port of tagging and mapping of a major QTL for BPH resistance introgressed from *O. rufipogon* on chromosome 7 by Chen Jie (China); evaluation of a gene pyramided line, with *Bph1* and *bph2* genes, against two populations of the pest by Naeemullah (Japan), and a new gene (*Bph18t*) isolated from *O. officinalis* by Jeung (Korea). While Yolanda Chen (IRRI) observed that yeast-like endosymbionts in BPH gut could influence virulence status of the insect, Yasui reviewed work on four resistance genes, *GRH1* to *GRH4*, conferring resistance against green rice leafhopper and map-based cloning of *GRH2* gene. Jagadish Bentur (India) reviewed the work on gene pyramiding for durable gall midge resistance. Gurdev Khush, who chaired the session, summed up the progress made on the genetics of insect resistance in rice and emphasized the need to establish allelic relationship of any new gene being reported with those of earlier ones.

Besides the above platform presentations, 378 posters organized into 15 sections were on display. Novel breeding objectives and approaches, focused in one of the sections, involved enhancement of iron content in rice in Vietnam, high-yielding doubled haploids in India and generating polyploid rice targetting two-fold heterosis in China. Extensive use of molecular markers for diverse breeding targets was evident in another section, while the targets ranged from pyramiding blight and blast resistance genes, selection for BPH resistance, transfer of beta carotene loci, analysis of QTL X E interaction for yield and improving drought or submergence tolerance. Great pace of progress in gene mapping for agronomic traits, heterosis, biotic and abiotic stresses was evident in over 70 posters, and targetted genes ranged from those determining grain size, number, dormancy, storability, aroma to heading time, internode elongation and the entire range of biotic and abiotic stresses. Posters covering genetic diversity, evolution and alien introgression had a gamut of interests spanning from varietal classification, gene flow, reproductive isolation to genetic diversity in blast pathogen, *Magnaporthe grisea* and sibling species of BPH. A range of posters on analysis of rice mutant lines effectively conveyed the immense potential of this genetic resource in identification of useful mutants to understanding gene action of specific genes through loss-of-function mutants. Posters on gene identification and function reported cloning of an array of genes responsible for seed shattering, seed length, tiller bud growth, rice aroma and phosphorus-deficiency tolerance. These also uncovered the molecular interactions between plant resistance gene and blast pathogen avirulence gene products.

Studies on gene expression highlighted available tools like enhancer traps, SAGE-microarray analysis, suppression subtractive hybridization, PCR-based subtraction method, RNAi and others, and their application to study specific genes related to stress and pest resistance genes. There were representative posters covering organelle genome, analysis of rice genome, novel molecular markers, including SNPs, genomic databases and transgenics for rice improvement.

The symposium concluded with an overview by Khush. A discernable thread woven all along the proceedings was the commonality in genome structure and organization among the major cereal crops like rice, maize and barley. Also evident was the similarity between the genomes of rice and *Arabidopsis*. While functions of all the genes in the latter will be known in a few months time, leading participating rice geneticists responded positively to commit to unravel functions of all the rice genes possibly by 2010. This will be a unique gift to mankind on the 50th anniversary of foundation of the International Rice Research Institute in Manila, the Philippines.

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MEETING REPORT

Biotechnology and insect pest management*

Biotechnology has contributed much to the field of insect pest management so far, through development of transgenic plants and other novel ecofriendly products to control insects. Recognition of the value and relevance of biotechnological applications in insect control is gaining momentum. There is also increased interest among scientists in developing novel strategies for insect pest management. Realizing the potential benefits and constraints in the use of biotechnology in insect pest management, a national symposium on 'Biotechnology and Insect Pest Management' was organized recently. Deliberations during the symposium covered various aspects such as insect resistant transgenic crops, microbial pesticides – process and development, botanical pesticides – process and development, hybridization techniques in the production of potential natural enemies, insect and animal vectors of diseases and biosafety concerns, etc.

Sixty-one papers were presented at the symposium. Inaugurating the symposium, M. S. Swaminathan (Chairman, National Commission on Farmers, and Chairman, M. S. Swaminathan Research Foundation, Chennai) said that the theme had two important areas, namely core molecular biology for development of transgenic crops and processes for producing and using biopesticides. He emphasized that these are urgently required in order to reduce the use of hazardous chemical pesticides. B. Jeyaraj (Loyola College, Chennai) talked about non-chemical methods of pest management, including the use of insect sex pheromones.

S. Jayaraj (S. Jayaraj Research Foundation, Chennai) spoke on 'Host plant

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resistance derived through biotechnological means for insect pest management (IPM)' and mentioned that as donors for resistance to certain major pests are not available for conventional crop breeding, transgenic crop varieties by cloning *Bt* delta-endotoxin genes have been adopted successfully. However, pests like cotton bollworm have developed resistance to the *Bt* toxin and hence gene deployment strategies must be designed and implemented to delay or prevent the breakdown of resistance like use of multiple genes, combining the host plant resistance derived through conventional and biotechnological means to pyramid resistance genes, rotation or alteration of genes, use of different gene promoters, and manipulation of the levels of expression of genes. Besides *Bt* toxins, photorhabdus toxins, proteinase inhibitors, lectins, cholesterol oxidases, chitinases, peroxidases, cytokinins, secondary metabolites, cyanogenic glucosides, Dimboa, etc. have also been investigated.

P. Vidhyasekaran (Formerly at the Centre for Plant Protection Studies, Tamil Nadu Agricultural University (TNAU), Coimbatore) presented a paper on 'Transgenic technology employing plant-derived genes for insect pest management'. Many defence genes against insect pests have been recognized in plants. Transgenic plants over-expressing these genes from the same plant species will be more advantageous than plants expressing microbial genes with regard to biosafety aspects. Proteinase inhibitor (PR-6) gene is the most potential, which can be exploited to develop pest-resistant plants.

S. Ignacimuthu (Entomology Research Institute, Loyola College, Chennai) reported on the isolation of α-amylase inhibitor gene from *Phaseolus vulgaris* seeds and introduced into chickpea for significant reduction in the survival rate of bruchid, *Callosobruchus maculatus* in storage. Prospects for DNA marker-assisted selection to improve insect resistance in cereals were indicated by G. M. Sajjanar (Regional Agricultural Research Station, Bijapur).

N. Roychoudhury (Tropical Forest Research Institute, Jabalpur) presented work done in different forest research institutes of India on tree resistance to insects, with particular reference to teak foliage pests.

K. Narayanan (Project Directorate of Biological Control, ICAR, Bangalore) highlighted the biotechnological approaches for effective utilization of insect viruses for pest management. With the advent of recombinant r-DNA technology, an opportunity has emerged in alleviating certain commercial shortcomings of insect viruses and fostering the creation of new-generation biopesticides in order to improve the speed of action through the insertion of insect-specific neurotoxic genes from scorpion, spider, predatory straw itch mite and parasitic insects.

S. Jayaraj elucidated the techniques of mass production and field application of microbial pesticides, increasing their efficacy and persistence, formulation, compatibility with other components of IPM, and safety to non-target species. The cloning of *Bt* toxin genes and their transfer and expression in alternative organisms has been achieved by producing transgenic bacteria (*Pseudomonas*) that express the *Bt* toxin gene. These bacteria may be capable of longer survival on leaf surfaces or in soil.

V. Sivasundaram (TNAU, Coimbatore) presented the results of the study on chitinase as the molecular tool/marker for the selection of effective entomo-pathogenic fungal pathogens *Beauveria* and *Metarhizium* against rice leaf folder and BPH under *in vitro* conditions. S. Subramanian (TNAU, Coimbatore) reported the glycerol-based aqueous formulation of NPV in the management of *Spodoptera litura.* The comparative virulence of *in vitro* and *in vivo* produced UV-selected *Helicoverpa armigera* NPV was presented by S. Jeyarani (TNAU, Coimbatore). M. Ingobi Singh (Manipur University, Imphal) indicated the storage effect of SoNPV and cannibalism among the virus-infected Bihar hairy caterpillar, *Spilarctia obliqua.*

S. Maria Packiam (Entomology Research Institute, Loyola College) reported that certain non-edible oil formulations had synergistic effects in controlling *S. litura.* P. V. Krishnayya (Agricultural College, Bapatla) reported the adverse effect of certain botanicals on the growth of *Bacillus thuringiensis* var. *kurstaki* when incubated for 0–30 days. The morphogenetic effects of neem formulations on coconut red palm weevil were reported by Leenamma Joseph (Mar Ivanios College, Thiruvananthapuram).

During the panel discussion, the need for avoiding monocropping of transgenic crops to minimize the problem of insect pests developing resistance to *Bt* toxin genes, developing strategies for resistance management and biosafety, evolving IPM tactics for *Bt* crops, studying the effect of *Bt* crops on natural enemy diversity, interaction of biocontrol agents with *Bt* crops, economic thresholds and economic analysis on cost-effectiveness were stressed.

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