SCIENCE NEWS

SYMPOSIUM ON DYNAMICS OF INSECT-PLANT INTERACTION
28–30 OCTOBER 1988

To commemorate 25 years of continued service of the Entomology Research Institute of the Loyola College (Madras, India) to the nation and science, a symposium on the focal theme 'Dynamics of Insect-Plant Interaction: Recent Advances and Future Trends', the primary research objective of the Institute, was organised, wherein 40 scientists working in this area of research from India and abroad participated.

Inaugurating the Symposium, Dr S. Ramachandran (Secretary, Department of Biotechnology, Government of India, New Delhi) indicated that location-specific plant protection measures need to be developed, since ecological and evolutionary problems determining insect-plant interaction are becoming more complex. He emphasized that a better understanding of the sensory mechanisms in the insects and the genetic resistance mechanisms of the plants to insect pests is absolutely essential. With the growing knowledge of several allelochemicals, he added that the interaction pattern between these two kingdoms needs to be better understood and moderated to design appropriate plant protection measures in farm operations. Delivering the key-note address, Prof. M. S. Mani, the doyen among Indian Entomologists, called for an integrated approach in the study of insect-plant interaction to appreciate and understand the nuances in their relationship, essentially because the insect and its host plant form more of an integrated system that has evolved from the upper Cretaceous. Inaugurating the permanent photographic exhibition that highlights the work of the Entomology Research Institute over the last two and half decades, Prof. S. Jayaraj (Vice-Chancellor of the Tamil Nadu Agricultural University, Coimbatore) reiterated that 45–60% of the pests are controlled by their natural enemies in Nature; only when the subtle balance between these organisms is upset, we face problems such as pest outbreak and flare-up. Because plants are evolving with the changing environment, the insects that depend on them too are co-evolving through the development of newer biotypes. Aiming at viable and practicable solutions for the current agricultural problems, he called for an integrated research involving the plant breeder and the entomologist.

Prof. T. N. Ananthakrishnan (Director of the Entomology Research Institute, Madras) outlined the scope and purpose of this symposium and highlighted how the mechanisms of insect-host plant interaction is a complex process including several overlapping physical and chemical factors; further to the seasonal, functional, environmental, and behavioural factors that monitor this interaction. He indicated that plant allelochemicals play a key role in facilitating this association. Setting the trend for the Symposium, he emphasized that increasing diversification of the defense mechanisms of the host plants promote new exploitation strategies among phytophagous insects. During the deliberations, 16 theme papers were presented in the following areas: (i) Host plant resistance to insects, (ii) Insect behaviour modifying phytochemicals, (iii) Insect-plant mutualism, (iv) Gall-insect host relations, and (v) Plant protection through genetic manipulation.

Host plant resistance to insects

Indicating the potential of host plant resistance (HPR) as a vital component of the integrated pest management procedures (IPM), Prof. S. Uthamasamy (Tamil Nadu Agricultural University, Coimbatore) discussed the nature of chemicals that are responsible for the non-preference mechanisms in resistant host plant species. Since evolution of the mechanism of antibiosis is the basic factor in the resistant species, he emphasized that the nutritional mechanism of phytophagous insects needs to be understood in terms of physiological, behavioural and biochemical sequences to know the mechanism of resistance in the host species. Continuing the trend, Dr H. David (Sugarcane Breeding Institute, Coimbatore) illustrated how contact plant characters such as pubescence, hardiness, the nature of cell wall and cuticle, proliferation ability of tissues, surface waxes and the lability of host cells for histogenetic modifications are important in regulating host selection processes of phytophagous insects.

Insect behaviour modifying phytochemicals

Obviously since millions of years are behind the evolution of phytophagous insects and their respec-

tive host plants, these herbivores have learnt to locate their hosts, utilizing several of the clues that are available, incidently learning to avoid the toxic hosts. As such, these insects have evolved under the most compelling competitive environmental conditions, essentially because their chemical constituents (volatile and otherwise), further the ability of the host species to modify the behaviour of the feeding insects. In view of such a complex situation, Prof. H. Rembold (Max Planck Institute for Biochemistry, Munich, Federal Republic of Germany) highlighted that the biological balance that emerges subtly between the susceptible host and the invading insect is hinged on a summit. He estimated that modern agricultural practices such as mono-culture and wide spread use of broad spectrum insecticides have tampered this delicate balance, which has eventually necessitated the evolution of some of these to turn into voracious pests. He illustrated these key issues of pest management using the signal selection pattern of the gram stempod borer, *Heliothes armigera*, and specific insect growth inhibition process using the azadirachtin group. Discussing the role of several plant products on the breeding potentials and strategies of diverse Hemiptera, Dr S. S. Krishna (University of Gorakhpur, Gorakhpur) highlighted how the vapours of volatile compounds of neem, eucalypt, and *Ocimum* alter the egg yield and egg hatchability. Dr Kumuda Sukumar (Regional Research Laboratory, Hyderabad) illustrated the phenomenon of chemical heterogeneity of Nature using the process of co-evolution undergone by both plants and plant feeding insects as a model system. Emphasis was laid on the role of sensory receptors of insects in assisting them to select the right food plants. Tactile efficiency of plant feeding insects in terms of their ability to discern their hosts was linked to the effective control of insects by suggesting the use of plant chemicals that are not preferred by the insects in farming operations. These naturally occurring feeding inhibitors tend to ultimately prove advantageous in agricultural practice, so that this method seemed specific to particular insects, without harming the beneficial ones. Dr G. Suresh (Agrochemical Research Laboratory, Southern Petrochemical Industries Corporation, Madras) spoke on the biogenetic mechanisms of plant secondary compounds and the role of the constitutive and induced plant natural products against insect phytophagy. He stressed the need for analysing the roles of these compounds in the light of plant resistance/tolerance.

Dr B. P. Saxena (Regional Research Laboratory, Jammu-Tawi) indicated how exploitation of some of the weak links in insect-plant relationship can form a sound basis for the successful control of insect pests. Against this background, he discussed the roles of secondary plant products like Conassine, Vasicine, Vasicinol, Vasicinone, Deoxyvasicine, and Deoxyvasicinone that acted effectively on the larvae of several phytophagous Hemiptera as potential growth retardants. The emerging roles of *P. asorone* and plumbagin as potential chemosterilants were also indicated.

Insect-plant mutualism

Dr William D. J. Kirk, (University of Keele, Staffordshire, England) highlighted the processes of insect pollination syndrome. Attempting to describe several mechanisms to evaluate effectively the pollination process, he highlighted some of the newer trends in pollination research, using thrips pollination models. Establishing a positive correlation between faecal weight on the one hand as against food consumption, metabolism, and growth on the other, Prof. T. J. Pandian (Madurai Kamaraj University, Madurai) presented a new and a realistic procedure for the prediction of the energetics components of phytophagous insects. Dr K. N. Ganeshiah, (University of Agricultural Sciences, Bangalore) described the selective forces, and the adaptive changes that happen eventually, drawing examples essentially from ant-angiosperm association. While testing several of the hypotheses that explain this mutualism, he argued that these facultative associations are not merely random assemblages, but a consequence of coevolution for various adaptive reasons.

Gall insect-host plant relationships

An insect induced gall on a higher plant is one of the outstanding examples of the obligatory relationship between an insect and the host. Both the participating organisms display a high level of specilization: (i) in the feeding behaviour and the life cycle pattern of the gall insect that is well-synchronized with the phenology and the life history performance of the host, and (ii) in the nature of the response of the host plant to the 'stimulus' from the gall-insect. Illustrating this interesting and intimate association, Dr P. Grover (University of Allahabad, Allahabad) while providing a vivid account of the diversity patterns among the galls formed by Cecidomyiids, indicated that the

shape of the gall depends on the response of the host plant tissue, using examples of mango gall midges. Evaluating the biology of some cecidogenous Thysanoptera and Homoptera, Dr A. Raman (Entomology Research Institute, Loyola College, Madras) highlighted how the gall insects are able to develop more than one strategy that equip them to survive successfully in a gall guild. He emphasized that the stability in the behavioural pattern vis-a-vis organic evolution and time becomes significant primarily because variability in behaviour leads to genotypic plasticity in relation to time. This is considered as an important evolutionary strategy among the non-cecidogenous phytophages. He also dwelt at length on the mechanisms of host response, clinching the issue to be more of an epigenetic modification. Dr Vidya Ramani (University of Rajasthan, Jaipur) illustrated the behaviour of insect gall tissues under *in vitro* conditions, using two economically important, gall suceptible plant genomes. The roles of phenylammonia lyase, IAA oxidase and polyphenoloxidase were also indicated.

Plant protection through genetic manipulation

Genetic manipulation of plants towards the development of insect-resistant varieties, principally involves two emerging trends. Both of these exploit the traits of different strains of *Bacillus thuringiensis* which produce a wide range of intracellular materials that are toxic to several phytophagous Coleoptera and Lepidoptera. Taking off from this plane, Prof. Kunthala Jayaraman (Anna University, Madras) dialated upon two trends: (i) that involves *B. thuringensis-Agrobacterium* mediated T-DNA transfer to express the chimeric toxic gene factor in the host plant; and (ii) that involves the use of endophytes that act as integrative vectors within the host plants. Although these techniques need detailed evaluation on the field level, she emphasized the immense potential these biotechnological approaches have in the future of Indian Agriculture.

The second part of the Symposium involved about 20 brief presentations of either case studies or newer techniques developed and testing of hypotheses, capitalising on the theme papers presented earlier. This discussion session, tried as a novelty was spread over a whole day, thus providing ample opportunities to hear the views and works of younger Indian Scientists, besides indepth discussions on the focal theme assessed from 5 divergent angles.

Concluding the deliberations, Prof. T. N. Ananthakrishnan (Entomology Research Institute, Loyola College, Madras) indicated that in the interdisciplinary research of insect-plant interaction, a clearer and closer rapport between entomologists, botanists and biochemists is essential. He emphasized that aspects such as the development of behavioural models of major crop pests, assessment of morphological, physiological, and genetic polymorphism in geographically isolated phytophagous populations, feeding ecology (both at the individual and at population levels), evolution of the gall inducing behaviour and the host responses to gall insects, how preadapted insects process the potential toxic compounds that exist in their preferred host plants, and their growth regulating effects, need to be examined in greater depth in future. Particular stress was laid on three aspects which could emerge as thrust areas in this field, viz. sensory physiology of phytophagous insecs, detoxifying mechanisms involving multiple enzyme systems and the impact of pheromones in insect-plant interaction.

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