



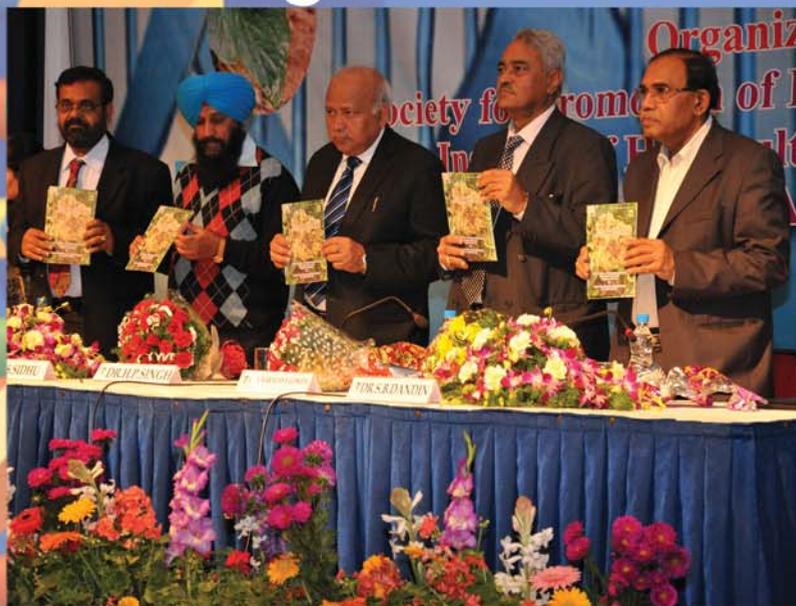
National Symposium on Molecular Approaches for Management of Fungal Diseases of Crop Plants

December 27-30, 2010

Venue : Indian Institute of Horticultural Research
Bangalore



Proceedings and Recommendations



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ORP on leaf spots

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Cover design: **Dr. P. Chowdappa**
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Printed by: **Jwalamukhi Mudranalaya Pvt Ltd.**
44/1, K.R. Road, Basavanagudi, Bangalore - 560 004
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National Symposium on Molecular Approaches for Management of Fungal Diseases of Crop Plants

December 27-30, 2010

The National Symposium on “Molecular Approaches for Management of Fungal Diseases of Crop Plants” was organized during December 27-30, 2010 at Indian Institute of Horticultural Research, Bengaluru jointly by The Society for Promotion of Horticulture, Bengaluru, Indian Institute of Horticultural Research, Bengaluru; Confederation of



Horticultural Associations of India, New Delhi and ALCOCERA, an Outreach Programme on *Alternaria*, *Colletotrichum* and *Cercospora* diseases, with financial support of Department of Horticulture, Government of Karnataka, Bengaluru; Department of Science and Technology, New Delhi; Department of Biotechnology, New Delhi; National Bank for Agriculture and Rural Development, Mumbai and Board of Research in Nuclear Sciences, Mumbai, and many private and public sector organizations. More than 300 participants consisting of policy makers, scientists, students and industrialists from research institutes, universities and industry and officials from developmental agencies across the country were attended. The National symposium provided a common platform for all stakeholders to share their experience and expertise for better understanding of molecular tools for disease diagnosis, resistance, genetic engineering and prospects of bioactive molecules in disease management. This also provided as an excellent forum to researchers for interaction with experts, to take stock of the present status, generate new ideas and plan new strategies for management of fungal diseases in an event of emerging newer pathotypes.

The symposium started with registration of delegates followed by inaugural function which included welcome address by Dr A.S. Sidhu, Director, Indian Institute of Horticultural Research, Bengaluru, introduction by Dr.P. Chowdappa, National Network Coordinator, ALCOCERA and Organizing Secretary and addresses of guests of honour, Dr.B.V. Patil, Vice-Chancellor, University of Agricultural Sciences, Raichur, Dr. Bushan L. Jalali, Ex-Director of Research, Harayana Agricultural University, Hissar and release of publications . This was

followed by the Chief guest address by Dr.S. Nagarajan, Former Chairman, PPV&FRA, New Delhi. Dr. R.P. Tewari, Dr. R.D. Rawal and Dr. Jagadish Chandra, former colleagues from Division of Plant Pathology, Indian Institute of Horticultural Research, Bengaluru were felicitated for their valuable contribution to the institute, which was followed by vote of thanks by Dr.N. Ramachandran, Acting Head, Division of Plant Pathology, IIHR, Bengaluru.

While welcoming the guests and delegates, Dr A.S. Sidhu highlighted the need of molecular strategies in managing fungal diseases in an era of climate change.

Dr. S. Nagarajan underlined the need for innovations in agricultural research. He said that horticultural and cereal crops are affected by two different set of pathogens and accurate and reliable diagnosis is needed to counter the spread of the emerging diseases before they cause too much damage. Dr. B. V. Patil said that advances in non-chemical control measures of fungal diseases hold promise. Already great advances in Molecular Plant Pathology have been made and genomics in particular is proving to be corner stone of Plant Pathology. He stressed these methods could help to combat outbreak of blight in tomatoes and potatoes. Dr. B. L. Jalali expressed that biotechnological tools opened abundant opportunities to devise means and modes of suppressing progression of disease development for achieving sustainable productivity gains in agriculture. He further stated that engineering plants with targeted genes involved in the recognition of the pathogen or in the expression of defense molecules which can lead to activation of multiple defense pathways. Dr. P. Chowdappa mentioned that new emerging diseases in crops impact both National and International food security and added that timely management of these diseases and adequate research on molecular approaches can result in an appreciable increase in food production in India. He further added recent emergence of late blight on tomato and fungicide resistant fungal pathogens are becoming a major constraint to crop production. The symposium, according to him, was planned with following theme areas for deliberations and to evolve molecular strategies in suppressing fungal diseases.

- ⌘ Genetic diversity and molecular diagnosis of emerging fungal pathogens.
- ⌘ Secondary metabolite and proteome profiling of fungal pathogens.
- ⌘ Molecular markers for fungal resistance.
- ⌘ Genetic engineering for fungal resistance.
- ⌘ Exploitation of bioactive molecules.
- ⌘ Nanotechnology in fungal disease diagnostics and management.
- ⌘ Seed and biotech industry perspective.
- ⌘ Bio-informatics.
- ⌘ Student-Academic-Industry interaction.

Four experimental manuals were released during inaugural function.

1. Laboratory Manual on Biological Control of Plant Diseases.
2. Laboratory Manual for Molecular Identification of Plant Pathogenic Fungi.
3. Laboratory Manual on Short and Long Term Storage of Fungal Cultures.
4. Laboratory Manual on *Phytophthora infestans* on tomato

The symposium included three plenary lectures from eminent scientists, invited lectures from experts, corporate houses, contributory oral papers and poster presentations spread over 12 sessions.

PLENARY LECTURE I : Plant bio-security, Trans-boundary movement of pathogens in the wake of WTO agreement : role of molecular approaches

Chairman : **Dr. B.V. Patil**, Vice-Chancellor, UAS, Raichur

Co-Chairman : **Dr. A.S. Sidhu**, Director, IIHR, Bengaluru

Convenor : **Dr. P. Chowdappa**, National Network Coordinator, IIHR, Bengaluru

Dr. S. Nagarajan, Former Chairman, PPV& FRA, New Delhi spoke on movement of plant pathogens in the wake of free trade of seed and planting material and cautioned against movement of exotic plant pathogens that could affect national food security. Quick and reliable diagnostic techniques need to be developed and applied for detection of fungal plant pathogens. He emphasized the need for establishment of National Clean Plant Health Project for production of disease free seed and planting material in horticultural crops.



Dr. S. Nagarajan

PLENARY LECTURE II : *Trichoderma* for plant disease management – a reality or myth.

Chairman : **Dr. P. Parvatha Reddy**, Former Director, IIHR, Bengaluru

Co-Chairman : **Dr. R.D. Rawal**, Former Head, Plant Pathology, IIHR, Bengaluru

Convenor : **Dr. Girija Ganeshan**, Principal Scientist, IIHR, Bengaluru

Dr. R. Thangavelu, Principal Scientist, NRCB, Thiruchirapalli

Dr. A.N. Mukhopadhyay, former Vice chancellor, AAU, Jorhat focussed his entire speech on *Trichoderma* as a bio-pesticide and its growth over the last 30 years in India. It

is heartening to note that there are about 135 bio-pesticide units commercially producing different species of *Trichoderma*. Today, *Trichoderma* formulations are well accepted for seed and soil treatment. The *Trichoderma* bio-pesticides are as effective as any broad spectrum chemical pesticides against several plant pathogens such as fungi, nematodes and bacteria. *Trichoderma* is known for its induced systemic resistance, as nutrient solubilizers and growth promotor in several crops. Hence, Dr. Mukhopadhyay in his talk stressed that “*Trichoderma* is gift of god to human being” in plant disease management. *Trichoderma* is a versatile fungus very effective in managing of soil-borne fungal plant pathogens such as *Pythium*, *Phytophthora*, *Fusarium*, *Rhizoctonia*, *Sclerotium*, *Sclerotinia* and *Macrophomina* spp, and in managing bacterial, viral and nematode diseases of crop plants. It is also used for controlling post-harvest diseases of fruits and vegetables. His talk also covered mass production of *Trichoderma* on liquid and solid substrates, mode of action in controlling the pathogens, success stories at field level in crops like chickpea, lentil and tea etc in management of diseases, and its potential in organic production of several crops. Dr. Mukhopadhyay brought out drawbacks in the technology such as non-availability of strains tolerant to high temperature, high pH, high soil moisture and short shelf life of *Trichoderma*.



Dr. A.N. Mukhopadhyay

PLENARY LECTURE III : **Harnessing molecular approaches for diagnosis and management of plant diseases: need for paradigm shift**

Chairman : **Dr. R.P. Tewari**, Former Director, DMR, Solan

Co-Chairman : **Dr. N. Ramachandran**,
Acting Head, Division of Plant Pathology, IIHR, Bengaluru

Convenor : **Dr. Meera Pandey**, Principal Scientist, IIHR, Bengaluru

Dr. B.L. Jalali highlighted the role of molecular approaches in management of fungal diseases and called upon young researchers to publish quality research papers in high-impact journals. He stressed the importance of classical Plant Pathology in disease diagnosis and that it should be a part of identification systems in is era of Molecular Plant Pathology. As Mycologists are dividing in number, there is a need to give special importance to basic Mycology.



Dr. B.L. Jalali

SESSION-I : GENETIC DIVERSITY OF FUNGAL PATHOGENS

- Chairman** : **Dr. M. Anandaraj**, Project coordinator, IISR, Calicut
Co-Chairman : **Dr. C. Aswath**, Head, Division of Biotechnology, IIHR, Bengaluru
Convenor : **Dr. Indu Sawant**, Principal Scientist, NRCG, Pune
Dr. Ramesh Sundar, Principal Scientist, SBI, Coimbatore

Dr. Ashok Kumar gave a very informative lead presentation on different types of DNA based biosensors, which can be employed for detection of plant pathogens. This was followed by Dr. P. Chowdappa, who elaborated on the use of secondary metabolite profiling for inter and intra diversity characterization of *Alternaria* species, that could not be differentiated by regular DNA based markers. The third presentation was by Dr. R. Thangavelu on the genetic diversity and molecular characterization of *Fusarium oxysporum* (FOC) and *Fusarium cubense*. He grouped different isolates of the fungus into nine different major groups by VCG analysis and r DNA- ITS- RFLP analysis. SCAR markers were developed specifically for detecting FOC isolates of India (Race 1 & 2).



Dr. P. Chowdappa

SESSION - II : MOLECULAR DIAGNOSIS OF EMERGING PLANT PATHOGENS

- Chairman** : **Dr. R.K. Khetrapal**, Director, CABI, New Delhi
Co-chairman : **Dr. H.S. Prakash**, Professor, University of Mysore, Mysore
Convenors : **Dr. R. Vishwanathan**, Head, Crop protection, SBI, Coimbatore
Dr. A.K. Saxena, Senior Scientist, IIHR, Bengaluru

Dr. R.K. Khetrapal gave an overview in his lead presentation on the potential of molecular diagnostics for import and export of quality seeds. The second lead talk was by Dr. H.S. Prakash who gave an insight into the molecular bar coding of seed borne fungal pathogens. The third lead talk was by Dr. M. Anandaraj on molecular approaches for production of disease free seed and planting material. The fourth lead talk was by Dr. Akella Vani who presented her work on development of antibody based detection technique for diagnosis of



Dr. R.K. Khetrapal

plant pathogenic fungi. Under oral paper category, Dr. Bindu Roy analyzed in detail the species specific sequence characterized amplified region (SCAR) markers delineating leaf disease in rubber. The second oral paper was by Dr. Prameela Devi who presented *Proliferosphaera*, a new genus of *Sphaeropsidaceae* from India. Dr. Girija Ganeshan presented third oral paper who spoke regarding diversity in *Alternaria* infecting vegetable crops.



Dr. H.S. Prakash

SESSION-III : SECONDARY METABOLITE AND PROTEOME PROFILING OF FUNGAL PATHOGENS

- Chairman** : **Dr. G.R. Janardhana**, Professor, University of Mysore, Mysore
Convenors : **Dr. Girija Ganeshan**, Principal Scientist, IIHR, Bengaluru
: **Dr. M. Santha Lakshmi Prasad**, Principal Scientist, DOR, Hyderabad

Dr. Hemant K. Gautam presented a lead talk on “Recent trends for accessing the microbial diversity for novel bioactive molecules”. He has emphasized the importance of molecular DNA sequencing technologies and metagenomics for identification of fruit micro flora. Apart from, he dealt with new drug discovery from fruit and fruit products for human health. Two research papers under oral presentation category were presented. Viz., “Bioactive principle in inhibition of uredospore germination of groundnut rust pathogen by phylloplane fungi from of groundnut” which was presented by Dr. Jayapal Gowda, indicated the involvement of secondary metabolites of *Acremonium* and *Myrothecium* species in the inhibition of uredospore germination



Dr. Hemant K. Gautam

Another research paper on “Molecular detection and differentiation of fumonisin producing isolates of *Fusarium verticillioides* and *Fusarium proliferatum*, from cereals and cereal based feeds” was presented by Dr. G.R.Janardhana. In this paper, FUM 1 & FUM 2 set of primers, designed from the “FUM 1” region of *Fusarium* sp. were used to differentiate fumonisin producing *Fusarium* species from non fumonisin producers.

SESSION-IV : MOLECULAR MARKERS FOR FUNGAL RESISTANCE

- Chairman** : **Dr. K. Veluthambi**, Professor, MKU, Madurai
Co-chairman : **Dr. P.B. Kirti**, Professor, University of Hyderabad, Hyderabad
Convenors : **Dr. T. Saha**, Senior Scientist, RRII, Kottayam
Dr. D.C. Lakshmana Reddy, Senior Scientist, IIHR, Bengaluru

Dr. P. B. Kirti presented a lead paper on “Transcript profiling in plant fungal interaction and characterization of genes involved in hypersensitive cell death for manipulating fungal disease resistance”. He highlighted gene expressions in diploid wild *Arachis diogeni*, which is resistant to various foliar diseases in response to a fungal pathogen *Pheoisariopsis personata*. He had indicated that 300 genes have roles in cell wall strengthening, hypersensitive cell death, cross linking and ROS generation in resistant species. Fifty per cent of the expressed genes were of unknown nature. Novel cell death factor associated with hypersensitive cell death was identified. Functional significance of various domains is being studied. The next lead paper was on “Elicitor active molecules from fungal cell walls” by Dr. Appa Rao Podile. Major focus of his talk was on bacterial chitinases that affect the structural component of the cell wall of fungal pathogens. Identifying available sources of chitinases and the approaches to improve the enzymatic properties from bacterial sources using biotechnological tools were discussed. Their observation on the use of bacterial chitinases and elicitor active molecules (bio-control agents) seem to open new ways for plant disease control.



Dr. P. B. Kirti

The third lead lecture was by Dr. K. Veluthambi on “Generation of selectable marker free transgenic rice plants with sheath blight resistance by *Agrobacterium tumefaciens* mediated co-transformation”. Antibiotic selectable marker is essential for the selection of transformed cells from the untransformed ones. However, the selectable marker gene is not required after the selection of transgenic plant. One school believes on horizontal transfer of antibiotic resistance genes to gut bacteria in animals and humans are of major bio-safety concerns. Dr. Veluthambi reported his work on selectable marker elimination from the transgenic rice plants with chitinase (*chi11*)



Dr. K. Veluthambi

through a simple genetic exercise involving co-transformation followed by segregation in T1 generation. Segregation of the marker gene from the gene of interest (*chi11*) was accomplished in the T1 generation in two of the co-transformed plants, which was evidenced by Southern analysis. Homozygous T2 plants were established successfully at the same time they showed high chitinase activity in transgenic lines exhibiting 48 per cent reduction in sheath blight disease.

The session had two oral presentations. Dr. T. Saha presented on “Characterization of a family of disease resistant gene analogues (RGAs) in rubber (*Hevea brasiliensis*) and their relationship with functional RGAs in response to *Corynespora* infection”. He highlighted their work on isolation and characterization of RGAs from rubber and their functional relevance in response to *Corynespora* infection. Functional RGAs were isolated from rubber plants after challenge inoculation with *Corynespora*. One of the functional RGAs was cloned in its full length, which may be of importance in identifying R genes against *Corynespora*. The second oral presentation was on “Molecular markers in breeding fungal resistance in horticultural crops” by Dr. D.C. Lakshmana Reddy.

SESSION-V : GENETIC ENGINEERING FOR FUNGAL RESISTANCE

- Chairman** : **Dr. V.A. Parthasarthy**, Director, IISR, Calicut
Co-Chairman : **Dr. M.V. Rajam**, Professor, University of Delhi, New Delhi
Convenor : **Dr. J.B. Mythili**, Principal Scientist, IIHR, Bengaluru
Dr. M. Srinivas Prasad, Principal Scientist, DRR, Hyderabad

The first lead talk by Dr. Anand Kumar gave an overview on transgenic crop scenario in the country vis-a-vis the global scenario. He appraised about transgenics with various traits. He also addressed the concern regarding bio-safety issues associated with the cultivation of transgenic crops. Dr. Parthasarthy in his lead talk gave an overview of “Historical perspective of breeding of horticultural crops in comparison to field/cereal crops”. He highlighted need to focus on quality parameters as these had a major role to play in the success of transgenics in horticultural crops. The third lead talk was by Dr.M.V. Rajam on “RNAi technology”. The advantages of this technology and its impact on development of fungal transgenic plants was presented. He highlighted the work carried out in his laboratory, which could be useful in generating fungal resistant transgenic plants through use of RNAi technology.



Dr. V.A. Parthasarthy

The fourth lead talk was by Dr. Sukhada Mohandas who presented her groups work on the development of transgenic banana for *Fusarium* resistant through over expression of AMP gene using embryogenic cell suspensions. The final lead talk was by Dr. J.B. Mythili who analysed in detail the constraints behind the lack of success in development of fungal resistant transgenic crops and some strategies to overcome these constraints. The oral talk by Dr. Srinivas Prasad highlighted the research findings with regard to pyramiding of resistance genes in rice for rice blast disease at DRR, Hyderabad.

SESSION-VI : MOLECULAR MECHANISMS OF HOST PATHOGEN INTERACTION

Chairman : **Dr P. Anand Kumar**, Director, NRCPB, New Delhi

Co-Chairman : **Dr. N. Ramachandran**,
Acting Head, Division of Plant Pathology, IIHR, Bengaluru

Convener : **Dr B. Ramanujam**, Principal Scientist, NBAII, Bengaluru

In the lead talk on “Functional genomics of plant fungal interaction” by Dr. Praveen Varma reported association of oxidative and nitrosative stress during interaction of blight pathogen *Asochyta* in chick pea. The lead talk on “Mechanism of plant fungal pathogen interaction and activation of defense response” was presented by Dr. B.N. Chakraborty. He emphasized the metabolomic approach using HPLC, NMR, MS or ESI-MS for identifying the metabolite fingerprinting of the interactions of pathogens in tea and rice.

Dr. Vishwanathan presented a lead talk on “Molecular basis of red-rot resistance in sugarcane”. He indicated that different accumulation of transcripts of flavonoid biosynthetic compounds like coumarate-4-hydroxylase, chalcone synthase, chalcone reductase etc are involved in phytoalexin based red-rot resistance in sugarcane. A research paper on “Identification of differentially expressed protein in chick pea *Fusarium oxysporum* infection” was presented by Dr. Yeshwant Kumar. The study indicated use of mass spectrometer technique for identification and quantification of different protein produced in plant defence mechanism in chick pea upon *Fusarium* infection. Dr. Shivashankar presented a research paper on “Systemic acquired resistance as a tool for management of fungal diseases of horticultural crops”. The paper dealt with various elicitors involved in plant defence mechanism like potassium phosphate, β -aminobutyric acid and salicylic acid and their utilisation in control of foliar diseases of horticultural crops.



Dr P. Anand Kumar

SESSION-VII: EXPLOITATION OF BIOACTIVE MOLECULES

- Chairman** : **Dr. R. Samiyappan**, Director, CPMB, TNAU, Coimbatore
Co-Chairman : **Dr. Appa Rao Podile**, Professor, University of Hyderabad, Hyderabad
Convener : **Dr. S.S. Veena**, Senior Scientist, CTCRI, Tirvandrum
Dr. M. Loganathan, Senior Scientist, IIVR, Varanasi

The lead paper "Expression of defence and infection related genes in plants during plant pathogen interactions" was by Dr.R.Samiyappan. He spoke on up or down regulation of defence genes during the interaction, PGPR mediated cross talking of signal pathways, ubiquinin ligase complex protein and WRKY transcription factor. Second lead paper was on "Systemic acquired resistance- an emerging strategy management" by Dr. A. Ramesh Sundar. He spoke on role of SAR chemical salicylic acid and its analogues viz., acibenzolar S-methyl Benzoxtiadiazole (BTH) and iso-nicotinic acid (INA).The session ended with an oral presentation on "Biotic elicitor mediated indication of systemic resistance in rice" by Dr. A. Mondal. She focused on use of biotic elicitors for the management of sheath blight of rice.



Dr. R. Samiyappan



Dr. Appa Rao Podile

SESSION-VIII : BIO-FUNGICIDES

- Chairman** : **Dr. H.B. Singh**, Professor, BHU, Varanasi
Co-chairman : **Dr. P.K. Mukherjee**, BARC, Mumbai
Convenors : **Dr. N.P. Eswara Reddy**, Head, Plant Pathology, ANGRAU, Tirupati
Dr. A. Ramanathan, Assoc. Professor, TNAU, Coimbatore

The first lead talk was by Dr.P.K.Mukherjee who gave detailed account on the "Molecular mechanisms of bio-control by *Trichoderma* spp. – *Trichoderma virens* IMI 304061 as a case study". The second lead talk was by Dr. H.B. Singh who spoke on "Bio-pesticides: Regulatory requirement , quality control, commercialization and IPR related issues". The third lead presentation was by Dr. S.R. Niranjana who spoke about



Dr. H.B. Singh

Management of plant health in vegetable crops through seed treatment. The first oral talk for this session was given by Mr.S. Thahir Basha on “Molecular diagnosis of *Colletotrichum gleosporioides* causing mango anthracnose and its management by fungicidal compatible potential bio-agents”. The second oral talk was by Mr.Jasdeep C.Padaria regarding “Genes involved in bio-control property of *Bacillus pumillus* MTCC7615”.



Dr. S.R. Niranjana

SESSION-IX: NANOTECHNOLOGY IN FUNGAL DISEASE DIAGNOSTICS AND MANAGEMENT

- Chairman** : **Dr. Pankaj Poddar**, Scientist, NCL, Pune
Co-chairman : **Dr. M. Krishna Reddy**, Principal Scientist, IIHR, Bengaluru
Convenors : **Dr. Indu S. Sawant**, Principal Scientist, NRCG, Pune
Dr. C.N. Biju, Senior Scientist, IISR, Appangala

The first lead talk was given by Dr. Pankaj Poddar. He gave “New insights into interaction of functionalised nanomaterials in respect to plant pathogen”. The second talk was by Dr. Absar Ahmad, NCL, Pune on “Extracellular synthesis of inorganic nanomaterials using plant pathogenic fungi”. He gave detailed information about the interaction of fungal pathogens with silver nanomaterials.



Dr. Pankaj Poddar

SESSION-X: BIO-INFORMATICS

- Chairman** : **Dr. Sudershan Kumar**, Programme Leader, NBRI, Lucknow
Co-chairman : **Dr. Ramesh Chand**, Head, Division of Plant Pathology, BHU, Varanasi
Convenors : **Dr. V. Suryanarayana**, Associate Professor, UHS, Sirisi

The session included three lead presentations, the first one was by Dr. Sudershan Kumar. He introduced the concept of Indian microbial diversity information system (IMDIS). He stressed on bringing all taxonomic service centers under unique platform with the inter linkage of database in comparative mode depictions. The second talk by Dr. Malathi, who stressed the need and explained the process of identification/



Dr. Sudershan Kumar

characterization of virulent pathogenic genes to address functional analysis in *Colletotrichum* and also explained practical implicity of this in developing transgenics resistant to *Colletotrichum* and to develop protein inhibitors. The third talk was on potentials of RNAi in managing insect pests like *Helicoverpa armegira* by Dr.R.Ashokan.

SESSION-XI : SEED AND BIOTECH INDUSTRY PERSPECTIVE

Chairman : **Dr. R.D. Rawal**, Former Head, Division of Plant Pathology, IIHR, Bengaluru

Co-chairman : **Dr. K.S. Mohan**, Monsanto, Bengaluru

Convenors : **Dr. D.K. Samuel**, Senior Scientist, IIHR, Bengaluru

Dr. R. Rangeshwaran, Senior Scientist, NBAII, Bengaluru

Dr. Rekha Chaturvedi stressed the role of PPV&FR act in protecting IP rights of farmers, breeders and developers of new varieties of plants under WTO regime. Dr. M. Krishna Reddy in his lead talk mentioned importance of plant protection services to implement phytosanitary measures to avoid introduction and spread of pathogens and pests through commercial exchanges of plant and plant products. He also said a National surveillance system for exotic pathogens and rapid response team to contain problem is essential. Dr. K.S.



Dr. K.S. Mohan

Mohan said that private sector is known for its post-discovery product development which includes marketing. Both private and public Institutions should be brought together on specific priority issues in horticulture and made to explore a collaborative venture. Dr. R.N. Verma remarked that concerted and consolidated efforts are needed to evolve effective and integrated mushroom disease management practices based on molecular diagnostics, epidemiological analysis based preventive hygiene and bio-control to keep mushroom industry on sound footing. Dr.R.D. Rawal talked about avoiding of 35 per cent crop losses in field, transit and storage by using appropriate IDM technology.

SESSION-XII : STUDENT –ACADEMIC –INDUSTRY INTERACTION

- Chairman** : **Dr. V. Muniyappa**, Former Head, Department of Plant Pathology, UAS, Bengaluru
- Co-chairman** : **Dr. Ramesh Chand**, Head, Division of Plant Pathology, BHU, Varanasi
Dr. B.N. Chakraborty, Dean, University of North Bengal, Silguri
Dr. V. Krishna, Professor, Department of Biotechnology, Kuvempu Univeristy, Shimoga
- Convenors** : **Dr. Vineeta Singh**, Associate Professor, BHU, Varanasi
Dr. M. Sujatha, Principal Scientist, DOR, Hyderabad

Dr. G.V.S. Saiprasad gave a lead talk on Signalling mechanism and plant defence. He talked about development of new strategies based on a plants own defence mechanisms for disease control for sustaining agricultural production and improving environment and health. Dr. J. Kumar emphasized need of development of package for management of mango malformation, a century old disease. Dr. Anita Grover spoke on application of NPR-1 gene in alleviating *Brassicae juncea* plants against *Alternaria* infections. Dr. Ramesh Chand highlighted the application of molecular sequence analyses for reassessment of morphological criteria in cercosporoids fungi. Mr. Rudra Ray described better resistance of BABA treated jute against *Macrophomina phaseolina* infection and found higher level of peroxidase enzyme activity in BABA treated jute plants. Mr. Nirmal Kumar described the molecular detection and quantification of *Phytophthora infestans* in tomato using conventional and real- time PCR assays. Detection level by RT PCR is ten folds higher than conventional PCR. Mr. Mohan Kumar explained that *Trichoderma* and *Bacillus* based formulations enhanced the growth of tomato seedlings and also induced the systemic acquired resistance in tomato against leaf blight pathogens, *Alternaria solani* and *Phytophthora infestans*.



Dr. V. Muniyappa

PLENARY SESSION

- Chairman** : **Dr. Anupam Verma**, National Professor, IARI, New Delhi
Co-Chairman : **Dr. T.P.Rajendran**, ADG (PP), ICAR, New Delhi
Convenor : **Dr. P.Chowdappa**, National Net work Coordinator, IIHR, Bengaluru

The recommendations emerged from the various sessions were presented session wise, discussed and categorized under the following headings as per the suggestions of Dr. Anupam Verma and Dr. T.P. Rajendran.



Dr. P. Chowdappa, Dr. Anupam Verma and Dr. T.P. Rajendran

RECOMMENDATIONS OF THE SYMPOSIUM

1) Basic Research

- Genetic diversity among major fungal pathogens in relation to host cultivar specificity, virulence, geographical identity and climatological factors etc., should be worked out.
- Strains of *Trichoderma* tolerant to salinity and adaptable to wide range of temperatures need to be identified/developed using recombinant DNA technologies.
- Chemical mechanisms /secondary metabolites /antibiotics and growth promoting compounds from antagonistic microbes responsible for disease suppression or growth promotion of host can be identified and used for development of products.
- There is a need to explore the possibility of developing simple identification system based on secondary metabolite fingerprints' using thin layer chromatography for complex plant pathogenic and other fungal genera such as *Alternaria*, *Aspergillus*, *Cercospora*, *Fusarium*, *Penicillium* after detailed understanding by HPLC, MALDI TOF-MS and LC-MS.
- Identification of resistant gene analogues (RGAs) can help in the discovery of new resistant genes that can be deployed for improving disease resistance by genetic engineering.
- Use of nanoparticles of copper, silver and other metals for improving efficacy in disease management of fungal pathogens needs to be explored. Nanoparticles can also be employed to construct nano-lattices for antagonistic microbes to improve their bio-control efficiency.

- Identification and quantification of various Pathogenesis Related proteins produced in plant defence mechanism and their application for disease management may be explored.
- In - depth study of signalling pathways that governs the expression of defence in systemic acquired resistance (SAR) need to be carried out.

2) Applied Research

- Simple, quick and reliable diagnostic kits need to be developed for seed borne and quiescent fungal pathogens, as mycologists are diminishing, for rapid detection. While developing molecular diagnostic kits, data on taxonomy and symptomatology should also be included, along with molecular data.
- Biosensor development can be explored of a reliable and precise tool for detection of seed borne pathogens, to strengthen plant quarantine systems, for avoiding introduction of exotic threats and to produce quality seed and planting material.
- Explore the possibility of using *Trichoderma* as pre-harvest spray for management of certain pre and post-harvest diseases of horticultural crops. This practice will help to reduce the residue of fungicide/pesticide in horticultural produce.
- Exploration of *Trichoderma* spp for ISR against plant disease will further strengthen disease management strategies.
- Potential bio-control agents identified need to be converted into commercial products after conducting multi-locational trials.
- Seed treatment is recommended in order to reduce the cost of application to soil to control soil-borne plant pathogens.
- Techniques for selectable marker elimination facilitating successive transformation of transgenic plants with a second desirable trait (stacking of transgenes) may be practised in transgenic research to fulfill biosafety norms, at the same time achieving benefits of gene pyramiding for desirable traits. The public needs to be educated in GM technology.
- Strategies for developing of fungus resistant transgenic plants need to be analyzed critically before taking up transgenic work. RNAi technology seems to be a promising area and needs to be explored further.
- Application of genomics together with conventional breeding may be explored wherever possible. Pyramiding of resistance-genes in breeding using MAS may be exploited wherever possible.
- In view of development of resistance in pathogens against fungicides, greater emphasis should be given to bio-control strategies.

- More focus should be paid to use of biotic and abiotic elicitors for the management of field and horticultural crop diseases. Use of exogenic elicitors like potassium phosphate, β -aminobutyric acid and salicylic acid control of foliar diseases needs to be exploited

3) Future Directions

- National Clean Plant Health Management project needs to be initiated on the lines of the USDA, USA. Indian Institute of Horticultural Research, Bengaluru should take lead. If required, one scientist may be deputed to USDA to get trained on project development.
- The concept of Indian microbial diversity information system (IMDIS) should be taken up on priority involving various organizations and plant health clinics. As a start, a pilot project may be taken up jointly by NBRI Bioinformatics and IHR (Dr. P. Chowdappa) on applying IMDIS on ORP Leaf spot diseases. Couple of work-shops/meetings may be organized to elaborate upon IMDIS concept.

4) Policy Matters

- As a policy, the term “bio-pesticide” should not be used for the microbial formulations, like those of *Trichoderma*. It was unanimously agreed that such formulations should be termed as ‘Microbial Bio-control Agents’ (MBA), so that these formulations do not require usual toxicological data mandatory for ‘pesticides’. It was also pointed out that many of the microbial formulations also act as “growth promoter”.
- There is an urgent requirement to establish an appropriate national certification programme to ensure production of good quality commercial MBA products.
- Bioinformatics platform for Indian fungal diversity, disease diagnosis and management should be established at selected institutes for selective pathogen which should serve as centres of excellence for rapid identification and monitoring of exotic threats.

VALEDICTORY FUNCTION AND AWARD CEREMONY

Dr. A.S. Sidhu, Director, Indian Institute of Horticultural Research, Bengaluru in his welcome address called upon the scientists to develop management strategies to overcome the fungicidal resistance in fungal pathogens by adapting molecular techniques. Dr. K. Narayana Gowda, Vice-Chancellor, University of Agricultural Sciences, Bengaluru and guest of honour said that pests and diseases are responsible for loss of Rs 90,000 crores every year. He called upon younger scientists to address disease problems using molecular breeding in developing breeding lines resistant to fungal diseases for minimizing the losses.



Dr. H.P.Singh, DDG (Horticulture), ICAR, New Delhi

elusive of effective management strategies. Due to fluctuations in weather conditions and population changes, the intensity of the fungal diseases may vary over a period and there is need to prioritise the diseases and to develop new management techniques including multiple disease resistance.

Dr. H.P.Singh, Deputy Director General (Horticulture), ICAR, New Delhi and Chief Guest at the function, said that feeding an evergrowing population was a major concern across the country as water, land and workforce engaged in agriculture is declining. Growth in horticulture has increased by eight folds since the First Five Year Plan as compared to a three fold increase in field crops. He said that technologies are available to enhance farmers profitability in horticulture even in wastelands. New diseases and climate change affecting crops and it is hampering production. There have been several instances of crops being damaged by sudden and severe fungal diseases in India. In the light of sudden emergence of late blight in tomato since 2008, Dr. H.P. Singh said there is also a need to keep vigil on imported crops to avoid dangers of introduction of exotic pathogens, that may cause extinction of native vegetations. There is also need to understand such sudden and severe outbreaks and identify factors responsible for the same employing molecular techniques. Dr. H.P. Singh remarked that we should be prepared to develop new crop varieties that resist new races in the event of emergence of new virulent biotypes as in the movement of wheat stem rust Ug 99 race. Field based diagnostic tools, particularly dip-stick assays, which can be used at farm level by farmers is the need of the hour, as PCR-based assay is restricted to the lab only. Disease forecasting models need to be developed to reduce fungicidal load and cost of the production as none of the available models are effective as these are based on regression equations using certain parameters. These



Dr. H.P.Singh

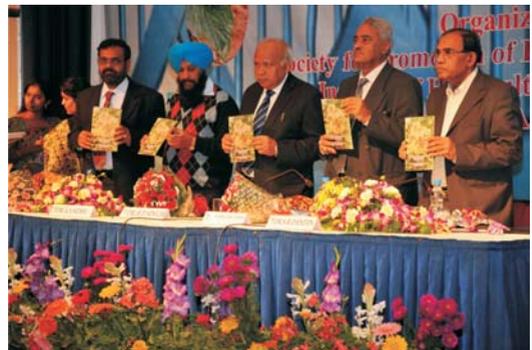
models should be refined using leaf wetness duration and temperature, and should be web-based. Management systems including acquired systemic resistance, nutrition, transferring resistance, silencing of genes, early detection and plant resistance are the future challenges.

Dr. P. Chowdappa, Organizing Secretary, while proposing a vote of thanks said that the deliberations over four days ignited young minds and provided a platform for exchange of ideas on molecular technologies.

Release of publications

The following technical bulletins published under ORP on Leaf spots were released during valedictory function.

1. Alternaria Leaf Blight of Cruciferous Vegetables.
2. Alternaria Blight of Rape Seed Mustard.
3. Alternaria Blight of Sunflower.
4. Anthracnose of Grapes.
5. Anthracnose of Mango.
6. Downy and Powdery Mildew of Cucurbits.
7. Phytophthora Blight of Capsicum.
8. Purple Leaf Blotch and Stemphylium Blight of Onion and Garlic.
9. Red Rot of Sugarcane.
10. Leaf Spot of Mungbean and Urdbean.
11. Early blight and Late blight of Tomato.
12. Anthracnose of Chilli.



Dr. H.P.Singh, Dr. K. Narayana Gowda and Dr. S. B. Dandin



Publication released

AWARDS

Life-time achievement award

Dr. H.P. Singh was conferred with Life-time achievement award by the Society for Promotion of Horticulture, Bengaluru for his contributions to development of horticulture industry in India. In addition, following awards were given as detailed below:



Best student awards

I-Prize

Influence of *Trichoderma* and *Bacillus* based formulations on growth and induction of systemic acquired resistance in tomato- Mohan Kumar, S.P., Jyothi Lakshmi, M, Shivashankar, S. and Chowdappa,P.

II-Prize

Effect of BABA priming of jute against *Macrophomina phaseolina* infection -Rudra Ray., Ghosh, A., Dutta, N., Chattopadhyay, C. and Chakrabarti,K.



III-Prize

Molecular detection and quantification of *Phytophthora infestans* in tomato using conventional and real-time PCR assays - Nirmal Kumar,B.J., Madhura, S., Padma Priya, H.V., Reddi Bhargavi, B., Sandhya,H. and Chowdappa, P.

Best oral presentation

I-Prize

Pyramiding of three blast resistant genes (Pi-1(t) + Pi-2(t) Pi-kh) using marker assisted selection into elite Indica cultivar Sambamahsuri - Srinivas Prasad, M., Ratna Madhavi, K., Madan Mohan K., Balachandran,S.M and Viktamath, B.



II-Prize

Species-specific sequence characterized amplified region (SCAR) markers delineating *Colletotrichum gloeosporioides* and *C.acutatum* causing leaf disease in rubber (*Heaea brasiliensis*)- Bindu Roy, C., Ravindran, M and Saha, T

III- Prize

Identification of differentially expressed proteins in chickpea upon *Fusarium oxysporium* infection – Yashawant Kumar, Gayatri Gurjar, Vidya S.Gupta and Ashok P.Giri

Best poster presentation

I-Prize

QTL Mapping of durable and race-specific stem rust resistance in wheat-Zwart, R.S., Banarjee.R., Shah, N., Bansal, U.K., Sivasamy, M., Singh,D., Miah, H., Martin, P., Raman, H., Bariana, H.S and Gupta, V. S.



II-Prize

Development of seed coating formulations of bio-control agents and their effects on seeding growth and blights of tomato- Chowdappa,P., Mohan Kumar, S.P., Bhanuprakash K and Yogeesh, H.S

III-Prize

Extra cellular biosynthesis of protein capped CdTe nanoparticles using fungus *Fusarium oxysporum*- Asad S Syed., Ankita Bedi., Sana Moez and Absar Ahmad.

ACKNOWLEDGEMENTS

We are high grateful to Dr. H.P. Singh, Deputy Director General (Horticulture), Indian Council of Agricultural Research, New Delhi and Dr. A.S. Sidhu, Director, Indian Institute of Horticultural Research, Bangalore for support, encouragement and timely advice.

We thank Department of Horticulture, Government of Karnataka, Department of Biotechnology, New Delhi, Department of Science and Technology, New Delhi, Board of Research in Nuclear Science, Mumbai, NABARD, Mumbai, other public and private organizations and private industries for financial support.

We are also highly thankful to Dr. S. Nagarajan, Dr. A. Mukhopadhyay, Dr. B.L. Jalali, Dr. T.P. Rajendran, Dr. Anupam Verma, Dr. B.V. Patil, Dr. K. Narayana Gowda and Dr. S.B. Dandin for their support and valuable advice.



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