MEETING REPORT

Entomology Academy of India*

An Academy to promote the cause of entomology, the Entomology Academy of India, was recently founded in Chennai.

Welcoming the entomologists gathered, R. W. Alexander Jesudasan (Secretary and Treasurer of the Academy) highlighted the need for having an Academy, in view of the importance of this discipline in the fields of agriculture, horticulture, medical, veterinary and forensic sciences with both agriculture and entomology being intertwined. He recalled the services of M. S. Swaminathan (MSSRF, Chennai) and the role of the National Academy of Agricultural Sciences in the field of agriculture and looked forward to his guidance in the promotion of the cause of entomology in the country. T. N. Ananthakrishnan (the Patron of the Academy), in his welcome address, traced the formation of the Academy to a series of discussion meetings on entomology organized for the past seven years, which paved the way for the genesis of this Academy. In view of the developments in chemical ecology and molecular biology, intimate interactions among systematists, ecologists, geneticists and molecular biologists are needed to recognize entomology as a holistic science. It is with these aspects in mind that an Academy of this stature was thought of, so that there could be increased interactions and understanding between specialists and generalists in National institutes, universities and colleges and to facilitate regional interaction involving 'regional chapters', in order that there would be integration of entomologists with diverse viewpoints, from biodiversity to biotechnology.

In his inaugural address, Swaminathan emphasized that the Academy has a 'large responsibility' of bridging the knowledge deficit between scientists and the public, especially in rural areas. There is a need to transfer the existing knowledge of pest management to the field, he opined. Swaminathan remarked, 'we also have to bridge the gap between the potential and actual yields of crops in many States. In India, plant protection is crucial as major crops such as rice, jowar and sorghum are prone to pests'. He appealed to the Academy to produce policy-oriented papers that would seek to address knowledge deficit. B. Vasantharaj David (President of the Academy) made a reference to the pioneering contributions made by both overseas and Indian entomologists to the study of insects in India.

He touched upon aspects such as the importance of revival of taxonomy, critical study of invasive species and the synergy of several disciplines in entomology for a holistic understanding of vital pest species.

S. E. Hasnain (University of Hyderabad) outlined the studies made on *Anopheles* and *Drosophila*, and stressed that there is need for an efficient quarantine system to prevent the transport of pathogens causing plant diseases. He indicated that a better utility of recombinant biocides developed against insects and pathogens should be utilized properly. H. A. Ranganath (Bangalore University) mentioned that there is a shift in biological research from descriptive to analytical. He regretted the lack of entomology departments in traditional universities in the country, except in agricultural universities, and with the enormity of the insects occupying diverse habitats, there is a dire need for the establishment of an exclusive department in postgraduate institutes. Entomological research should also be resurrected in the country, he opined.

A symposium on the 'Thrust areas in entomological research' was organized after the inaugural meeting. R. J. Rabindra (Project Directorate of Biological Control, Bangalore), while speaking on the current status and prospects of classical biological control of exotic pest species for sustainable agriculture in India, outlined the several introductions of insect pests of weeds which have brought varied levels of success, the recent one being the introduction of the gall fly, *Cecidochares connexa* for the suppression of the Siam weed, *Chromolaena odorata*. Management of *Parthenium* and *Mimosa invisa* has been envisaged through the use of the seed gall-forming insect, *Smicronyx lutalentus* for the former and a psyllid, *Heteropsylla spinulosa* for the latter. He also mentioned the importation of two strains of rust fungus, *Puccinia* for the release against the pernicious weed, *Mikania micranta* in Assam, Kerala and Andaman and Nicobar Islands. Aparna Dutta Gupta (University of Hyderabad) spoke on the possibilities of alternate Cry toxin targets in lepidopteran insects with a view to develop control strategies and to overcome the problem of resistance to *Bt* Cry toxins. She reported the presence of novel aminopeptidases in the fat body of two noctuid moths, *Achaea janata* and *Spodoptera litura*, being cloned and characterized for the first time. Alok Sen (National Chemical Laboratory, Pune) spoke on the responses of different bitter-sensitive gustatory cells to feeding inhibition in *Helicoverpa armigera*. He indicated that neural recordings revealed that *H. armigera* had only one pair of inositol-sensitive cells on the median sensilla which responded selectively and strongly to myo-inositol, and a pair of sugar-sensitive cells on the lateral sensilla which responded specifically to sucrose. Besides, each of the two sensilla had a deterrent cell which differed in the responsiveness to bitter compounds. Collective response profiles of the five gustatory sensilla on the maxillary palpi indicated perception of sugars, inositol as well as deterrents. S. Mohan Kumar (TNAU, Coimbatore) outlined the current status of information available on insect genomics. He brought to light the databases available for *Drosophila*, *Anopheles*, *Apis* sp. and *Tribolium*. He also emphasized that information on gene structures in the entire genome of these insects had accelerated the process of identification and characterization of genes responsible for various biological phenomena. Recently, the sequences of the genomes had permitted the development of more comprehensive approaches for the functional manipulation of genes such as large-scale destruction of genes, transcriptome and proteome analysis, according to Mohan Kumar. R. S. Annadurai (Vittal Mallya Scientific Research Foundation, Bangalore) discussed the role of actin as a novel target towards developing new molecules

*A report on the inaugural meetings of the Entomology Academy of India founded on 18 August 2007 at the Council for Cooperation in Science and Technology among Developing Societies (CCSTDS), Chennai with M. S. Swaminathan (MSSRF, Chennai), in the Chair, besides S. E. Hasnain (University of Hyderabad) and H. A. Ranganath (Bangalore University) as special invitees.

with insecticidal activity. He dwelt on the identification of different stage-specific isoforms of actin present in insects which could be targeted to design highly specific novel insecticides. Since targeting stage-specific isoforms of actin causes global impact on insect embryos, larvae, pupae and adults, there was little scope for the insect to mutate itself to confer resistance to the insecticide. A phytochemical with selective target on insect actin has been reported, he indicated.

B. K. Tyagi (Center for Research in Medical Entomology, Madurai) presented a paper on arthropods and their biomedical importance. He summarized the biomedical and public-health importance of arthropods and stressed that the meticulous evaluation of the whole Arthropoda from the angle of biomedical significance and impact on public health would be an inevitable scientific necessity of the hour. Earlier in his presentation, Tyagi introduced a new concept of medical arthropodology, which encompasses all the disciplines, including medical entomology which deals with biomedical importance of insects, ticks, mites, spiders, centipedes, millipedes, scorpions and crabs. K. Narayanan (Multiplex Bio-Tech Pvt. Ltd, Bangalore) discussed the impact of host plant–insect and pathogen interactions on microbial control of insect pests. He highlighted the impact on the interaction between chemical composition of plants, insects and pathogens on the efficacy of various insect pathogens. He also indicated the change in insect behaviour due to viral infection in better utilization of insect viruses. N. K. Krishnakumar (Indian Institute of Horticultural Research, Bangalore) discussed the role of the predominant aphid vector species of Papaya Ring Spot Virus (PRSV), their influence of epidemiology, efficiency and few aspects of their management. According to him, three aphid species are involved, viz. *Aphis gossypii*, *Myzus persicae* and *Aphis craccivora*. Single-aphid inoculation studies indicated that *M. persicae* was the most significant vector compared to *Aphis craccivora* and *Aphis gossypii*. A simple and novel, leaf-disc assay was standardized to study the vector efficiency of PRSV, he indicated.

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RESEARCH NEWS

The florigen mystery: A potential solution for an ancient riddle

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Way back in 1865, Julius Sachs proved that leaves exposed to light produce a 'flower forming' substance, later christened 'florigen', which directs flower formation even in dark-adapted leaves. Much later, in 1934, Knott[1] proved that the day-length signal is perceived in the leaf, where it induces a signal that moves through the phloem sieve elements to the shoot apex, thus initiating the process of flowering. However, it was the classical experiment of Chailakhyan[2] in 1936 that proved beyond doubt, that the photoperiodic signal is indeed perceived by the leaf and translocated to the shoot apex where flowering is induced. In a set of simple and elegant experiments, he showed that this flowering signal could be transmitted from an induced leaf, via a graft union, to initiate the flowering process in a dark-adapted stock. However, though the existence of a flowering signal was firmly established, the exact nature of this signal has remained a riddle. Research into the nature of signal for the past eight decades has been inconclusive and has only kept the florigen mystery alive.

Recently, a seemingly significant breakthrough in unravelling the identity of florigen occurred when Huang *et al.*[3] reported that the mysterious flowering signal could after all be the mRNA of the flowering locus (*FT*) gene, one of the two genes that had been identified to be critical to photoperiod-induced flowering in *Arabidopsis thaliana*. Huang conjectured that upon light induction of leaves, the Constans (*CO*) gene, a transcriptional regulator, activates the transcription of the *FT* gene. The transcribed product (mRNA) is further believed to be transmitted from the induced leaf to the apical region through the phloem tissue[4]. Having come nearly 80 years after Chailakhyan's work, this report fuelled renewed interest into the story of florigen and the discovery made it to the list of 'Breakthroughs of the Year' in *Science*.

However, there was a twist in the tale when Corbesier *et al.*[5] reported the movement of the FT protein from the leaf to the shoot apex of *Arabidopsis*. They claimed that the FT protein itself, and not the mRNA, acts as the long distance, mobile flowering signal. *In situ* hybridization analysis by probing the chimeric DNA fragment spanning the junction between FT and the Green Fluorescent Protein (GFP) did not detect the presence of the FT mRNA in the shoot apex, thus excluding the possibility of the FT mRNA being the flowering signal. In another experiment, Corbesier *et al.*[5] fused the *FT* gene with the *GFP* reporter gene and reported the presence of GFP in the phloem and shoot apex. These results suggested that the FT protein per se, and not the mRNA, is the mobile flowering signal. Tamaki *et al.*[6] also corroborated these results in rice, where they further confirmed that the protein of the *FT* gene homologue is indeed the mobile flowering signal. Both papers failed to find evidence for movement of the FT mRNA[7].

Adding intrigue to the already colourful history of florigen, Nilsson, who led the team that reported the FT mRNA results, accused Huang, the first author of the original *Science* paper[3], of manipulating data[7]. Nilsson claimed that Huang selectively excluded some datapoints and statistically overweighted others[8]. Following these reports, the original paper that suggested the FT mRNA to be the mobile signal, has been retracted[8]. However, Huang, who left Nilsson's laboratory for the Xiamen University in China after publication of the paper, did not agree to the retraction, terming it premature.