction even more challenging. Under climate change the more unpredictable nature of the weather will create greater challenges in trying to respond to potential disease risks. In-season responses to changes in disease risk will become more important as the weather patterns become more chaotic and outcomes of prevailing conditions become less easy to predict. Under such unpredictable weather, pre-planning programmes of disease management will become more difficult. As a consequence, in-season monitoring of epidemic development by growers, agronomists and expert systems will become increasingly important particularly at the regional and local level. While discussing the above, we feel that the use of robust agronomic practices and well-judged disease management strategies would be required to cope with such challenges. Breeding programmes will possibly be required to align to changing climatic and disease scenario to meet the challenges of continued food security under climate change.

IL - 3: Impact of climate change on insect pests and management options

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Insects being poikilothermic, increase in the incidence and pest load could be anticipated with climate change and plant protection need to undergo dramatic adjustment .Temperature and precipitation can strongly influence the life history and fitness of ectotherms, such as insects. Ectotherms rely on external heat sources and sinks to regulate their body temperature, and small changes in temperature can have dramatic effects on the rates of biochemical reactions .As their body temperature varies with the surrounding temperature they are strongly influenced by climate and weather. Insect life stage predictions are most often calculated using accumulated degree days from a base temperature and biofix point. The effect of temperature on insects largely overwhelms the effects of other environmental factors. It has been estimated that with a 2° C temperature increase, insects might experience one to five additional life cycles per season.

Reports of climate change in altering the distribution, incidence and intensity of plant pests are available. Migrant moths of the Old World bollworm (*Helicoverpa armigera*) had a phenomenal increase in the United Kingdom from 1969-2004 and there have been outbreaks at the northern edge of its range in Europe. Cottony cushion scale (*Icerya purchasi*) populations appear to be spreading northwards perhaps as a consequence of global warming. Cottony camellia scale [*Pulvinaria* – (*Chloropulvinaria*) – *floccifera*] has become much more common in the United Kingdom, extending its range northwards in England and increasing its host range. In Sweden this was previously only known as a greenhouse species, but is now established as an outdoor species. The range of the oak processionary moth (*Thaumetopoea processionea*) has extended northward from central and southern Europe into Belgium, Netherlands. Polar ward extension of several plant pests in Japan over the period 1965 to 2000 . About 40 of the 250 butterfly species in Japan have exhibited northward range extensions in recent years. *Nezara viridula*, a tropical and subtropical crop pest, is gradually moving northward in southwestern Japan, possibly due to global warming, replacing the more temperate species Nezara antennata.

In India the out break of citrus blackfly in seventies during dry weather and humid conditions (due to sprinkler irrigation) in Maharashtra, red spider mites in summer, mealy bugs in dry weather , rice thrips in rainfed rice, heavier incidence of cotton leafroller in shady edges, *Spodoptera* with the advent of rain fall after long dry spell, redhairy caterpillar after rains are some of the examples that reminds the influence of climate/weather on pests.

Temperature influences consumption, developmental rates,distribution and migration, larval survival, larval emergence ,the number of generations a year. As temperature increases insects can respond in several ways – adapt, migrate, or become extinct. The absence of Helicoverpa problem on cotton in Egypt indicates the impact of

temperature on soil pupating pests. Lower winter mortality of insects due to warmer winter temperatures could be important in increasing insect populations. Moisture and CO_2 effects on insects could be other potentially important considerations in a global climate change setting .The washing down of aphids, mites, early instars of mealy bugs and thrips by heavy precipitation is the other extreme. Changes in climate will influence geographical distribution, increased overwintering, change in population, growth rate, increase in number of generations, extension of development season, changes in crop-pest synchrony, changes in interspecific interactions and increased risk of invasion by migrant pests and invasive pests cotton and papaya mealy bug. Coccids mainly mealy bugs and whiteflies due to their above qualities may pose greater threat due to global warming. The cotton mealybug *Phenacoccus solenopsis* Tinsley was reported in 2006 on *Parthenium hysterophorus* for the first time,subsequently recorded on many crops is a serious threat to cotton in every state in India. Recently introduced papaya mealy bug *Paracoccus marginatus* Williams and Granara de Willink is causing heavy loss in more than 50 hosts including papaya, mango, pomegranate and is a serious impediment to upcoming biofuel,Jatropha (considered to be less pest prone) plantations.

Farmers would incur increased costs as a result of increased frequency of insecticide treatment/ pest control measures. Need to focus on insecticides with positive temperature cefficient, measures to prevent inactivation of insect viruses , more heat tolerant parasitoids and predators .Need to , develop pest management strategy taking in account of the impact of climate change on pest status and pest management components is emphasized. Farmers and researchers should keep in mind that climate change is likely to be a gradual process that will give them some opportunity to adapt and develop required pest management strategies.

OP - 1: Current and future climatic distribution of the invasive aquatic weed *Hygrophila polysperma* T. Anders

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Ecological niche modeling is based on the assumption that climatic tolerance of a species primarily limits its geographic distribution. In our current research, we used the Maximum Entropy (MaxEnt) model to predict areas susceptible to invasion by the aquatic plant hygrophila, *Hygrophila polysperma* (Acanthaceae) under current and future climatic conditions. Initially brought to the United States as an aquarium plant, this invasive weed, native to the Southeastern Asiatic mainland now pose a serious threat to Florida water ways by clogging irrigation, navigation and flood control structures. In all, 234 presence only point locations and 20 climatic parameters, including altitude and 19 other bioclimatic variables with spatial resolution of 2.5 arc-minutes available from the WORLDCLIM database were used in this simulation. Two projected emission scenarios of the CCCMA climate model, A2a and B2a for the years 2020, 2050 and 2080 were used to predict potential distribution. Results of the simulation for current situations showed that in United States, MaxEnt predicted that most part of Florida, except the Florida Keys were found to be very suitable for growth of this weed. The model also predicted invasion along the coastal regions of the southern United States with parts of Alabama, Mississippi, Louisiana, and Texas approximated to be highly suitable for its growth. While considering the two climate change scenarios, simulations projected expansions of its existing range in both cases. As evidenced by the fractional predictive area, except for 2050, range expansion for B2a scenarios were found to higher than that of years of A2a scenario. However, no range shift has been predicted for any of these years. Thus it can be concluded that the changing climate will indeed make new area vulnerable to invasion by this weed. This model thus can provide an a priori basis to the land managers for managing new invasions of hygrophila at its very inception.

Session E : Pest Diagnostics

- **Chairman : Prof. Salil K. Gupta**
- **Co-Chairman : Dr. (Mrs) V.G. Malathi**
- **Rappoteurs : Dr. A.K. Das**
  Dr. S. Chakraborty

Lead Lecture : 02
Invited Lectures : 02
Oral Presentation : 02

LS - 1: Diversity and diagnosis of agricultural mites with their importance either as pests or as predators

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The mites of agricultural crops are receiving global attention because of their dual importance, some as destructive pests and others as important predators having potentiality in biological control. The phytophagous mites which belong to families Tetranychidae, Tenuipalpidae, Eriophyidae and Tarsonemidae are known from India by about 775(+) species and predatory mites which include families like Phytoseiidae, Ascidae, Anystidae, Bdellidae, Cheyletidae, Cunaxidae, Erythraeidae, Stigmaeidae and Tydeidae are known by little over 300 species. Among the most diversified Phytophagous mites are Eriophyidae (500 spp./100 genera), followed by Tetranychidae(100 spp/20), Tenuipalpidae(100/20) and Tarsonemidae(20/6). Among predatory mites, Phytoseiidae is the most abundant and diversified group, known by 175 spp/10 genera, followed by Stigmaeidae(25/6), Cunaxidae and Tydeidae both (21/5), Cheyletidae(17/8), Bdellidae(14/6), Ascidae(12/5) and Anystidae, Erythraeidae both (9/4).

The phytophagous groups comprising pest mites can be diagnosed under microscope by body chaetotaxy (dorsal, ventral surfaces, legs, palp etc.), body shape, colouration, nature of leg clawas, specialized sensory structures, male genital organ, etc while their field identification mostly depends upon their occurrence on leaves (upper/ lower surface), nature and extent of leaf discolouration, presence/ absence of web on leaf surface, colonial/non colonial habitat, etc. In case of predatory mites, their field identification will depend upon their colouration, body shape habitat on leaf, movement etc and laboratory identification will depend upon morpho – taxonomic characters.

7This paper discusses diversity and identification of both phytophagous and predatory mites both under laboratory and field condition and highlights the economic importance of these mites with special reference to predatory mites and their role in biological control of pest mites.

LS - 2: Diversity and of begomoviruses-a challenge to crop cultivation in India

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Diseases caused by whitefly transmitted geminiviruses, designated as begomoviruses, are the major constraints in improving the productivity of crops in India. In recent years, several new diseases such as cotton leaf curl, bhendi leaf curl, leaf distortion and yellow mosaic of cucurbits and potato apical leaf curl have emerged. Whether these diseases are caused by new viruses or by new strains of the earlier viruses could be ascertained only when their genomic components are characterized. In the last decade, several research groups have made concerted efforts towards characterization of begomoviruses in Indian subcontinent. Considerable progress has been made in this direction. Investigations on genome revealed the presence of three types of begomoviruses viz., bipartite, monopartite and monopartite viruses with satellite DNA â , which are distributed throughout India. phylogenetic analysis of nucleotide sequence of DNA â of begomoviruses showed distinct nature of Indian viruses among Old World begomoviruses. The analysis of genomic components of begomoviruses infecting cassava, tomato and cotton gave good indication of genetic variability arising out of mutation, deletion and recombination. One interesting feature is association of multiple DNA â components with yellow mosaic virus of legumes and tomato leaf curl viruses. Another feature that contribute to increased pathogenecity is the presence of satellite DNA â. Detection of DNA â in many begomoviruses-disease complex is a matter of concern as it expands host range of the helper begomovirus. The disease scenario is devastating due to heavy build-up of whitefly population causing active spread of the viruses. There are also indications that more than one type of the *Bemisia tabaci* biotypes may be involved in Indian subcontinent. Genetic diversity of the viruses and diverse whitefly population in begomoviruses-disease complex certainly pose a serious threat to Indian agriculture.

IL - 1: Recent developments in diagnosis of *Candidatus liberibacter asiaticus*, the bacterium causing citrus greening (Huanglongbing) disease

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Citrus greening, also called Huanglongbing or yellow dragon disease, is one of the more serious diseases of citrus. The disease infects citrus trees of almost all cultivars and causes substantial economic losses. It is estimated that globally more than 60 million trees had been destroyed by the disease. The disease is now known to occur in 40 different Asian, African, Oceanian, South and North American countries and is slowly invading new citrus growing areas. The causal pathogen of greening is a fastidious bacterium, a member of the a- subdivision of the phylum Proteobacteria, resides in the sieve tube elements in the phloem tissue of infected plants. The greening bacterium belongs to the genus Candidatus Liberibacter, three species of which are currently known, *Candidatus Liberibacter asiaticus*, occurring in Asian countries and in Brazil and the USA (Florida), *Candidatus liberibacter africanus*, recorded from African countries, and *Candidatus liberibacter americanus* present in Brazil. The disease is graft- and vector-transmitted. The psyllids Diaphorina citri and Trioza erytreae are the natural vectors. It has been difficult to consistently detect the Liberibacters using traditional methods, presumably because of the low concentration and the uneven distribution of the pathogens in host plants and insect vectors. In addition, the non-specific nature of foliar symptoms makes the disease difficult to distinguish from nutrient deficiencies or other diseases. In recent times, different PCR-based molecular approaches are developed to detect and differentiate Ca. Liberibacter species using species-specific primers primarily based on 16S rRNA gene or rplKAJL-rpoBC operon sequences.

Greening is one of the most important diseases of citrus in India. A major survey and disease diagnosis project was initiated at the beginning of this decade at National Research Centre for Citrus, Nagpur. Extensive surveys were conducted during 2003- 2008 in some of the major citrus belts of the country (Vidarbha and Marathwada regions of Maharashtra, Abohar and Hosiarpur regions of Punjab, Chettalli, Gudur and Periyakulum regions of Southern India and different parts of North-East India) to record the incidence and distribution of this disease. Commercially important citrus cultivars like sweet orange (Mosambi, Sathgudi, Malta), mandarin (Nagpur, Kinnow, Coorg, Darjeeling) and acid lime (Kaghzi, Vikram, Pramalini, Jayadevi)) and lemon (Assam) were surveyed. Biological indexing of budwoods collected from greening- suspected plants was done on 1- year old sweet orange indicator plants. Typical symptoms of disease on the indicator plants developed 4-6 months after inoculation. Leaf mottling symptom was found to be highly diagnostic for the disease. The disease was initially diagnosed through analysis of the fluorescent marker substances by thin layer chromatography (TLC). To confirm the presence of this bacterium through polymerase chain reaction (PCR), DNA was extracted from leaf midrib and bark tissues by CTAB procedure / Qiagen Dneasy™ Plant mini kit. PCR was performed with different sets of greening-specific primers for amplification of 16S rDNA (OI1/ OI2c), ribosomal protein genes (A2/ J5) and

16S/23S intergenic regions (OI2 / 23S1). All the infected samples yielded specific amplification products indicating the presence of the causal bacterium and the size of PCR products obtained were found similar to that amplified from *Candidatus liberibacter asiaticus*. PCR amplicons were sequenced and the sequencing and phylogenetic analyses (conducted in MEGA 4.0) confirmed amplification of '*Ca. L. asiaticus*' DNA from the GenBank database. Further, digestion of the 16S rDNA PCR product (amplified fragment using primers OI 1/ OI 2c) yielded two fragments of 640 and 520 bp as reported only for *Ca. L. asiaticus*. The psyllid vector of greening, Diaphorina citri was found present in most of the areas surveyed. Ca. L. asiaticus could also be detected by PCR from psyllids (subdivided in batches of 10 insects) collected in HLB-affected orchards. Efforts are, however, continuing to improve every steps of the diagnostic protocol for developing more robust and highly sensitive diagnostic tools.

IL - 2: Recent advances in geminivirus detection

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The detection and identification of viruses has been a challenge since the advent of the discipline of plant virology over a century ago. Till then, a great variety of methods have been developed that permit differentiation of viral pathogens. These methods were initially based solely on identifying the distinct biological characteristics of different viruses, but were soon supplemented with methods based on light or electron microscopy and serology. Later still, the arrival of ELISA and the use of molecular (nucleic acid-based) techniques have revolutionized the diagnosis of plant viruses. While the technologies available to virologists have obviously become more diverse and improved, the challenges have also changed greatly. Detection of plant viruses is becoming more challenging as globalization of trade, particularly in horticultural commodities. The potential effects of climate change have further aggravated the movement of viruses and their vectors, transforming the diagnostic landscape. Additionally, increased human interference and pathogen and vector evolution have combined to increase the spread of invasive plant viruses.

Techniques for geminivirus detection include biological indexing, electron microscopy, antibody-based detection, including enzyme-linked immunosorbent assay (ELISA), polymerase chain reaction (PCR), and microarray detection. Of these, microarray detection provides the greatest capability for parallel yet specific testing, and can be used to detect individual, or combinations of viruses and, using current approaches, to do so with sensitivity comparable to ELISA. Methods based on PCR provide the greatest sensitivity among the listed techniques but are limited in parallel detection capability even in "multiplexed" applications. Better, easier and cheaper than polymerase chain reaction (PCR) or antibody detection, rolling circle amplification (RCA) using the bacteriophage 29 DNA polymerase allows for a reliable diagnosis of geminiviruses and presumably all viruses with small single-stranded circular DNA genomes. The results show the efficiency of this technique in characterizing viral DNA components of several geminiviruses from experimental and natural host plant sources. Nucleotide sequence data offers identification of viral molecule to strain / species level for accurate diagnosis.

In our laboratory, we have developed nucleic acid based diagnostics for a number of begomoviruses causing leaf curl diseases in tomato, chillies, radish etc. We have cloned full-length genome of several begomoviruses associated with these diseases in India. Nucleotide sequencing data suggests occurrence of new Begomovirus species infecting several important crops in India. Case studies on Indian effort for geminivirus detection will be presented. Molecular diversity of begomoviruses and mechanism of synergistic interaction leading to severe leaf curl disease in tomato will also be presented.

OP - 1: Pathogenicity determination of a single complementary sense transcript of satellite DNA-â associated with cotton leaf curl virus

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β a

Cotton leaf curl virus is a type species of genus begomovirus falls under family Geminiviridae. The viral genome is characterized by single-stranded (ss) DNA associated with satellite DNA-â. Satellite DNA-â is a small ss circular DNA of ca.1.3 kb, approx. half the size of DNA-A (ca. 2.6-2.8 kb). This satellite DNA-â encodes a complementary open reading (ORF) âc1 of approx. 350 bp, responsible for inducing cotton leaf curl disease symptoms.

Initially, in order to check the presence of Cotton leaf curl virus infection, coat protein gene was PCR amplified from DNA isolated from infected leaves of cotton by using coat protein (CP) primers. The amplified product was hybridized with the probe of known CP gene of begomovirus, giving a strong signal.

For detection of beta DNA gene in CLCuV infected plants, known beta primers â1/â2 were employed, the gene was amplified and the amplified product was cloned and subsequently sequenced. On the basis of sequence data, primers were designed to amplify âc1 gene and mutated beta gene unable to amplify showing no âc1 gene.

For expression of âc1 gene, Nicotiana benthamiana was used as experimental plant material. Transgenic tobacco plants were regenerated to access the effects of âc1 expression under the control of CaMV 35S promoter. Leaf discs of N. bethamiana were agro inoculated and selected on MS medium supplemented with kanamycin (100 mg/l). After 2 weeks, the callus tissue was differentiated by inoculating them into differentiating medium (shooting medium). The transgenic plants thus produced were phenotypically different from control plants. On the other hand when these plantlets were transferred to soil, showed symptoms typical to naturally infecting CLCuV in field whereas 35S- âc1 (mut) showed no significant change in phenotype. Therefore, for engineering resistance against this virus, DNA-â can be used as a potent candidate. This will help us reducing the yield losses and subsequent control of cotton leaf curl disease.

OP - 2: Identification of *Meloidogyne* species infecting crops in West Bengal

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The nematode infected plant-root samples collected from various crops like rice, tomato, cucumber, frenchbean, brinjal, jute, bittergourd etc. from different locations viz. Gayeshpur, Alaipur, Chandamari of Nadia, Barrackpore of North 24–Pargonas, Bagmundi of Purulia, Coochbehar and Dhupguri of Coochbehar, Khatra of Bankura and Kalimpong of Darjeeling districts were examined for identification of the nematode species (*Meloidogyne* spp.) associated with various crops grown in West Bengal. Nematode infected root samples were processed by NaOCL-Acid Fuchsin method. Nematode egg masses from the infected roots were separated and female nematode specimens were dissected from the root-gall for whole body measurement and preparation of perineal patterns. Freshly dissected females from knotted root were used for identification of *Meloidogyne* species. At least 20 mature females from each root samples were used for preparation of perineal patterns. Identification of species was tentatively done on the basis of perineal pattern. The nematode population from different locations was maintained on the susceptible host for further studies. Morphometrics of females, their perineal pattern and eggs were generated for comparison of *Meloidogyne* populations and identification of the species. The nematodes species identified in this investigation were *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949 infecting jute and cucumber from Gayeshpur of Nadia, tomato from Kalimpong of Darjeeling and Khatra of Bankura, bitter gourd from Alaipur of Nadia districts. While *Meloidogyne javanica* (Trueb, 1885) Chitwood, 1949 was found infecting tomato in Barrackpore of North 24-Paraganas, french bean in Bagmundi of Purulia, tomato in Coachbehar, brinjal in Dhupguri of Coochbehar districts. The occurrence of *Meloidogyne graminicola* Golden and Birchfield, 1965 in rice was found at Balagarh of Hooghly and Chandamari of Nadia.

Concurrent Poster Session II : Plant pest management using pesticides or related products

Posters PP 37 to PP 85

- **Judges for Evaluation :**

Prof. M.R. Ghosh, BCKV

Prof. N. Mukherjee, BCKV

Prof. A. K. S. Huda, Australia

PP - 37: Bio-management of root knot nematode and root rot disease by antagonistic fungi and rhizobacteria

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Four antagonistic fungi and six rhizobacteria isolates were selected, out of eleven fungi and sixteen bacteria isolates from rhizosphere of the vegetable crops. They were studied for suppression of root knot nematode, *Meloidogyne incognita* and root infecting fungi *Fusarium oxysporum* in laboratory and pot experiment on tomato. They not only inhibited egg hatching of root knot nematode and the radial growth of root infecting fungi in vitro but also exhibited strong nematicidal activity by killing the second stage larvae of *M. incognita* to varying degree in pot experiment. All the antagonists were cultured in liquid protein supplemented broth medium and culture filtrates were prepared. The exposure of *M.incognita* eggs and juveniles to the culture filtrates showed strong nematicidal activity than the control ($p > 0.05$). The antifungal activity was determined by dual plate culture test between antagonists and root infecting fungi in vitro. The toxic principle of antagonistic fungal and bacterial isolates was partially characterized by quantitative determination and SDS- PAGE. All the antagonists showed reduction in root knot and root rot disease and promote plants growth as the length and weight of root and shoot in pot trials on tomato plants.

PP - 38:Performance of some carrier's formulations of *Nomuraea rileyi* against *Helicoverpa armigera*

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Nomuraea rileyi (Farlow) Samson is one of the most potential entomopathogen for control of *Helicoverpa armigera* (Hubner). An effort was made to know the usefulness of this entomopathogen in different carriers viz. charcoal, talc, kaolin, lignite, wheat bran and soil on viability and virulence of conidia against *Helicoverpa armigera* under four temperature (4, 10, 25 ^{o}C and room temperature) regimes for six months storage. Outcome of the effectiveness of carrier's formulation revealed that kaolin supported maximum colony forming units of *N. rileyi* followed by lignite and charcoal under four different temperature levels. Low temperature i.e. 4 ^{o}C and 10 ^{o}C retained the relatively higher viability in comparison to 25 ^{o}C and room temperature storage. The efficiency of *N. rileyi* tested at 0, 60, 120, and 180 days of interval and results indicated that virulence of conidia decrease drastically after 180 days even at 4 ^{o}C storage temperature. However, kaolin was the most promising among the entire carrier in respect of infectivity followed by lignite, charcoal and talc.

PP - 39: Evaluation of oil formulations of *Nomuraea rileyi* against *Helicoverpa armigera*

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Nomuraea rileyi (Farlow) Samson is known to infect mainly several economically important and polyphagous pest. Therefore, it has great potential development of myco-insecticide. In this context, effect of different oil formulation (Groundnut, soybean, sesame, sunflower, coconut oil, DC-Tron , Sparrow-888,Tween 80 solution) on viability and virulence of *N. rileyi* under the four temperature regimes(4, 10, 25 ^{o}C and room temperature) assessed and results indicated that conidia formulated in oil formulated in soybean and sunflower oil retain sufficient number of propagules at 4 ^{o}C and 10 ^{o}C temperature storage. Whereas, viability drastically reduced at room temperature. The infectivity of *N. rileyi* in oil formulation in four temperature levels tested at 0, 60, 120, and 180 days of interval and results revealed that infectivity drastically reduces at room temperature however at 4 ^{o}C and 10 ^{o}C maintained virulence in appreciable manner. Higher larval mortality observed in Dc-Tron oil formulation followed by soybean and sunflower oil formulation at both intervals.

PP - 40: Efficacy of plant growth promoting rhizobacteria against soil borne pathogen in cotton

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The interaction of PGPR with soil borne pathogen in cotton was studies *in vitro*. Ten distinct PGPR were selected from rhizosphere and rhizoplane region of different cotton cultivars. The PGPR population from rhizosphere and rhizoplane of different cotton cultivars and from various locations ranged between $6.33x10^{6}$ to $14.66x10^{6}$ cfu and $4.66x10^{6}$ to $13x10^{6}$ cfu respectively.
Efficacy of PGPR was studied by inoculation of fungal pathogen in bacterial mass in plate by inhibition method. PGPR isolates significantly inhibit the mycelial growth of *Sclerotium rolfsii, Fusarium oxysporum, Rhizoctonia bataticola* and *Colletotrichum dematium.* Maximum inhibition of mycelial growth was recorded by CoRb-9 (62.66%) in *Sclerotium rolfsii,* CoRb-8 (56.97%) in *Fusarium oxysporum,* CoRb-10 (55.16%) in *Rhizoctonia bataticola,* CoRb-9 (61.24%) in *Colletotrichum dematium,* while interaction among PGPR and *Trichoderma viride* has not recorded any detrimental effect on the growth of each other.

PP - 41: Effect of agrochemicals on PGPR in cotton

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The studies were conducted to estimate the effects of different pesticides which are used in plant protection practices have been tested on beneficial PGPR and their toxic effect on plant growth promoting rhizobacteria.Sensitivity of PGPR isolates to different pesticides viz. Carbaryl, Carbendazim, Copper oxychloride, Thiram, Vitavax and Paushamycin was tested turbidometrically at 620 nm. The pesticide were tried at recommended dose and bacterial cell growth was measured in terms of absorbance which was recorded at 24,48 and 72 hr.PGPR was found to be sensitive to Carbaryl 50 WP @ 0.3 % (CoRb-1,12.07%), Vitavax @ 0.25 % (CoRb-8 ,20.43 %),Thiram @ 0.3 %(CoRb-3 ,44.67 %),carbendazim (CoRb-1,0.11 %),*Copper oxychloride* @ 0.3 % (CoRb-6, 0.25 %). Antibiotic Paushamycin @ 250 ppm showed maximum inhibition of growth of PGPR isolates .Maximum suppression in growth was observed in CoRb-2 (48.20%) at 72 hr.

PP - 42: Effect of arsenate on growth and yield attributing traits of rice in simulated condition

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Arsenic (As) contamination of rice is a newly uncovered disaster on a massive scale. The physical and chemical techniques available for remediation of As has not shown promise to deal with this huge problem. Various conventional and biotechnology approaches are being employed to develop durable tolerance to biotic and abiotic stresses. However, no efforts have been made to develop As tolerant cultivars. Development of arsenic tolerant rice cultivars through breeding and molecular approaches is an urgent need for improving the safe crop productivity in developing countries, particularly in India. To achieve the goal of developing As tolerant rice variety, a collaborative research work has been undertaken. A pot experiment in simulated As condition with different doses of AsV (20, 30, 50 ppm and control) was done with four popular rice varieties viz. Triguna, IR 36, PNR 519 and IET 4786 for grain As levels and other phenotypic/physiological characteristics. From this experiment some striking results have come out. With the increase of As concentration in soil, the number of tillers increased in Triguna and IR 36 upto 30 ppm while PNR 519 and IET 4786 exhibited less number of tillers when exposed to different doses of As concentration. The average plant height of these varieties also showed a similar trend and it increased upto 20 ppm in Triguna and IR 36 and IET 4786 but PNR 519 was found inhibitory. In contrast, seed weight of all the varieties was found to have increased with the increase in concentration of As upto 30 ppm. In general, As (V) exposure had led to early flowering in rice cultivars and consequently early seed maturity in almost all the cultivars.

PP - 43: Effect of *Streptomyces avermitilis* as a biopesticide for the management of root knot nematode, *Meloidogyne incognita* in Bhendi

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An experiment conducted under glasshouse conditions for the management of *Meloidogyne incognita* on bhendi with *Streptomyces avermitilis* , revealed that the plants treated with *S. avermitilis* isolate (Manp) as seed treatment recorded the highest shoot length of (55.5) cm, fresh shoot weight of (67.8 g), dry shoot weight of (43.7g,) and fruit weight of (164.0) g/plant. This treatment significantly increased the root length (30.7cm), fresh root weight (22.5g), dry root weight (8.80g) and number of fruits/plant 14.0. The treatment was on par with the isolates of comp and Poul as seed treatment. Among all treatments, the isolate of Manp recorded the least gall index (1.62), soil nematode population (108.6).

PP - 44: Bioefficacy of pesticides against *Aphelenchoides besseyi* and sensitivity of tuberose bulbs to hot-water treatment

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Bioefficacy tests with neem based formulations on *A. besseyi* population infecting tuberose showed that azadirachtin at 1% and 5% was nematicidal. Neem based formulations containing 1% and 5% azadirachtin caused 27% to 42% mortality after 2 hours of exposure. Among other synthetic pesticides tested, monocrotophos 36SL showed killing to the extent of 41% while cartap hydrochloride 50WP and carbosulfan 25EC showed up to 14% killing effect at relatively higher concentration (0.2%) after 2 hours of exposure. Among the formulations of pesticides tested against *A. besseyi*, none of synthetic chemicals was found promising except monocrotophos. The results on temperature sensitivity of tuberose bulbs to hot-water showed that bulbs were highly sensitive to hot-water temperature and germination of tuberose bulb was not affected at temperature of 50± 2 ^{0}C for 30 minutes but at 54^{0}C about 80% and at 58^{0}C to 60^{0}C, 100% germination of bulbs was lost.

PP - 45: Effect of seed soaking of different doses of agroneem, carbofuran and neem cake against *Meloidogyne incognita* on okra crop cv. A4 Hybrid

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The root-knot nematodes are considered as one of the most important nematode pest of agricultural crops all over the world. This nematode was first discovered in 1855 on cucumber by M. J. Berkeley in England and named them as Vibrios. In India, there are fourteen species, which have either been reported or described. The two important species of *M. incognita* and *M. javanica* are responsible for causing 80% of the damage due to root-knot nematodes. Management of this nematode is considered to be an important criterion. Therefore, a fieldfrial was undertaken to study the effect of seed soaking of different doses of Agroneem, Carbofuran (3G) and Neem cake (soil application) on okra crop cv. A4 Hybrid against root-knot nematodes, *Meloidogyne incognita*. The experiment was carried out in microplots of 3 x 2 sq.m at IARI field with three replications. The initial average population of root-knot nematodes was 2 larvae/g soil. The treatments were T1= Agroneem @ 1000ppm, T2= Agroneem @ 500ppm, T3= Agroneem @ 250ppm, T4 = Carbofuran (3G) @ 1 kg a.i/ha, T5= Neem cake @ 10q/ha (soil application) and T6= Control. All treatments from T1 to T3 were applied as soaking of okra seeds for two hrs exposure period. The observations were recorded at harvesting of the crop on plant biomass, first, second third picking of pods or fruit weight and final nematode population in soil. Results revealed that Carbofuran @ 1 kg a.i/ha (T4) recorded maximum weight of picking of okra pods with minimum root-knot nematode population as compared to check. This is followed by Neem cake @ 10q/ha and Agroneem @ 1000ppm as compared to check. Thus, the present investigation clearly indicates that the effective components can be used in combination with botanicals or bioagents in the Integrated Nematode Management Programme for managing nematode population.

PP - 46: Effect of seed soaking of ozoneem trishul, Agroneem, *Aspergillus terreus*, phorate and neem cake against *Meloidogyne incognita* on Pea

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The root-knot nematodes are by far the most important pests of vegetable crops. The four most common species viz., *M. incognita*, *M. javanica*, *M. hapla* and *M. arenaria* are by far most important and leads to formation of conspicuous root galls. *M. incognita* and *M. javanica* are most widespread in distribution and have a wide host range among vegetables. The destructive plant parasitic nematodes are one of the major limiting factor in vegetable production throughout India. *Meloidogyne incognita* are the limiting factor in commercial production of vegetables and responsible for 15-70% yield loss. Hence, nematode management is therefore,

important for high yields and quality that are required by the high cost of modern crop production. An IARI Field trial on the effect of seed soaking of Ozoneem Trishul, Agroneem, *Aspergillus terreus* (Talc Formulation + FYM), Phorate (10G) and Neem cake (soil application) on Pea crop cv. DDR44 was carried out against root-knot nematodes, *Meloidogyne incognita*. The experiment was carried out in microplots of 3 x 2 sq.m at IARI field with three replications. The initial average population of root-knot nematodes was 2 larvae/g soil. The treatments were T1= Ozoneem Trishul @ 1000ppm, T2= Agroneem @ 1000ppm, T3= *Aspergillus terreus* @ 5 kg/ha (Talc formulation + FYM) (2 x 10^8 spores/g), T4 = Phorate (10G) @ 1 kg a.i/ha, T5= Neem cake @ 10q/ha (soil application) and T6= Control. All treatments from T1 to T2 were applied as soaking of Pea seeds for two hrs exposure period. The observations were recorded at harvesting of the crop on first, second third picking of pods or fruit weight and final nematode population in soil. Results revealed that Ozoneem Trishul @ 1000ppm (T1) recorded maximum weight i.e, first picking as 2.4 kg/plot, second picking 4.0kg/plot and third picking 4.5kg/plot of pea pods with minimum root-knot nematode population as compared to check. This is followed by *Aspergillus terreus* @ 5kg/ha (T3) having weight of first picking of pods as 2.0kg/plot, second picking 4.2kg/plot and third picking 3.5kg/plot while Phorate @ 1 kg a.i/ha has weight for first picking as 2.3kg/plot, second picking 4.0kg/plot and third picking as 3.2kg/plot weight of pods. Neem cake also showed similar trend but application of Agroneem showed stunted plants with yellowing as compared to check. The growth of plants in Ozoneem Trishul treatment was better and healthy with more biomass as compared to the plants treated with Agroneem. It is suggested that all these components can be utilized in the Integrated Nematode Management programme for controlling nematode population and boosting crop yield.

PP - 47: Antifungal compounds in mango sap provide natural protection to anthracnose disease in mango

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Postharvest disease, especially due to anthracnose (*Colletotrichum gloeosporioides*) and stem-end rot (*Dothiorella dominicana*), cause serious losses in quality of harvested mango fruits. Chemical control of diseases is an integral part of postharvest handling, but public reaction against fruits treated with chemicals is of increasing concern. Therefore, any natural disease control alternative merits investigation. Therefore, the present study was designed to investigate the influence of natural antifungal resorcinols in fruit on the postharvest disease resistance in mango. Results showed that 'Kensington Pride' mango fruits stored with 2-3 cm long peduncles had significantly smaller anthracnose lesion areas after being inoculated with *Colletotrichum gloeosporiodes* (1x10^7 spores/ml) than fruits desapped according to normal commercial practice. Anthracnose arising from natural field infections and stem-end rots were also reduced due to retention of long peduncles. Fruits with peduncles attached, contained significantly higher levels of constitutive 5-n-heptadecenylresorcinol and 5-n-pentadecylresorcinol in peel compared with the desapped fruits. Mango sap was found to be an abundant source of the constitutive

alk(en)ylesorcinols that may contribute to elevated levels of resistance in the not-desapped fruits. Moreover, at harvest, concentrations of 5-n-heptadecenylresorcinol and 5-n-pentadecylresorcinol were much higher in sap than in peel. These results suggest that retention of long peduncle and sap may play an important role in maintaining natural resistance of mango fruits against potential pathogens, and could reduce disease severity in commercial mango production.

PP - 48: Utilization of predatory mite, *Amblyseius longispinosus* Evans (Acari: Phytoseiidae) for management of spider mite, *Tetranychus urticae* Koch in pointed gourd ecosystem

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Predatory mite, *Amblyseius longispinosus* is one of the most important predatory mites used for management of red spider mites infesting many crops. The predator was mass multiplied on banana leaf using *Oligonychus oryzae* as pray. After producing the predatory mite under laboratory conditions those were released in the pointed gourd observing natural infestation of red spider mite, *Tetranychus urticae.* A field of 1000 sq.m was divided into two halves where each of the halves were divided into fifty subplots each measuring 10 sq.m. The predatory mites @ 20 mites per subplots were released on 28.2.08 to 25.6.08 at regular 15 days interval. No predators were released in the adjacent other halves to observe the efficacy and dispersal speed of predators. The predators and prey populations were measured every 15 days interval from both the predator released and non released plots. The results revealed that the rate of dissemination of the predator in adjacent plots were quite satisfactory and have the potential to keep suppress the spider mite population well below damaging level.

PP - 49: Screening of chilli microflora and other biocontrol agents for their antagonistic effect on *Colletotrichum* sp. infecting chillies

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Forty five leaf samples, eight fruit samples and one flower sample of chillies were collected from different regions of Karnataka for isolation of chilli microflora. From these samples, 94 fungal isolates and 89 bacterial isolates were isolated from chilli leaves, fruits and flowers. From phylloplane and pomoplane, 50 isolates of fungi and 44 isolates bacteria were isolated. From inside the leaf, fruit and flower tissues,

44 isolates of fungi and 45 isolates of bacteria were isolated. Of the total 94 isolates of fungi isolated from chilli, 52 isolates were identified belonging to 29 genera and 33 species and the rest of 29 fungi are yet to be identified. All the 183 isolates of chilli microflora and 49 isolates of *Trichoderma*, 19 isolates of *Bacillus* sp. and 34 isolates of *Pseudomonas fluorescens* from NBAII germplasm collection of biocontrol agents were tested for their antagonistic effect on *Colletotrichum gloeosporioides* (Cg-1) and *C. capsici* (Cc-1) by dual culture technique on Potato Dextrose Agar. Among the 94 fungal isolates of chilli microflora tested, *Aspergillus flavus* (EXF-14) showed highest percent inhibition (70.20%) against *C. gloeosporioides* followed by *Penicillum citrinum* (EX-F6) which showed 61.63% inhibition.An unidentified isolate EX-F48 showed 59.91% inhibition of *C. capsici* followed by *Aspergillus flavus* (ENF-2) which showed 56.74% inhibition. In bacterial isolates EN B29 and EN B24 showed highest percent inhibition of *C. gloeosporioides.* (33.31%) and *C. capsici* (46.03%) respectively. Among the 49 isolates of *Trichoderma* sp., from NBAII culture collection, *T. virens* (TVS KSD) and *T. pseudokoningi* (TPK-1) showed highest percent inhibition 69.69% of *C. gloeosporioides. T. viride* (Tv-5) isolate showed highest percent inhibition of *C. capsici* (51.88%) followed by *T. viride* (Tv-4) which showed 50.38% inhibition of *C. capsici.* Among 19 *Bacillus* isolates tested, S-15 isolate showed highest percent inhibition of *C. gloeosporioides* (30.0%) and S-9 isolate showed 51.33% inhibition of *C. capsici*. Among 34 isolates of *P. fluorescens* tested, PBA 6(2) isolate showed 25.6% inhibition of *C. gloeosporioides* and PBA 5 & PBA 14(1) isolates showed 41.26% inhibition of *C. capsici*.

PP - 50: Sudden outbreak of mealybug and armoured scale causing severe damage to economic crops in Bangladesh

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In Bangladesh, recently attack of different vegetable crops viz., eggplant, lady's finger, papaya, basil etc. by citrus mealybug, *Planococcus citri* (Risso) (Homoptera: Pseudococcidae) has been noticed. It is mainly a pest of citrus and coffee crops but now its infestation is polyphagous in nature. Based on laboratory studies on immature and mature fruits of lady's finger; the total period of 1st, 2nd, 3rd and 4th nymphal stages lasted for about 23 days during September, 2009. Male mealybug has a short life span of 2-4 days, after the final nymphal moult. Females live for nearly 85 days with an oviposition period of approximately 21 days. This mealybug is capable of active movement throughout its adult life. The stripped mealybug, *Ferrisia virgata* (Cockerell) (Homoptera: Pseudococcidae) was found to infest the leaves and twigs of different ornamental plants in Rajshahi and Dhaka, Bangladesh. It is a polyphagous pest damaging coffee, sweet potato, jute, groundnut, tomato, citrus, cotton, guava etc. causing enormous damage to them. The female lays about 300-400 eggs which hatch in few hours. The life cycle is completed in about 40 days. The small and big black ants tend *F. virgata* and they keep other insects including hymenopteran parasites away from the mealybug.

The cottony cushion scale, *Icerya purchasi* Mask. (Homoptera: Margarodidae) is a soft-bodied mealybug infesting guava leaves all over Bangladesh. It is reddish-brown and lays up to 600-700 eggs during her lifetime. The life cycle is completed within 46-240 days depending on different environmental conditions. The females develop by parthenogenesis. It is a sucking pest and mainly feeds on citrus. Its secondary hosts include fig, apple, almond, guava etc. Due to severe infestation, premature falling of leaves occurs. The ber or plum scale, *Aonidia ziziphi* Rah. was recorded from Rajshahi, Bangladesh as a serious pest of ber plant damaging the leaves and immature fruits during December- January , 2007. Due to severe attack of mealybug, the pericarp of immature fruit is damaged to some extent and it becomes unfit for human consumption and market value is reduced.

PP - 51: Seasonal activity of spotted beetle, *Epilachna vigintioctopunctata* infesting ashwagandha (*Withania somnifera*) and its relation to weather factors

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The spotted beetle, *Epilachna vigintioctopunctata* (Coleoptera:Coccinellidae) has been observed as a major foliage feeding pest on ashwagandha (*Withania somnifera*), an important medicinal cash crops grown in Madhya Pradesh, Rajasthan, Gujarat and Maharashtra in late kharif season. It was observed that there were changes in the occurrence and abundance of this pest from season to season. Hence an attempt was made to study the seasonal activity of this pest in relation to weather factors prevailing in this region. Ashwagandha variety JA134 was sown at the DMAPR Farm during August 2008. A total of 20 plants were taken randomly and total number of eggs, grubs, pupa and adults of spotted beetle per plant were counted at weekly intervals. The activity of adults and grubs were maximum on JA134 during October, 2008 with its peak (1.95 adults, 16 eggs and 5.75 grubs/ plant) during the second week (41st standard week).There after the population gradually decreased. The weather conditions prevailed during the peak period was an average maximum temperature of 35.8^{o}C, minimum temperature of 18.9^{o}C and relative humidity of 54%. Though adults activity was observed up to first fortnight of December 2008 but their population remained low. The pest activity was not observed after 2nd week of December, 2008 when the average maximum and minimum temperature had fallen to 28.2^{o}C and 16.9^{o}C respectively. It was found that atmospheric temperature (maximum and minimum) had significant positive correlation with the population of adults, grubs and number of eggs.

PP - 52: Seasonal incidence of major insect pests in okra under subtropical conditions

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An experiment was conducted at the ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram to study the major insect pests and natural enemy complex of okra during 2008-2009. The okra was invaded by eleven insect pests, one mite and four natural enemies in Mizoram. Among them, the *Mylabris pustulata* and *Dysdercus cingulatus* were found economically important, most dominant pest and it categorized as major pest. The incidence of *Mylabris pustulata* and *Dysdercus cingulatus* were noticed during reproductive stage and attained the peak level of infestation on first week of July and first week of August. The second most important and dominant insect pest was Nodostoma spp. and it also categorized as major insect pests of okra and it was noticed through out the cropping period but attained the peak level of infestation on last week of July. The sucking insect pests viz., *Aphis gossypii, Amrasca biguttula biguttula* and *Bemisia tobacci* were more abundant during last week of June, second week of July and second week of June, respectively. A number of natural enemies were recorded during the period of investigation. Three species of lady bird beetles were found to predate upon aphid. Both the grub and adult were found abundantly during later stage of crop growth. Maggot's syrphid flies were found within aphid colony. A number of species of spiders were found predating upon Sylepta derogota larvae and Aphis gossypii nymphs and adults. On other hand, the stem borer, Alcidodes affaber was mostly found during later stage of the crop, the Myllocerus spp. was mostly found during early stage even up to harvest and the grasshopper was found during new flesh period. The non-insect pest, red spider mite was more dominant pest and it could cause severe damage to the crop. This red spider mite also categorized as major pests of okra in Mizoram.

PP - 53: Comparative effect of some plant growth regulators on growth and quality leaf yield of Mulberry (*Morus alba* L.) under low temperature stress during winter

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It is widely essential that strategies should be adopted which may be used to get maximum crop yield and economic returns from stressful environments. However, Low temperature stress is one of the most important factors, limiting crop productivity (15-20%) by reducing physio-biochemical activities of plants (Blum, 1986 and Lichtenhaler, 1996).

Sericulture is a traditional enterprise in the entire Eastern and North -Eastern regions of India.Mulberry is quite responsive to temperature and humidity. It grows well under optimum temperature condition, i.e., at 23 - 26º C. Winter (Nov-Feb) with low temperature (below 13º C) coupled with foggy weather / frost adversely affects physiological system of mulberry plants which resulted in stunted growth, reduction in photosynthetic rate, changes in endogenous hormonal level, ceases apical buds to sprout and dormancy sets in, which ultimately reduces leaf productivity and quality significantly leading to severe scarcity of quality mulberry leaf especially in Falguni (Dec-Jan) seed and Jan-Feb commercial crops. But November to February is the most congenial season for silkworm rearing with minimum disease incidence, sustainable cocoon crop productivity and quality; thereby leaf can most efficiently be converted into quality cocoons.

Thus, to minimize the stress effect on mulberry growth and to produce better quality leaf, an experiment was conducted at Central Sericultural Research & Training Institute, Berhampore, WB for 2 years (2007 and 2008) during Nov and Feb crop seasons with an objective to study the impact of Brassinosteroid, Kinetin and Auxin individually and in combination so as to determine the effective combination and concentration of plant growth regulators (PGR) on growth, leaf yield, physiological traits and quality of mulberry variety , S-1635 in field condition. The results revealed that individual application of Kinetin, Brassinosteroid and Indole acetic acid (IAA) as well as their various combinations could reduce the adverse effect of low temperature stress on growth and leaf yield of mulberry by increasing photosynthetic efficiency, stomatal conductance, total chlorophyll and soluble protein content in leaf and leaf water status. Leaf yield was increased significantly in T5: IAA (0.25%)+ Kin (0.1%)+BR (0.05%) by 32.6 % followed by T9: Br (0.1%) + Kin (0.2%) by 26% over control (water spray) under low temperature stress. However, all the treatments influenced growth, leaf yield and quality.

PP - 54: Studies on the improved mulberry genotypes suitable for eastern and north eastern region of India

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Drastic changes of climate due to global warming influences directly the agricultural crop and thereafter the livelihoods of poor farmers and consumers. The North Eastern part of India is more affected due to the limited resources available there. Sericulture is one of the promising sources of income to the rural backward people of North Eastern state. For development and expansion of any agricultural crop in different agro-climatic condition, evaluation and adoption of suitable variety is a must and it was felt necessary to recommend region specific mulberry varieties suitable to particular agro climatic condition. Hence, this study was taken for evaluation and adoption of a suitable mulberry variety for different region so that the farmers get sustainable leaf yield and thereafter harvesting of good cocoon

crop, which can help them boosting up in their economic condition. Five improved mulberry varieties (SV1, JRH, RFS-175, MR-2 and V-1) with two checks were considered for this study. Before initiation of plantation, Initial Soil nutrient status of experimental field of different eco-climatic zones was measured. After establishment of plantation in different eco-zone viz. Berhampore (Irrigated), Purulia (Kashipur), Ranchi, and Jorhat under rainfed condition, leaf harvest data and other physiological and biochemical parameters such as. moisture content and moisture retention capacity, total soluble protein, total soluble sugar and nitrate reductase activity of leaves of different mulberry varieties were taken during different crop seasons at different eco-zones over a period of three years. Based on the findings as reflected by the yield and quality parameters, S-1635 identified as suitable variety for Gangetic alluvial soil of West Bengal (in irrigated) and also for Jharkhand, JRH for Assam and C-1730 for red laterite soil of West Bengal .So these varieties can be recommended for different agro climatic zone.

PP - 55: Survey and monitoring of pests, parasites and predators on pulses in central and eastern Uttar Pradesh

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A survey was conducted during December 2008 to May 2009 in chickpea, pigeonpea and lentil crops in different districts of Uttar Pradesh. During this period, in a total of 22 districts were surveyed, gram pod borer *Helicoverpa armigera*, Bihar hairy caterpillar, Spilarctia obliqua, plant hopper *Pantatomorpha* spp, termite *Odontotermis* spp, and cut worm *Agrotis ypsilon* were recorded on chickpea while *Campoletis chloridae* was recorded as natural enemy feeding on *H. armigera* larvae.
In pigeonpea crop, H. armigera, leaf webber Myloceros spp, spotted pod borer *Maruka testulalis,* Plume moth *Exelastis atomosa,* Tur pod bug *Clavigralla* gibbosa, jassid Amrsca bigutulla, Termite Odontotermis spp, Green bug Nizara *virudula,* tur podfly *Melanogromyza obtusa*, blue butterfly *Lampidous botticus* and Cow bug *Pantatomorpha* spp were recorded while on lentil crop, Black aphid, *Aphis craccivora* was recorded as major pest and *H. armigera* and cut worm *Agrotis ipsilon* as minor pests.
A total number of 10 parasites and predators were observed in these crops during the period of study. The bioagents recorded belonged to Order Dictyoptera, Hymenoptera, Diptera and Coleoptera.

PP - 56: Response of plants to pathogens under elevated levels of carbon dioxide

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The earth's climate is facing green house effect and other associated changes which are causing or may cause tremendous impact on the global crop production. Increase in global temperature due to green house effect is one of the major concerns which have far reaching consequences. The green house effect has developed mainly due to release of CO_2 and other gases with similar property in amounts and concentrations beyond the self regulating capacity of the environment. The average global concentration has increased by 20-25% during the last 50 years which is mainly produced during burning of fossil fuels. Under elevated levels of CO_2 plants may grow differently producing greater growth and biomass than that they produce under normal CO_2 level. It is mostly expected that plant growth may get enhanced under elevated levels of CO_2 due to increase in the photosynthetic rate in general and decrease in photorespiration in particular in C_3 plants. The studies conducted under artificial treatment conditions have demonstrated that plant growth may be promoted by 20-30% at around 500 ppmv CO_2. Consequently the response of plants to pathogens may be influenced and host-parasite relationship will be affected under the changed climate. Greater biomass production shall lead to development of healthier plants which may express tolerance against pathogens or the greater biomass may provide opportunity to pathogens of greater availability of food and space for pathogenic invasion and multiplication particularly obligate parasites like nematodes, powdery mildews and rusts. In such a situation plant diseases may become aggravated and severe. In the present paper attempt is made to examine the available information on this aspect to draw conclusions on how would phytopathogens respond to elevated levels of CO_2 and what would be the fate of plant diseases and associated crop damage.

PP - 57: Seasonal incidence of major insect pests and their succession in broccoli under subtropical conditions

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A field experiment was conducted at the ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram to study the major insect pests and natural enemy complex of broccoli during rabi seasons of 2008-2009. The broccoli was invaded by fourteen insect pests, one mite and six natural enemies under subtropical climatic conditions of Mizoram. Among them, the *Pieris brassicae* and *Plutella xylostella* were found economically important, most dominant pest and it categorized as major pest. The incidence of *P. brassicae* was noticed during seedling stage to till harvest and attained the peak level of infestation on second week of December

and second week of February. The second most important and dominant insect pest was Liaphis erysimi and it also categorized as major insect pests of broccoli and it was noticed through out the cropping period but attained the peak level of infestation on first week of March. Flea beetle, *Phyllotreta cruciferae* Goeze. was found to occur regularly in a sizeable population causing a noticeable damage. A number of natural enemies were recorded during the period of investigation. Three species of lady bird beetle were found to predate upon aphids. Both the grub and adult were found abundantly during later stage of crop growth. Maggot's syrphid flies were found within aphid colony. A number of species of spiders were found predating upon leaf webber larvae and aphid nymphs and adults. On other hand, the Crocidolomyia binotalis was mostly found during early stage and the grasshopper was found during new flesh period. The non-insect pest, mite was more dominant pest and it could cause severe damage to the crop. This mite also categorized as major pests of broccoli in Mizoram.

PP - 58: Studies on susceptibility of Indo- African pigeonpea derivatives of medium maturing pigeonpea against pod borer complex

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A field trial was conducted during kharif 2008-09 at Jabalpur, Madhya Pradesh, to assess the relative susceptibility of Indo- African pigeonpea derivatives of medium maturing group against pod borer complex viz. pod fly, *Melanagromyza obtusa* (Malloch), gram pod borer, *Helicoverpa armigera*, pod bug, *Clavigralla gibbosa*, pigeonpea plume moth, E*xelastis atomosa* (Wals.) and physiological disorder respectively. Nineteen Indo- African pigeonpea derivatives were sown in three replications in 6 rows of 5m row length, under unsprayed conditions.

Pod damage due to pod fly, gram pod borer, plume moth and pod bug significantly ranged from 33.63% (ICP-11488 X C-11-10) to 87.57% (BDN-2), 0.9% (ICP- 12102 X C-11-26, ICP-11488 X C-11-9, ICP-11488 X KPL-43-3, ICP-11912 X K-2-35, ICP-12102 X 96053-18, BSMR-893 and C-11) to 13.52% (JKM-7), 0.9% (BDN-2) to 50.30% (ICP-11912 X K-2-35), and 0% (ICP-12102 X C-11-22, ICP-12102 X C-11-26, ICP-12102 X C-11-28, ICP-11488 X C-11-9, ICP-12102 X 96053-20, ICP-11912 X K-2-35, ICP-12102 X Asha-31, ICP-11488 X C-11-10, ICP-11912 X ICPL-87-37, ICP-11912 X JKM-7-33, JKM-7, BDN-2, BSMR-893 and C-11) to 13.03% (Khargone-2),respectively.

Grain damage due to pod fly, gram pod borer, plume moth and pod bug significantly ranged from15.59% (ICP-11488 X C-11-10) to 47.69% (BDN-2), 0.10% (ICP- 12102 X C-11-26, ICP-11488 X C-11-9, ICP-11488 X KPL-43-3, ICP-11912 X K-2-35, ICP-12102 X 96053-18, BSMR-893 and C-11) to 5.57% (JKM-7), 0.20% (BDN-2) to 21.57% (ICP-12102 X 96053-18) and 0% ((ICP-12102 X C-11-22, ICP-12102 X C-11-26, ICP-12102 X C-11-28, ICP-11488 X C-11-9, ICP-12102 X 96053-20, ICP-

11912 X K-2-35, ICP-12102 X Asha-31, ICP-11488 X C-11-10, ICP-11912 X ICPL-87-37, ICP-11912 X JKM-7-33, JKM-7, BDN-2, BSMR-893 and C-11) to 5.91% (ICP- 12102 X 96053 -21) respectively.
Pod and damage grain damage due to physiological disorder significantly ranged from 16.66% (ICP-11488 X KPL-43-3) to 66.66% (BDN-2) and 6.23% (ICP-11488 X KPL-43-3) to 33.53% (BDN-2) respectively.
Entries ICP-11488 X C-11-10 and ICP-11488 X KPL-43-3 recorded minimum grain damage by pod fly and physiological disorder respectively. Entries ICP- 12102 X C-11-26, ICP-11488 X C-11-9, ICP-11488 X KPL-433, ICP-11912 X K-2-35, BSMR-893 and C-11 recorded minimum grain damage by gram pod borer and pigeonpea pod bug respectively. Further entry BDN-2 recorded minimum grain damage by pigeonpea plume moth and was also found to be promising as it recorded maximum grain yield of 915 Kg / ha.

PP - 59: Screening of pigeonpea genotypes against pod pest complex under late sown conditions

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In Madhya Pradesh, pigeonpea crop is cultivated in an area of about 323 thousand hectare with a production of 242 thousand tonnes . The low yields of this crop are due to pod borer complex and physiological shriveling.
Considering the seriousness of pod borer complex, studies were carried out on reaction of pigeonpea genotypes against pod borer complex under late sown conditions. Twenty two genotypes of medium maturing group were sown on 28th August, 2008 under unprotected conditions in three replications in the experimental field at Jabalpur during *kharif* season 2008-09.
Pod infesting insect pests recorded were pod fly, *M. obtusa,* gram pod borer, *H. armigera*, pod bug,*C. gibbosa* and plume moth, *E. atomosa.* Out of the four pests, M. obtusa established as the most important pest on the basis of pod and grain damage, followed by *E. atomosa, H. armigera* and *C. gibbosa* respectively.
Perusal of the data revealed that no genotype was found to be free from any one of the pod infesting pest complex. Pod damage due to pod fly, gram pod borer, plume moth and pod bug significantly ranged from54.68 to 84.69%, 0.00 to 12.27 %, 0.00 to 29.84 % and 0.00 to 7.87 % respectively. Whereas grain damage due to pod fly, gram pod borer, plume moth and pod bug significantly ranged from28.63 to 63.38 %, 0.00 to 4.38 %, 0.00 to 13.1% and 0.00 to 3.09 % respectively.
The pod and grain damage due to physiological disorder varied from 14.71% to 52.42% and 6.20% to 25.97%, respectively.
Out of the 22 genotypes screened against pod borer complex, no genotype was found to be free from damage from pod fly, whereas genotype BDN-2 was free from pigeonpea plume moth infestation and genotypes BDN-2, BSMR-893, C-11, ICPL-87088, ICPL-87089, JJA-65, JKM-7, JKM-187, JKT-115, TT-2000-1, VBN-12, VRG-17 and WRG-27 were found free from pod bug infestation, further, genotypes were BDN-2, C-11, JKM-191, JKM-01-02-3-4-41, VBN-12, VRG-17 and WRG-27 were

found free from pod borer infestation. Genotype ICPL-87060 was found to be least susceptible to major 3 insects pest species viz. pod fly, plume moth and pod bug respectively. Further genotypes JKT-240 and JKM-8 were found to be least susceptible against insect pest's viz. plume moth, pod bug and pod borer respectively. In addition they were least damage due to physiological disorder.

PP - 60: Influence of weather factors on the population of *Coccinella septumpunctata* L. in cotton

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The lady bird beetles, *Coccinella septumpunctata* L. (Coleoptera:Coccinellideae) is the most potential and effective predator of cotton pest. The grub and adult stages of *C. septumpunctata* feed voraciously on cotton pest i.e. aphids, jassid and white fly. The period and intensity of activity of this predator mainly depends on the prey density, plant protection practices and environmental factors. Of these the climatic factors such as temperature, relative humidity, sunshine hours, wind velocity and rainfall influenced the predator population greatly.
In view of that a investigation to assess influence of climatic factors such as temperature, relative humidity, sunshine hours, wind velocity and rainfall on the population of *Coccinella Septumpunctata* L. was conducted at the J.N. Krishi Vishwa Vidhyalaya, Cotton Research Station, Khandwa M.P. during 2004-05 & 2005-06. The hirsutam genotype JK-4 was sown on 29th June and 25th June during 2004 and 2005 respectively at a spacing of 60X60 cm. Normal agronomic practices recommended for the region were followed for raising the crop. No plant protection measure was taken throughout the crop season. The Regular observations on the population dynamics of *C. septumpunctata* and climatic factors were recorded. The influence of different meteorological parameters on population and infestation of pests were studied by graphical superimposition technique. All the possible Correlations, multiple regression and path analysis were worked out. The perusal of the data revealed that *C. septumpunctata* was first observed during the 27th SMW i.e. first week of July and remained active till 50th SMW (IInd week of December).The peak population was observed (9.76/5 plant) during 37th SMW i.e. 3rd week of September. The weather condition prevailed during this week viz. maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours, wind velocity, rainfall and rainy day were 34.07°C, 26.31°C, 83.54 %, 60.56%, 6.39 hours per day, 6.00 kmph, 53.50 mm and 3 days respectively. The simple correlation studies revealed that the LBB population had a significant positive correlation with maximum temperature (0.542) and minimum temperature (0.560). The multiple coefficient value indicated that 79.50% change in LBB population were affected by maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours, wind velocity, rainfall and rainy days. The path coefficient analysis revealed that minimum temperature had positive and high direct effect (1.6592) followed by morning relative humidity (0.1972), rainfall (0.1535), and sunshine hours (0.1519) and evening relative humidity (0.016), respectively.

PP - 61: Impact of different dates of planting on the incidence pattern of important insect pests of potato in West Bengal

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An experiment on the incidence pattern of various insect pests of potato under five different planting dates (P1 to P5) was carried out for two consecutive years, 2006-07 and 2007-08 at Adisaptagram Block Seed Farm, Hooghly, West Bengal. Kufri Chandramukhi was planted in five dates of planting starting from 3rd week of November with one-week interval up to 3rd week of December with a spacing of 60×20 cm. The trial was laid in Randomized Block Design (RBD) with four replications. The recommended practiced for raising the crop in the field was maintained except the application of insecticides. It was observed that the first planting (P_1) ie., third week of November shelter less pest infestation. However, the whitefly infestation was found lower in second and third plantings (P_2 and P_3). The infestation of soil pests such as mole cricket, cutworm and potato tuber moth was found minimum in P_1 resulted in producing highest number of healthy tubers. The rat damage was not so influenced by different dates of planting. But, the total tuber yield was obtained maximum in second date (fourth week of November), which was closely followed, by P_1, P_3, P_4 and P_5.

PP - 62: Incidence of pests in jute (*Corchorus olitorius* L.) ecosystem and pest-weather relationships in West Bengal, India

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Two years experiment on jute crop was conducted during pre-kharif to kharif seasons (April to August), 2004 and 2005 at Block 'C' farm of Bidhan Chandra Krishi Viswavidyalaya (BCKV), West Bengal, India in a view to record the pests incidence on olitorius jute and to determine the weather parameters impacting on pests population in jute under West Bengal conditions. Eighteen different species of pests belonging to insects, mites and nematodes were found feeding on jute. Among them, jute semilooper (*Anomis sabulifera* Guen.), bihar hairy caterpillar (*Spilarctia obliquaWlk.*), grey weevil (*Myllocerus discolor* Bohemus), yellow mite (*Polyphagotarsonemus* latus Banks), stem weevil (*Apion corchori* Marshall), and root knot nematode, *Meloidogyne incognita* are causing economic damage to the crop and other pests were considered as minor pests. Correlation studies (2004 and 2005) with weather parameters showed that incidence of semilooper was negatively correlated (r = -0.795 to - 0.725) with the maximum temperature but

had positive significant association with minimum temperature (r = 0.528 to 0.715), morning relative humidity(RH) (r = 0.579 to 0.857) and afternoon RH (r = 0.876). Bihar hairy caterpillar incidence also exhibited positively significant relationship with morning RH (r = 0.577) and afternoon RH (r = 0.545). Morning and afternoon RH and rainfall also had significant positive correlation with the incidence of M. discolor where calculated r = 0.535, 0.570 and 0.700, respectively. None of the meteorological parameters had any significant influence on the incidence of A. corchori. Yellow mite incidence showed positive association with morning RH (r = 0.563 to 0.679) and afternoon RH (r = 0.526 to 0.618). Rainfall was found favourable for proliferation and incidence of M. discolor only but had the negative effect on the incidence of stem weevil and yellow mite. Thus climatic factors particularly temperature, relative humidity and rainfall played a pivotal role on occurrence and existence of different pests on jute crop.

PP - 63: Dynamics of plant parasitic nematodes in vegetable based crop sequences in West Bengal, India

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Diversity and dynamics of soil nematodes was observed in vegetable based crop sequences in West Bengal, India. The major nematode genera identified were *Rotylenchulus reniformis, Meloidogyne incognita, Hoplolaimus indicus, Tylenchorhynchus mashhoodi* and *Criconemoides onoensis.* However, *R. reniformis* and *M. incognita* was found most abundant. The okra-cowpea-cabbage and okra-cucumber-mustard was found to have maximum suppressive effect on *M. incognita.* Cabbage, mustard and rice in the sequence had suppressive effect on *M. incognita* while okra, brinjal, cowpea and tomato supported nematode multiplication. Okra-rice-fallow suppressed R. reniformis. Low population of *H. indicus* and *C. onoensis* was found in okra-cowpea-cabbage, okra-brinjal-okra and okra-cucumber-mustard and their population was found maximum in okra-rice-tomato and okra-rice-fallow. *T. mashhoodi* was suppressed under okra-cowpea-cabbage, okra-rice-fallow, okra-cucumber-mustard and okra-brinjal-okra. Plant parasitic and free living nematodes in okra based system were estimated and their ratio was determined for understanding the sustainability of production system. The saprozoic nematode index (SNI) was found high (0.45) in okra-rice-fallow.

PP - 64: Natural incidence of alternaria leaf blight of mustard caused by alternaria brassicae in the lateritic zone of West Bengal

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Surveys on the natural incidence and severity of Alternaria leaf blight of mustard (*Brassica campestris, B. juncea,*and *B. napus*) were conducted during the four conjugative cropping seasons (2004-05 to 2007-08) in the lateritic zone of West Bengal.The results indicated that the disease severity varied with in the crop variety and increased during late in the season and reached the maximum level after 75 days of sowing of crop. Severity of Alternaria blight was increased constantly from the season 2004-05 and a sharp increase in disease severity was noticed during the season 2006-07, when maximum disease severity 64.52 was observed at 75 DAS.There after , disease severity was declined during the season 2007-08. Severity of Alternaria leaf blight was also found to be fluctuating during cropping stage . Maximum rate of increase in disease severity was observed at 60 DAS during the season 2006-07 , while it was found maximum at 75 DAS in other cropping seasons. A range of average disease severity 14.78 to 35.46 % with a minimum of 5.27 % and maximum 64.52 % disease severity were recorded during different cropping sessions (2004-05 to 2007-08) in the lateritic zone of West Bengal.

PP - 65: Influence of sowing dates on flowering pattern and melon fruit fly infestation in snap melon (*Cucumis melo* var. *momordica*) genotypes

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The present experiment on Snap melon (*Cucumis melo* var. *momordica*), popularly known as ' Phoot' or 'Phooti' was carried out at the Central Research Farm of Bidhan Chandra Krishi Viswavidyalaya,Gayespur, Nadia, to determine the best sowing date for higher female flower production & more number of fruits as well as lower melon fruit fly [*Bactrocera cucurbitae* (Coquillett), Diptera: Tephritidae] incidence. During 2004-2005 ,three sowing dates viz. S_1 = 25 November, 2004, S_2 = 25 January 2005 and S_3 = 25 March, 2005 were selected to evaluate performance of eight genotypes, named as BCSM-1 to BCSM-8 ,collected from different parts of the state. The experimental design was Randomised Block Design with 3 replications. Observations on days to first male and female flowers, node number of first male and female flowers, total number of fruits and number of fruit-fly infected fruits were recorded. Snap melon being a monoecious and warmth loving crop, tends to bear increasing number of female flowers with time; such transitions in flowering pattern is primarily conditioned by temperature and high light incidence and less

strikingly influenced by photoperiod. Considering earliness, total number of fruits and lower fruit fly incidence, BCSM-4 and BCSM-6 performed better when sown during end of January; BCSM-4 is affected the most when sown in March by fruit fly attack, possibly due higher population build-up of the pest.

PP - 66: Use of various geotextile as soil conditioner to increase groundnut crop productivity under inceptisol soils in West Bengal

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A study was under taken at the University farm of Regional Research station, New Alluvial Zone under Bidhan Chandra Krishi Viswavidyalaya of Gayespur, on the Nadia district of West Bengal to investigate the effect of various geotextites management on productivity and physico-chemical properties under summer ground nut crop (var. TAG-24). Four treatments combinations were taken viz. T_1- farmers practices(i.e. control) (NPK=20:40:40 kg/ha), T_2 -non woven jute geotextile (5 tons + NPK=20:40:40 kg/ha), T_3- non woven coco coir geotextile (5 tons + NPK=20:40:40 kg/ha), T_4- non woven vetiver root geotextile (5 ton + NPK=20:40:40 kg/ha) using winter potato as test crop in RBD design with 3 replication. The yield and yield component for each plot was recorded. Soil moisture was determined periodically at 7 days intervals from 0-15 cm soil depth during seeding to harvesting from each plot. Initial and final soil samples also analyzed for relevant physical and chemical properties following standard methods. The crop yield was recorded as 31.5 q/ha, 39.4 q/ha. 40.6 q/ha and 46.8 q/ha respectively in farmer practice (T_1), jute geotextile (T_2), coco coir geotextile (T_3) and vetiver root geotextile (T_4) and the response over control due to each treatment were 7.9 q/ha (25.1%), 9.1 q/ha (28.9%) and 15.3 q/ha (48.6%) respectively in jute geotextile, coco coir jeotextile and vetiver geotextile. The Moisture Use Efficiency (MUE) significantly highest value was observed in vetiver root geotextile than all other treatments and 48.5% more over the control. The results also reveals that bulk density of the soil decreased by 4.7%, 6.7% and 10.9% and porosity reversely increased by 11.4%, 14.5% and 19.3% respectively in jute geo textile, coco coir geo textile and vetiver root geo textile over control plot. Crops grown with vetiver geotextile content more organic matter (113.6%) than control plot. The water retaintion capacity is more through out the growing seasons in vetiver root geotextile. The results of the present study lead to suggest that non woven vetiver root geo textile improving the physical and chemical properties of soil in potato field as well as increase plant nutrient availability and ultimate increase crop productivity.

PP - 67: Studies on target spot of *Rauvolfia serpentina* caused by *Corynespora cassicola*

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Several biotic and abiotic factors limited the production of Medicinal plants. The pathogenic diseases caused significant damage of the crops as well as reduced the quality of the produces and their market value. Rauvolfia serpentina suffers from many fungal diseases - leaf spotting and blight caused by Rhizoctonia solani (anamorph of *Thanatephorus cucumeris*), *Pseudocercospora rauwolfiae-serpentinae, Periconia macrospinosa*, foliage diseases and inflorescence disease caused by *Macrophomina phaseolina, Phomopsis sethii* and *Mycosphaerella rouvolfiae*; viral diseases - severe mosaic and stunting of the whole plant which was transmitted by sap inoculation on *Nicotiana tabacum* cv. White Burley, *N. rustica* and *N. glutinosa*. In this paper, symptoms of target spot disease and isolation of the pathogen were made. Confirmation of the causal pathogen *Corynespora cassicola* causing target spot of Rauvolfia serpentine were established through Koch's postulate. Morphometric characters of the pathogen were also studied. Fixed plot survey revealed that the lowest disease, both % disease index and % disease incidence were recorded during May- August and highest during March- April. The antagonistic potential of isolates of *Trichoderma harzianum* and *Trichoderma viride* collected from All India Net Working Project on Betelvine Laboratory were tested against the pathogen on PDA medium by Dual Culture Plate Technique. The antagonistic potential of Trichoderma against the above pathogens showed that both the isolates were more or less effective under in vitro conditions.

PP - 68: Multiple disease resistance in wheat and triticales and utilization of sources of resistance over past one decade in India

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Host resistance has been utilized quite effectively in wheat and Triticales and there has not been any epidemic of wheat rusts and other diseases over past three decades in India in spite of threats from evolving pathotypes. It has been possible due to vigorous screening of pre coordinated yield trial entries in Initial Plant Pathological Screening Nursery (IPPSN) against leaf, stripe and stem rusts as well as leaf blight at hot spot multilocation and later coordinated yield trial entries in PPSN for three years against major diseases like rusts, leaf blight, Karnal bunt, powdery mildew, loose smut, flag smut, hill bunt, head scab, foot rot and cereal cyst nematode as well as major insect pests. The material found resistant to rusts and other diseases in PPSN as well as other international nurseries is again tested for confirming resistance in Elite PPSN and Multiple Disease/ Insect Pests Screening

Nursery. The entries identified as confirmed sources of resistance are contributed in National Genetic Stock Nursery (NGSN) planted every year at 30 major wheat breeding centres all over India along with passport data, for their utilization in breeding for disease and insect pests resistance. Since 1997-98 till 2008-09 crop seasons, a total of 398 genotypes of wheats (Triticum aestivum, T. durum and T. dicoccum) and Triticales have been contributed in NGSN. Out of these, 385 genotypes have been utilized in the range of 4.0-63.6 per cent at different breeding centres. A number of such genotypes are figuring in the parentage of pipe line material in NIVT and AVT trials of wheat and Triticales and also in case of recently released varieties, DBW 14, DBW 16, DBW 17, HD 2888, PBW 527, PBW 533, Raj 4083 and RAJ 4083. A number of genotypes were also found to possess combined resistance to diseases and insect pests. Besides these, some have been registered as genetic stocks. The seed of these genotypes has been deposited in gene bank at DWR Karnal and NBPGR New Delhi along with passport data.

The genotypes utilized most at different breeding centres are: Bread wheat (*T. aestivum*): DBW 18, DBW 28, DWR 240, DL 547-2, GW 276,HPW 217, HPW 237, HPW 42, HPW 89, HS 460, HD 2851, HD 2830, HD 2784, HD 2777, HD 2747, HD 2770, HD 2760, HD 2747, HD 2590, HD 2747, HD 2639, HD 2618, HD 30, HD 2937, HD 2962, HI 1436, HI 1462, HPW 191, HPW185, HPW 155, HP 1731, HP 1749, HP 1744, HS 468, HS 240, HS 295, HS 318, HS 240, HS 295, HS 345, HS 375, HS 485, HS 490, HW 3018, HW 1081, HW 3082, HW 3064, HW 3083, HW 2017, HW 3027, HW 3067, HW 3083, HW 2045, HW 2007, HW 2044, HW 3033, HW 1084, HW 2004, HW 5021, HW 5102, HW 5204, K 9441, K 9107, K 9527, K 9351, NW 1012, NW 1012, MACS 2959, PBW 283, PBW 343, PBW 373, PBW 486, PBW 493, PBW 498, PBW 525, PBW 554, PBW 550, PBW 549, PBW 530, PBW 475, PBW 64, PBW 570, PBW 573, PBW 585, Raj 4028, Raj 4027, Raj 3777, Raj 4012, Raj 3856, Raj 3896, Raj 3765, UAS 295, UP 2632, UP 2400, UP 2481, UP 2473, UP 2425, UP 2687, VL 890, VL 868, VL 804, VL 892, WH 1021. Durum wheat (T. durum): AKDW 4155, MACS 6145. Khapli wheat (*T. dicoccum*): MACS 2956.

The identification of resistant genotypes and their utilization by wheat and Triticales breeders will go long way in managing the diseases and insect pests through deployment of resistant varieties and will continue to pay dividends to farmers, reduce cost of cultivation by curtailing use of pesticides and provide cleaner environment in India.

PP - 69: Effects of different levels of nitrogen under different fertility gradient soil on foliar disease severity of potato and yield were determined on field condition

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Leaf blight, leaf blotch and multiple disease complex were minimize in high fertility gradient soil as compare to other gradients and control except late blight of potato. Among the three nitrogen levels early blight, leaf blotch and multiple disease complex were decreased in high nitrogen doses (250kg/ha) except late blight. Interaction between four different soil gradients with three nitrogen doses showed minimum

late blight severity in moderate fertility soil with low nitrogen dose, minimum early blight severity in high fertility gradient soil with medium nitrogen dose and minimum leaf blotch in both high nitrogen and soil fertility gradient condition. Where as multiple disease complex was also minimum in both high nitrogen and fertility gradient field condition. Yield (t/ha) also maximum in both high nitrogen and high fertility gradient condition.

PP - 70: Influence of weather parameters on pheromone trap catches of *Spodoptera litura* in groundnut ecosystem

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Field experiments were conducted at Regional Agricultural Research Station, Tirupati during 2006-09 to study the influence of various weather parameters like maximum, minimum temperature, Relative humidity, rainfall, sunshine hours and wind velocity on the pheromone trap catches of *Spodoptera litura* (Fabr.) on groundnut. Correlation analysis of *S.litura* with weather parameters of 2006-07, 2007-08, 2008-09 and 2009 indicated no significant influence was noticed during 2006-07. During 2007, maximum temperature (0.5209) had significant positive influence and evening relative humidity (-0.5460) had negative influence on moth catches of *S. litura*. During 2008-09 season morning relative humidity (0.4407) had a significant positive correlation. During Kharif, 2009 season all the weather parameters collectively influenced moth catches to the extent of 75.30% and both temperatures had significant negative correlation, relative humidity, rainfall and rainy days had a significant positive correlation on moth catches of *S. litura*. Field incidence of 24.39 per cent defoliation due to *S. litura* was reflected earlier by high moth catches of *S. litura* in October, 2009 on Kharif groundnut which was sown on 30th July, 2009.

PP - 71: Evaluation of phyto-extracts against *Rhizoctonia solani* Kuhn. inciting sheath blight of rice

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Rice sheath blight is regarded as an internationally important disease that is second only to the rivals the blast disease, particularly since the introduction of high yielding varieties in the 1960s. The fungus,*Rhizoctonia solani* Kuhn. is the cause of rice sheath blight. Yield losses due to this disease is reported to range from 5.2 to 50.0 per cent depending on environmental conditions, crop stages at which the disease appears, cultivation practices and cultivars. Sheath blight disease incited by *Rhizoctonia solani* Kuhn., the imperfect stage of *Thanetophorous cucumeris* (Frank) Donk, was first recorded as minor disease of rice in West Bengal. Later the disease was referred as major ones in West Bengal. 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. So, one has to depend on chemical control quite often. But the chemicals are not an eco-friendly option for the management of plant diseases. Further, the chemicals applied, often create hazards to other beneficial and antagonistic organisms.

Therefore, in the present study six different phyto-extracts and a control without any phyto-extract were evaluated in field condition against the rice sheath blight disease. The results clearly indicated that all the phyto-extracts gave significantly lower per cent disease index (PDI) as compared to the control (33.70). Among the treatments neem extract showed minimum PDI (16.83) followed by turmeric (17.80), and *Lantana camera* (19.36). But there were no significant differences (CD at 5%) among the PDI for neem, turmeric and *Lantana camera*. The per cent decrease in PDI is also highest in neem extract (50.05%) followed by turmeric (47.18%), and Lantana camera (42.55%).The results also revealed that all treatments gave significantly higher yield as compared to control (29.99 q/ha). Neem extract gave highest yield (46.61 q/ha) followed by *Lantana camera* (42.60 q/ha) and turmeric (42.30 q/ha). The per cent increase in yield was highest in neem extract (35.66) followed by *Lantana camera* (29.60) and turmeric (29.10).

PP -72: Allamanda compounds are fungicidal to some important plant pathogens

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Allamanda cathertica is a recognised medicinal plant. Its extract has been proved effective in controlling Phomopsis vexans including other fungi. Allamanda leaves are also source of compounds which act as antifungal agent. Isolation of compounds of Allamanda and activity of these compounds against the target pathogen have been done. TLC and column chromatographic technique was employed to isolate the compounds. In the year 2007-2008 we were able to separate some single compounds from Allamanda extract. After different requisite studies of the compounds like m.p., R_f values, IR spectroscopy, specific rotation and finally mass spectroscopy we identified one of the compounds as plumieride. Its structural formula and configuration was also found out. Allamanda leaves were extracted by sox let, and repeated TLC and column chromatographic technique were employed. Finally the fraction consisting mixed solvent of ethyl acetate and methyl alcohol (9 : 1, 17 : 3) eluted the plumieride. The R_f value of this compound was 0.58 – 0.59 ($CHCl_3$: CH_3OH, 8 : 2). Its m.p. was found as 154- 159^{0}C. Its molecular weight was ascertained as 470 from base peak of mass spectral analysis. The IR spectra of this compound shows all the expected major functional group including conjugated and non conjugated double bonds, carbonyl groups attached to carbon- carbon double bond (-CO-C=C), ester group etc .Bio- assay of plumieride was carried out and found that it inhibited the mycelial growth of Phompsis vexans (100%) effectively. Plumieride was also tested against some other fungi like Phytopthora capsici, Fusarium oxysporum. Rhizoctonia solani, Sclerotium rolfsii and finally it was found that plumieride was active against those fungi also. pH of aqueous solution (1.41×10^{-3}M) of plumieride was measured and it was found to be 4.67. We extended our research to isolate more compounds other than plumieride by repeated

chromatographic studies and so far more four single compounds were separated and tested againt *Phomopsis vexans*. All these compounds were found to be active against *Phomopsis vexans* in different extent (69% – 100%). Their R_f values were 0.60, 0.62, 0.60, 0.58 respectively. Their melting point was also determined and these are 142-152 ,145-157,115-123,142-153 respectively. IR and Mass spectral studies of these compounds are under way. We hope very soon, we can identify and can confirm structural characterization of some more compounds other than plumieride in allamanda extract. Allamanda tablets have already been formulated against major seed-borne plant pathogens, root knot nematode and some virus diseases of important crops.

PP -73: Effect of nutrition on the incidence of leaf curl virus disease of tomato (*Lycopersicon esculentum* Mill.)under field condition

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Leaf curl disease of tomato caused by tomato leaf curl virus appears in the plains of West Bengal every year in varying intensity causing loss in yield of the crop. Field trial conducted to study the effect of nutrition on the incidence of the leaf curl virus disease of tomato and yield during the year 2007-2008 and 2008-2009. Among the twelve nutritional treatments tested, treatment N:P:K:: 150:60:60kg^{-1}ha + 64q/ha FYM + 34 q/ha.Vermicompost gave best result in regard to lowest disease incidence(21.50%) and higher fruit yield (351.67q/ha).

PP - 74 : Downy mildew disease risk of cucurbits by using weather and biological data

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The cucurbits are of tremendous economic importance and are cultivated throughout the world from tropical to subtropical and temperate zones in an area of 8.5 million hectares in the world with production of 17.9 million ton (FAO, 2004). Biotic stresses are of paramount importance in causing economic losses in cucurbits. Among them, downy mildew is the most destructive climate sensitive foliar disease caused by the Oomycetes fungus, *Pseudoporonospora cubensis* (Berk.& Curt.) Rostov. especially in humid conditions. The time of initial infection will depend on the availability of inoculum and the favorableness of weather conditions. Heavy dews, fogs, frequent rains, and high humidity favor infection and rapid multiplication of the pathogen. When a film of moisture is present on a leaf surface, the asexual spores called sporangia germinate and give rise to motile spores (zoospores) which swim about

for a while before they encyst and produce germ tubes that penetrate cucurbit leaves. Therefore, leaf wetness is critical for infection and spread of the disease under wide range of temperature 5-30 degree centigrade. Downy mildew disease of cucurbits epidemiology depends on the time of inoculum arrival i,e onset of disease and frequency of favorable weather conditions for further spread of disease in the field. Risk refers to the potential spread and development of disease in the cucurbits growing areas. By using 7-day recording Burkard spore trap near crop field population build up of cucurbits downy mildew pathogen has been assessed. Quantification of inoculum threshold level requires for the onset of the disease and epiphytotic development employing statistical relationship it is possible to quantify the pathogen load significant with respect to a particular set of weather condition and assessing the disease risk period. Crop-Weather-Disease relationship has been established in field condition by cultivating three different Cucurbits namely Cucumber Ridge gourd Bitter gourd in autumn-winter&spring-summer season which exposed them under variable weather regime. To understand the behavior of pathogen Pseudoperonospora cubensis an experiment was set up under controlled environmental condition with variable temperature and moisture regime in growth chamber. With the generated biological and weather data, an attempt has been made to develop a model to predict the onset and assessment of the spread of the Downy Mildew disease under new alluvial agroclimatic zone of West Bengal.

PP - 75 : Effect of dates of sowing and moisture regimes on incidences of aphid, *Lipaphis erysimi* (Kalt.) in rape and mustard

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Mustard aphid,*Lipaphis erysimi* (Kalt.), incurring a yield loss of as high as 90 %, is affected by weather conditions prevailing during the growing season of host crop. In view of dependence of growth of aphid on weather, research works have been intensified for development of forewarning system based on agrometeorological parameters. For the present study, which was aimed at to evaluate dynamics of aphid incidences in rape and mustard varieties sown on different dates and grown under rainfed and irrigated conditions and to develop weather based systems for its forewarning, field experiment was conducted in the 'C' Block Farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani (22°57´N; 88°20´E ; 9.75 m a.m.s.l.) during winter season of 2004-05 with two moisture regimes viz., rainfed and irrigated as main plots, six dates of sowing viz., 1 October, 8 October, 15 October, 22 October, 29 October and 5 November as subplots and 3 varieties of rape and mustard viz, 'Binoy', 'Sita' and 'Varuna' as sub-sub plots, replicated 4 times and designed in split plot. Results revealed that due to variation in dates of sowing and moisture regimes there were large differences in aphid population. On an average, aphid

population over all the varieties under study was lowest in crop sown on 1 October, while it was highest in crop sown on 5 November. The highest incidence of aphid was observed in 'Binoy', followed by 'Sita' and 'Varuna'. Aphid population was consistently greater in crops grown under irrigated condition than those under rainfed condition. With delay in sowing, there was a gradual increase in aphid population. In case of crops sown during 1 to 15 October, aphid population did not attain ETL level (e"30 aphids per plant), whereas in crops sown during 22 October to 5 November, there were severe infestations of aphid (e"30 per plant). First incidence times of aphid over all the varieties and moisture regimes varied from 19 November to 3 December, depending upon dates of sowing. In case of crops sown during 1 to 15 October, the periods of aphid activity was found to occur during 19 November to 31 December, while in crops sown from 22 October to 5 November, aphid activity prevailed during the period from 9 November to 21 January. Crops sown during 1 to 15 October did not require any spraying, but when sown during 22 October to 5 November, spraying was necessary. Weather conditions associated with aphid incidences in crops sown over different dates and moisture regimes have been identified. Maximum temperatures of 25.6 to 28.6 ^{0}C, minimum temperatures of 14.7 to 18.3 ^{0}C and mean temperatures of 20.1 to 23.4 ^{0}C were associated with first incidence of aphid. On the other hand, maximum temperatures of 25.5 to 26 ^{0}C, minimum temperatures of 9.2 to 10.4 ^{0}C and mean temperatures of 17.3 to 18.2 ^{0}C favoured the incidence of aphid at ETL (e"30 aphids per plant). These weather thresholds along with medium range weather forecasts of 4 days as available from IMD can be useful to forewarn aphid for farmers. Results further suggest that to escape aphid incidence at e"ETL, rape and mustard crops need to sown by 15 October and crops sown beyond this date are adversely affected, producing significantly lesser seed yield. Seed yield was highest in crop sown on 15 October and in crops sown beyond this, there was a gradual and significant reduction in seed yield in all varieties grown under both rainfed and irrigated conditions. When aphid population worked out over different phases of growth of crop, it was evident that in case of 'Binoy', aphid population was highest during ripening phase (end of flowering to maturity), followed by reproductive (first flowering to end of flowering) and vegetative phases (emergence to initiation of flowering), whereas in 'Sita' and 'Varuna', aphid population was highest in reproductive phase, followed by vegetative and ripening phases. Thus it is concluded that weather conditions as identified, which together with medium range weather forecasts, could be useful tools for forewarnings of first and ETL incidence times of aphid in rape and mustard crops grown in the New Alluvial Zone of West Bengal.

PP - 76 :Effect of ramederma plus on growth of yield of chilli

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An experiment was carried out at District Seed Farm, Bidhan Chandra Krishi Viswavidalaya, Kalyani, West Bengal on medium sandy loam fertile soil during Rabi season, 2008 to study the effect of *Trichoderma viride* (commercial formulation named as Ramederma Plus) on the growth and yield of chilli (var- BCCHSL – 4). The experiment was bid out in Randomized Block Design with seven treatment replicated thrice. After fertilizing the plot with recommended dose of one and half month old seedling was transplanted during the last week of December and harvesting started from last week of February. The result clearly indicated that the treatments were only soil application, only root dipping ,single spray only, soil application with root dipping, soil application with root dipping a single spraying, soil application and root dipping and followed by triple spraying at 15, 20,45 DAT.The result clearly indicated that the treatment T_5 (Soil application and root dipping followed by single spray at transplanting time 30 DAT respectively showed the best performance so far as the height, growth, canopy, yield parameter of yield is concerned.

PP - 77: Mealy bug infestation in jute and mesta crop- A case study

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Mealy bugs are economically important, soft bodied, sap sucking pests world-wide.They inflict direct damage to crops by feeding and some species act as vectors in transmission of plant diseases. It is a polyphagous pest which appeared recently and has attained the status of serious pest in wide range of agricultural and horticultural crops. Although this pest was reported to infest jute and mesta, not to that extent as it is in other crops. During 2009, summer season a survey was conducted in Bashirhat sub-division of North 24-Parganas to assess the extent and causes of mealy bug outbreak. The plant infestation in jute (cv. JRO-524) was 60-80% with average intensity of 2-3 in 0-4 scale, while it was 60% and 4 respectively in case of mesta (cv. Local). Other crops badly damaged in the locality were sesamum and okra. The damage of such proportion in the early crop growth (40-65 days old) was unprecedented. An insight into the weather parameters persisting during the past 6 years indicated that compared to the previous years there was increase in the maximum and minimum temperature and decrease in rainfall and number of rainy days from January to May. The warm and dry condition during the summer may be the pre-disposing factor for mealy bug outbreak in jute

and mesta. In addition to the earlier two reported species i.e. Ferrsia virgata Ckll and Pseudococcus filamentosus var. corymbatus, it was identified as *Phenacoccus solenopsis Tinsley*.

The farmers used wide array of insecticides (synthetic pyrethroids, organophosphates, phenyl pyrazoles and neonicotinoids) without any appreciable result. In the other hand repeated insecticide spray suppressed the natural enemy activity favouring the pest activity. In this context, the changing climatic factors may be the possible cause of outbreak of mealy bug in the early crop of jute and mesta. The multiplication of the insect under favourable condition almost nullified the effect of insecticides.

The ever increasing pestilence of mealy bug on new crops and regions is a major concern. There is a need to analyse the exact cause of the sudden pest upsurge and devise basic and applied strategies to combat the pest in an economically sustainable manner.

PP - 78 : Fungicide tolerance of rice sheath blight pathogen, *Rhizoctonia solani* Kuhn and its management

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The sheath blight (c.o. *Rhizoctonia solani* Kuhn) is one of the most devastating and yield limiting diseases of rice. Incidence of this disease becomes sometime severe due to cultication of susceptible cultivars, wrong diagnosis of disease, improper selection of fungicide, dose, time and method of application and faulty agronomic practices. Besides, the development of fungicide resistant/ tolerant R. solani isolates may be other reason for poor performance of fungicides against sheath blight disease control. For the reason the study on population structures of R. solani in a particular area and their tolerance level to a particular group(s) of fungicides are the vital considerations in any fungicide resistance management programme. Keeping these background information in consideration, an experiment was conducted with ten R. solani isolates viz. RS -1, RS - 2, RS – 4, RS - 5, RS - 6, RS -7, RS - 8, RS - 9, RS - 11 and RS -13 collected from different geographical areas to determine their level of tolerance in vitro to five commonly used fungicides viz. contaf 5 EC (hexaconazole), tilt (propiconazole), monceren 250 SC (pencycuron), bavistin 50 WP (carbendazim) and indofil M – 45 (mancozeb) and to identify appropriate fungicide(s) for fungicide resistance management schedules against R. solani. Results of the experiment indicated that R. solani isolates collected from different geographical regions varied in tolerance to fungicides measured by toxicity index and EC 50. A particular R. solani isolate exhibited differential tolerance response to five different fungicides. Highest tolerances to propiconazole, hexaconazole, mancozeb, carbendazim and pencycuron were observed in isolates RS – 13, RS – 4, RS – 8, RS – 8 and RS – 6 respectively based on toxicity index. However, based on EC 50, isolate RS – 1 exhibited 13.4 times higher tolerances to propiconazole than low tolerant isolate RS – 2. Similarly, isolate RS – 4 had 6.9 times higher tolerance to hexaconazole than low tolerant RS – 6; RS – 2 with 2.9 times higher tolerance to

mancozeb than low tolerant RS -9; RS-8 with 2.0 times higher tolerance to carbendazim than low tolerant RS- 11 and RS -5 with 64 times higher tolerance to pencycuron than low tolerant RS- 1. It was also revealed from the results that none of the isolates showed uniform tolerance to all the fungicides tested. So it may be proposed that the fungicide(s) against which a particular isolate exhibited low level tolerance can be identified as suitable fungicide(s) for the management of fungicide tolerance and can be incorporated as sole or in combination for developing spray schedule against sheath blight of rice.

PP - 79 : Population dynamics and varietal preference of mango fruit borer (*Autocharis albizonalis* Hampson) in New alluvial zone of West Bengal

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The present investigation on mango fruit borer (*Autocharis albizonalis*, Hampson) was carried out in Regional Research Station of Bidhan Chandra Krishi Viswa Vidyalaya at Gayeshpur to study the varietal preference and population dynamics of this borer. It was observed that the infestation of this borer was not highly significant to the mango growers during the course of investigation. It was also noticed that the fruits in pea to marble size stage were mostly susceptible to the pest attack during the month of March to April. Peak fruit damage (3.81%) was observed during 3rd week of March in the year 2006, where as highest infestation was noticed (0.79%) during the last week of April in the year 2007.

For varietal preference, fifteen commercially grown cultivers were selected in a RBD model with Duncun Multiple Range Test to identify least infested mango cultivars by this borer. From the findings it can be inferred that among the commercial mango varieties Himsagar, Arka Anmol, Fazli and Langra were the mostly susceptible. It was also observed during the course of investigation that west direction was the most suitable site for highest intensity of fruit damage.

PP - 80 : First report of a leaf blight disease of cabbage caused by *Colletotrichum capsici* (Syd.) E.J. Butler & Bisby 1931 in India

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Cabbage is a commercially important vegetable in India. In Shrirampur village of Chakdah and adjoining areas of Nadia district, West Bengal, this crop was severely affected by a leaf blight disease during post kharif season, 2009. Initial symptoms were the appearance of minute pin-head, circular, brown lesions on the leaves, which resulted in blighted appearance in the course of time. Infection started 30-35 days after transplanting of the cabbage seedling. The blighting was started from the leaf margins and rapidly covered more than half of the leaf area within seven days. The leaves of the severely infected plants dried prematurely, growth was restricted, and head was loosely fitted or not compact and size was also reduced. The disease occurred in second fortnight of October and caused losses to the extent of 25-30% in severely affected fields.

Isolations from the young and mature necrotic lesions on potato dextrose agar (PDA) invariably yielded a *Colletotrichum* species. The fungus initially produced white to grey mycelial growth. Acervuli were numerous, globose to saucer shape with large number of dark brown setae, the length of which ranging from 54.95-102.30 µm (average 71.42 µm). Conidiophores were short, simple. Conidia were aseptate, fusiform, sickle shape and single celled. The size of the conidia varies from 17.01-26.82 µm (average 22.44 µm). Based on these morphological features the fungus was identified as *Colletotrichum capsici* (Syd.) E.J. Butler & Bisby 1931. To prove pathogenicity, 35-day old healthy plants, were sprayed with *Colletotrichum capsici* isolates in aqueous suspensions of 1.5×10^6 conidia/ml. Symptoms were observed 5-6 days after inoculation. After 10-12 days the original lesions had spread length-wise producing leaf blight symptoms. Control plants sprayed only with water remained healthy. *C. capsici* was re-isolated from the inoculated plants. This is the first record of *Colletotrichum capsici* on cabbage from India.

PP -81 : Effect of dates of sowing and inorganic nutrients on leaf blight severity on wheat caused by *Alternaria triticina* under field condition

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Two experiment s were conducted to evaluate the inorganic nutrients (NPK) in different doses and their combinations and five different dates of sowing with their different nitrogen doses for two consecutive years showed that disease severity was maximum in the plots treated with 120 kg N ha^{-1} with combination of P0 and K40 kg ha^{-1}. With increasing level of nitrogen and decreasing level of potassium caused maximum disease severity and poor grain yield. Nitrogen, phosphorus and potassium at the ratio of 100:80:80 at 18th to 19th December sowing was suitable for low disease severity and maximum grain yield of wheat in West Bengal condition.

PP - 82: Laboratory evaluation of some new chemicals against tobacco caterpillar (*Spodoptera litura* Fab.)

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Spodoptera litura (Fabricius) is an international noctuid pest, is commonly known as tobacco caterpillar. This polyphagous pest had been reported to occur in different countries particularly in tropical regions of Asia, Africa and Australia. It is known to feed on chilli, tomato, cabbage, cauliflower, banana, cotton, groundnut, castor, soybean, tobacco, maize and many other cultivated crops in India and cause severe damage to agriculture based economy of the country. It is also empowered with high fecundity, high host range and ability to develop resistance quickly to all class of conventional pesticides and thus is a nightmare to the farming community. For the management of this pest farmers extensively used different synthetic pyrethroids, organo phosphates, carbamates and mixed formulation of traditional insecticides. Combating this pest with different improved measures of management is really a hard task today. To find out the bioeffectivenes of few new chemicals against *Spodoptera litura*, an experiment was conducted to test the relative toxicity of the following chemicals viz. fipronil, chlorfenapyr, flubendiamide, thiodicarb and Bacillus thuringiensis. In our findings thiodicarb performs exceedingly well against 2nd instar larval mortality after 24-hours followed by fipronil, chlorfenapyr and flubendiamide. Highest mortality in 3rd instar larvae was recorded again in thiodicarb treatment followed by flubendiamide, chlorfenapyr and fipronil. The microbial pesticide Bacillus performs moderately well but far behind than above four chemicals. The same trends of results were also reflected in cumulative mortality also. All the chemicals significantly reduced larval weight compared to normal untreated larvae.

The chemicals used in the experiment are highly vulnerable to the lepidopteron pest (*Spodoptera litura*) with their new mode of action and high selectivity. Thiodicarb is a propesticide of carbamate group with high larvicidal action, flubendiamide-a recently developed new chemical with new mode of action and excellent selectivity, chlorfenapyr- a new microbial of macro cyclic lactones and fipronil- phenyl pyrazole group are used in this experiment are safer to non target organisms and quickly degraded to non toxic products. All the chemicals are ideally fit for Integrated Pest Management Programme.

PP - 83: Effect of climatic change on plant diseases

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Plant diseases occur in all parts of the world. They are more severe in humid area as compared to dry areas. Climatic conditions prevailing in air and soil, after contact of a pathogen within host may affect the development of disease.Temperature, wind, humidity, soil pH, light and green house gases are the major component of climatic change. Temperature requirement for infection differs for different pathogens. The occurrence of many diseases in a particular region is closely correlated with the amount and distribution of rainfall and percentage of Relative Humidity. Wind is even more important in disease development, when it is accompanied by rain. The effect of light on disease development, especially under natural condition, is for less than temperature and moisture. The pH of the soil is also important in the occurrence and severity of plant diseases by certain soil born pathogens. Soil factors other than pH may also influence the development of plant disease. The elevated CO_2 increase the pathogen load due to increased leaf longevity and photosynthetic rate. Drought stress and disease stress may have additive effect on plant health. Becoming day by day more complex and unpredictable due to drastic change in climate. As plant disease forecasting provides early information about the probable occurrence of a disease, early informations are essential to determine to more economically sound disease control, and limit the chance for development of pathogen. Forecasting is generally done by established relationship between population and physical weather parameters like air, temperature, rain, humidity, dew wetness and leaf wetness. Besides, various management practice for many diseases are also becoming ineffective because of severe change in climate. Better strategies for the management of disease, need to be maintained and improved, even if the climate did not change. Climate change will increase some disease risks and decrease others.

PP - 84 : The hunger, poverty and silence: The synergy of danger and destruction

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More than, one billion people in the world are railing under the social venom of hunger and against each of 3.4 seconds we are losing one hungry child forever. This being the world scenario, the challenges of food security is turning into a struggle for food security (FS). While describing FS, it is the contribution of polymorphic factors like access to food, quality of food, cost of food and then food free of social and gender discrimination. The paper examines the trifoliate disposition of the threat that prevents a hungry bowl from getting food. The combination of three social decadents viz. hunger, poverty and silence have been inextricably tuned. It is found that when people go silent or are kept silent, poverty goes up and hunger becomes the worst and coercive consequence to poverty. Silence in this stud has been conceived as a situation of getting 'uninformed', 'unvoiced' and 'non-verbal'. The neo-information divide as a resultant of explicit globalization has vitiated the situation further. So, this would suggest a lot of interventions including scale neutrality of technology, announced entitlement to resources, drastic change in policy and governance and academic researches with human faces.

PP - 85: Begomo, tospo and leaf crinkle disease complex in mungbean (*Phaseolus aureous* Roxb.): A threat of grain productivity in India

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In the present study, estimation of disease incidence and detection of diseases caused by single, multiple and/or mixed infection were carried out, and yield losses caused by them was also determined, and effort was also made to identify resistance in mungbean against these viral diseases. Thus, eighteen cultivated varieties and 90 initial varietals lines (IVLs) of mungbean were used for study in kharif and pre kharif field condition during the last four years (2006-2009). Incidence and severity of viral diseases in natural conditions varied in cultivars/genotypes, seasons, locations and years. Overall, disease incidence up to 60.8 (cv. Pant M 4) by ULCD, 58.3 (cv. Pusa Baisakhi) by GBNV and 100 (cv. PS 16) by MYMIV were estimated considering seasons and locations in Delhi and west Bengal conditions. Mixed/multiple viral infections were also studied and incidence was also estimated in all the IVLs in field conditions, and incidence and severity varied similarly. Mungbean exhibits more susceptibility to MYMIV and GBNV in kharif (rainfed) but less in pre-kharif (Summer/ irrigated) conditions. The ULCD incidence in mungbean did not show considerable variation in kharif and pre-kharif condition, however, it was observed that this disease is found to be increasing gradually from initial year of 2006 to current year of 2009 with incidence from 5-15 to 20-32. Many biological and molecular techniques were developed (like biological insect and mechanical transmission, ELISA, PCR), and applied (like electron microscopy) to detect or characterize the diseases caused by MYMIV, GBNV and ULCD.

Session F: Integrated pest management in modern agri-horticultural production system

- **Chairman : Prof. A. Reghupathy**
- **Co-Chairman : Dr. Robert Spooner-Hart**
- **Rappoteurs : Dr. D.P. Singh**

Lead Lecture : 02
Invited Lectures : 01
Oral Presentation : 02

LS - 1: IPM for organic agriculture in Bangladesh

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IPM activities were introduced in Bangladesh Agriculture as early as 1981 as a part of enhancing food production through maintaining environment equilibrium. Since then IPM activities in the form of 12 projects were geared up in crop production. These projects were financed predominantly by international organizations mostly such as FAO, DANIDA, CARE, UNDP, ADB, and EC. DANIDA is being the largest donor participating in IPM activities in Bangladesh agriculture. Government forwarded its own funding only in 2006. Almost all IPM activities were focussed on rice production. Very little attention is given to other crops. Vegetable and cotton IPM have only very recently been taken into account. Insect pests were the sole targets of the IPM activities. Crop diseases are yet to be considered under IPM program. IPM programs resulted in the formation of 4621 FFS (Farmers Field Schools)/IPM Club and some 115,525 farmers received IPM training (Male 70 % and Female 30%). Farmers learned to diagnose insect pest, sweeping net, grabbing insect larvae, time of application of pesticide as a last resort, select healthy seeds, attained skill to go for surveillance and decision making in growing crops. Farmers are being trained now to use sex pheromone trap, predator and parasitic insects, trichoderma based bio-pesticides, pesticides based on plant products, compost prepared of the municipality waste etc. Private organizations especially seed businessman/companies have launched investment for the production of IPM tools locally. Farmers' interest on the use of IPM tools for the management of insect pest and diseases for maintaining eco-friendly environment are growing. More investment in terms of money and motivation are needed for promoting organic agriculture.

Biopesticides for insect and disease management have been formulated. Sex pheromone traps for brinjal shoot & fruit Borer, and cucurbit fruit flies; Predator insects like Ladybird beetles for destroying eggs and larvae of white flies; Trichograma and Bracon for flies are being multiplied and used in farmers' field. Application of Mahogany oil has brought a reduction in stem borer, leaf folders, green leafhoppers, white flies, aphids and epilachna beetles. Nimbicidin, an imported biopesticide has been marketed in Bangladesh by ACI. *Trichoderma* based biopesticide controls foot rot, root rot, collar rot and wilting of vegetables. Sheath blight of rice is excellently controlled by formulated trichoderma. Garlic and allamanda tablets control all seed-borne fungi and enhance seed germination. Soil application of allamanda tablet reduces root knot nematode. Spray of allamanda tablet reduces viral infection. Neem tablet spray contains brinjal shoot and fruit borer infestation. *Trichoderma* - decomposed municipality waste promotes excellent growth of vegetables and provides protection against soil-borne pathogens.

Garlic and allamanda tablets, trichoderma formulated IPM Lab biopesticide are in commercial use. BADC-a Government organization being the major user of IPM Lab biopesticide for potato cultivation, UnnayanDhara, Actio-Aid, Green Bengal agro, and Giant Agro- NGOs are promoting the use of IPM tools for organic production of vegetables. Cucumber growers are being the most interested users of IPM Lab biopesticide. Hot water seed treating machine is in commercial use by farmers in Bangladesh.

LS - 2: Integrated pest and disease management (IPDM)-based horticultural food production in Australia and possible impacts of climate change

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The application of integrated pest and disease management (IPDM) programs in horticultural production involves the reduction of synthetic pesticides, and increased reliance on other strategies such as biological control, quarantine and use of plant varieties more resistant or tolerant to pests and diseases. Increasingly, plant-derived chemicals, with insecticidal, attractant, repellent and antifeedant activity are also being utilised in IPDM. Pesticides are used selectively and judiciously, and so as to least interfere with other pest management strategies. The maintenance of such programs is highly reliant on development of effective monitoring systems. Effective IPDM systems reduce adverse effects of pesticides on the environment and improve food safety and health of farmers.This presentation will discuss developments in Australia towards IPDM programs in horticultural food crops, focussing on arthropod pests. The development of biological control systems incorporating inundative releases of biological control agents and the use of environmentally-friendly pesticides such as petroleum spray oils will be discussed, in particular the concept of use of semiochemicals and other compounds to reduce pest damage by suppression of feeding, oviposition and movement of arthropod pests. It will also discuss possible impacts on these IPDM systems resulting from predicted changes in climate.

OP - 1: Status of leaf blight of wheat caused *Alternaria triticina* over past one decade in India

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Leaf blight caused by *Alternaria triticina* has been a major disease of wheat in north eastern plains zone in India during seventies and known to cause heavy losses. However, during past three decades after introduction of new dwarf wheat varieties, there had been a major shift in the pathogens and Bipolaris sorokiniana is now considered major pathogen associated with leaf blight in wheat in India. The status of occurrence of *Alternaria triticina* with blighted wheat samples was assessed during 1998-99 till 2008-09 crop seasons at DWR, Karnal by collecting samples from 36 centres located in six agro-climatic zones of the country from diverse wheat and triticales genotypes. The isolations were done and identification of cultures was done in comparison with original description and culture of pathogen as well as confimed by ITCC, New Delhi. The pathogenicity tests were conducted on wheat variety, Bansi under a polyhouse at 20+2°C and at 95 per cent R.H. created with the help of humidifier which makes fine fog of water for 72 h with 12 h alternate light and dark cycles. The pathogen, however, did not produce symptoms on any other genotypes. The culture of *A. triticina* deposited in IMI, England from India during 1985 and 1973 (IMI Nos. 289962) was found infective on variety Bansi only during 2006-07 crop season.

The occurrence of *A. triticina* with the leaves of wheat and Triticales was in the range of 7.3-11.0 per cent whereas that of A. alternata considered a saprophyte on lower leaves was in the range of 20.9-72.0 per cent. It, however, failed to produce disease in pathogenicity tests on susceptible varieties like Bansi and A-9-30-1. The per cent occurrence of A. triticina was 3.0, 6.4, 3.9, 5.0, 14.2 and 12.3 in northern hills, north western plains, north eastern plains, central, peninsular and southern hills zones respectively, on an average basis. When taken the samples at different levels of plant growth, *A. triticina* was found more on lower leaves whereas B. sorokiniana dominated on upper most 2-3 leaves. It may, therefore, be concluded that *A. triticina* is no more a major pathogen of leaf blight in present day wheat varieties in India and is of no very little significance. High occurrence of *A. alternata* on blighted leaves also of no significance and is of saprophytic nature.

OP - 2: Integrated crop management for controlling fruits pest and diseases

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

OP - 3: Dissipation of carbendazim in mango (cv. Chausa) after pre and post harvest treatments

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Two pre harvest sprays of carbendazim @ 0.05 and 0.1 per cent were given to mango fruits (cv. Chausa) at 10 days interval in such a way that last spray falls 22 days prior to harvest to control post harvest diseases viz., anthracnose (*Colletotrichum gloeosporioides*) and stem end rot (*Lasiodilodia theobromae*). Cold water dip treatment in carbendazim solution @ 0.05 and 0.1 per cent was given to a separate lot of fruits having no pre spray for 10 min to control stem end rot. Fruits were stored at ambient conditions (30 ± 2°C, 80-90% RH) up to 10 days after post harvest dip for ripening and observations. Carbendazim dissipated to 1.01 and 2.14 mg kg^{-1} in mature whole fruits after harvest (12 days after second spray) at 0.05 and 0.1 per cent concentrations, respectively, following first order rate kinetics. The corresponding values in fruit pulp after 12 days were 0.57 and 1.26 mg kg^{-1}. Dissipation of carbendazim in whole fruits, when applied as post harvest dip, also followed first order rate kinetics with 0.92 and 2.06 mg kg^{-1} of the fungicide recovered after 10 days of storage from 0.05 and 0.1 per cent doses, respectively. The corresponding values in fruit pulp after same days of storage were 0.51 and 1.05 mg kg^{-1}. The residual half-life values of carbendazim in whole fruits were calculated as 4 and 3 days at both the concentrations from pre harvest

spray and post harvest dip treatment, respectively. Pre and post harvest interval of 3 and 7 days were suggested from 0.05 and 0.1 per cent concentrations. Neither anthracnose nor stem end rot was observed in fruits during harvest as well as storage from both the treatments. Carbendazim @ 0.05 per cent had been found safe (because of less waiting period of 3 days) and can be recommended as pre harvest spray as well as post harvest dip in cold water for management of post harvest diseases of mango.

Session G: IT- interface with climate change and plant protection

- **Chairman : Prof. D.K. Bagchi**
- **Co-Chairman : Dr. P. Krishna Reddy**
- **Rappoteur : Dr. Saon Banerjee**

Lead Lecture : 02

LS - 1: Development of eSagu system: Experiences and Future plan

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Indian farmers need timely expert advice to make them more productive and competitive. However, a wide information gap exists between the research level and farmer practice. It can be observed that recent advances in ICTs provide new opportunities to improve the utilization and performance of livelihood technologies like agriculture. The eSagu system ("Sagu" means cultivation in Telugu language) is developed to bridge the information gap by exploiting developments in ICTs. The eSagu is an IT-based personalized agro-advisory system. The objective of eSagu is to improve farm productivity by delivering high quality personalized (farm-specific) agro-expert advice in a timely manner for each farm without farmer asking a question.

In e-Sagu, rather than visiting the crop in person, the agricultural scientist delivers the expert advice by getting the crop status in the form of digital photographs and textual information.The operation of eSagu is as follows. A team of agriculture experts work at the eSagu (main) lab (normally in a city) supported by agricultural information system. One eSagu local center (few computers and one computer operator) is established for a group of about ten to twenty villages. Educated and experienced farmers (who are from the villages) work as coordinators. Each coordinator is assigned with a fixed number of farms. After registering the farm, the coordinator visits to the farm at regular intervals and collects crop observation data. Every day, the coordinator visits a fixed number of farms and takes four to five photographs for each farm. In addition, the feedback farm is filled-in by coordinator which contains the details of the crop problems and feedback from the farmer regarding previous advise.The data is uploaded through Internet.The Agricultural experts at the eSagu (main) lab analyze the crop situation and prepares expert advice for each farm. The coordinator collects the advice print out from local center and delivers it to the concerned farmer. The advice is also transmitted through SMS. In this way each farm gets the proactive advice at regular intervals starting from pre-sowing operations to post-harvest precautions.

Since 2004, we have implemented the system on several crops and farms in the state of Andhra Pradesh through eSagu experiment, it has been shown that it is possible for the agricultural expert to provide the expert advice by observing the crop status through digital photographs and text. It has been shown that the agricultural knowledge can play crucial role in improving the farm productivity. The impact results show that the system is encouraging IPM, judicious use of pesticides and fertilizers by avoiding their indiscriminate usage.The gains accrued to the farmers were significant.

In the era of globalization, the eSagu system aims to provide expert advice to the farmers based on the demand in the world market. The eSagu framework can be extended to all crops, cattle, sheep, pigs, aqua, and poultry. The lag period between research efforts to practice can be reduced significantly. The system could generate employment for educated rural youth. Also, the income levels of the farmers will increase; in turn, they will create more employment. The crop insurance scheme

can be piggy-backed and effectively implemented. The banking industry will pick-up due to improvement in loan recovery. The vigilance over private varieties and hybrids can be effective. Finally, if implemented, eSagu brings crucial benefits to every farmer's family (weaker, illiterate rural population in particular) by delivering timely personalized agricultural expert advice.

Encouraged by the results and possible benefits of eSagu system, Media Lab Asia is making efforts to develop an integrated agricultural service program (IASP). Under IASP, along with agricultural advisory service, other services such as input, finance, insurance and marketing will be provided to the farmers for more profitability and inclusive economic development.

LS - 2: Application of information and communication technology in IPM

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Adoption of Integrated Pest Management (IPM)in India remains at a very low level around 2 % due to lack of knowledge on IPM & critical inputs available to the farmers at appropriate time. To increase the adoption of IPM along with other agricultural technology - Information & Communication Technology (ICT) has been utilized in both national & international level in various forms e.g. kissan call center, kissan sanchar yojana in Rajasthan, e-Sagu in Andhra Pradesh, e-chowpal (of ITC) and in international level, e-k agriculture in Philippines, Digicel in Papua New Guinea, e-krishi in Bangladesh, Agrivision in Nigeria etc.

With a view to help farmers to adopt IPM & other agril technologies our institute ifmed (Institute of farm management and entrepreneurship development) has developed an e-agri clinic which may be set up at a much cheaper rate in comparison to other e-kiosks, in different market places where the farmers often visit to purchase their agri-inputs and to get knowledge on crop management from the agri-input shops, to apply them in their fields, but the farmers hardly get knowledge on IPM or the critical inputs for IPM.

These e-agri clinics can be operated even by the educated unemployed youths and can provide the farmers necessary information with the help of an unique type of information providing programs installed in the contextual hard disks, on critical inputs required for the farmers and coupling up the agri-input sellers, manufacturing companies to make available the critical inputs to the farmers.

Beside this, these e-agri clinics may be connected with the experts at different places through internet to solve the farmers' problems through two way audio visual communication i.e. farmers to experts and experts to farmers.

These e-agri clinics can be utilized also as discussion forum, digital awareness development center for farmers & to provide training through video conferencing. ifmed has achieved some success in this endeavor.

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