Book Reviews

Chemical Ecology of Phytophagous Insects edited by **T.N. Ananthakrishnan** and **A. Raman**, (1993). Published by Oxford and IBH Publishing Co. Pvt. Ltd., (New Delhi 110 001, India) 332 pp. (Price : Not indicated). ISBN 81-204-0835-7.

Flowering plants and insects have had a long history of interaction and co-evolution, both friendly and hostile, dating back to at least 65 million years. Barely ten thousand years ago man, an absolute new comer on the scene, began to cultivate flowering plants in large numbers for his own use and in the process, completely ignored insects as inevitable evolutionary partners of the plants. Not surprisingly, insects shot back and the history of insect pests of man's agriculture is as old as agriculture itself. Starting from the mid forties of this century, man unleashed a major offensive on the insects in the form of synthetic insecticides such as DDT. In Rachel Carson's famous words, ".... insects, in triumphant vindication of Darwin's principle of the survival of the fittest, have evolved super races immune to the particular insecticides used, hence a deadlier one has always to be developed — and then a deadlier one than that.....Thus the chemical war is never won, and all life is caught in its violent crossfire."

Fortunately we live in a time when the absurdity of unleashing such a chemical warfare on insects and thence on ourselves is being increasingly realized. But what of the insect pests? We cannot wish them away. Even more fortunately, we are witness to the birth of a new philosophy of pest control that is ecologically more realistic. This is to use nature's own chemicals to fight insects in nature's own way. In the 65 million years of co-evolution, plants too have waged a chemical war against insects. Plants produce a large variety of chemical compounds (often called allelochemicals) that adversely affect insects and hence are potential candidates for ecologically friendly insecticides. They are likely to be ecologically friendly because allelochemicals are not really foreign to the environment and are often easily degradable. A particularly ingenuous strategy is to use so-called, non-host allelochemicals. In the evolutionary battle neither insects nor plants can be said to have won; instead there has been a never ending arms race leading to resistance by the insects and newer chemicals by the plants. As a result, insects are often pretty specific about the plants they attack, choosing those against whom they have some level of resistance. The trick then is to fight each insect species with chemicals derived from plant species with which that insect species has not co-evolved and is therefore not resistant to.

The development of such insecticides depends very greatly on our understanding the intricacies of the chemical ecology of insect-plant interactions. The efficacy of allelochemical based insecticides is almost certain to be habitat, species, and cultivar specific. There is therefore no substitute for us but to develop our own knowleldge of chemical ecology of insect-plant interactions. A great deal of work goes on along these lines in the country, but as usual, information is hard to find as it is scattered in diverse journals of varying qualities and accessibilities. We therefore ought to be indebted to T.N. Ananthakrishnan and A. Raman for putting together this fine volume which represents much of the Indian work in the area.

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The book has 20 chapters including a useful overview by Ananthakrishnan (Chapter 1). The wide range of approaches represented by the different authors of this book is most impressive. There are at least 10 major themes running through the book and I will briefly mention them so that the readers of this review can get a glimpse of what the book has to offer. The chapters by Sharma (Chapter 2), Krishna (Chapter 3), Opender Koul (Chapter 4), Kumuda Sukumar (Chapter 5), and Rao & Mani (Chapter 7) represent the approach of reductionist studies of the effects of isolated allelochemicals on isolated insect species in the laboratory — the obvious first step. While the above-mentioned authors demonstrate the effects of allelochemicals on orientation, feeding, survival, oviposition, hatchability, etc., Muthukrishnan, Srinivasaperumal and Ananthagowri (Chapter 10) take such analysis to more sophisticated levels of bioenergetics and life-table analysis. I especially recommend the chapter by Opender Koul as a masterly review fit both for the specialist and the layman. In a slightly different approach, Mukhopadyay (Chapter 12) demonstrates the effect of plant biochemistry on seed predation by insects.

Chelliah & Bharati (Chapter 9) focus on adaptations of the insects to plant allelochemicals. In their fascinating chapter, they use the brown planthopper, the age-old pest of cultivated rice, to demonstrate the importance of insect evolution and biotypes in dealing with allelochemicals and by implication, for effective pest management. In contrast, Uthamasamy (Chapter 8) focuses on the plant and elucidates the role of chemical and physical factors in the development of resistance in the cultivars of cotton and okra to a leafhopper.

Chemicals produced by plants are not our only hope. Indeed, chemicals produced by insects themselves can be potentially useful as control agents. Insects produce a variety of hormones whose concentrations and time of production are intricately balanced for the benefit of the insect. But we can disrupt this intricate balance and create the wrong hormones or the wrong concentration of hormones and thereby affect the growth and development of the insect. There is of course a well known twist to this story namely that many insect hormones are chemically closely related and possibly derived from plant products. The applied potential for insect hormone research is examined by Nair (Chapter 6).

All insects are not pests. Life, as we know, would be impossible without the benefit of insects in soil nutrient recycling and in pollination. Can we then change sides and minimize the ill effects of plant allelochemicals and encourage beneficial insects? Reddi and Aluri's review of the chemical ecology of pollination (Chapter 14) and Gopichandran & Ananthakrishnan's study of the chemical ecology of forest litter dynamics (Chapter 17) show, at least to me, that this is not entirely impossible.

As in so many other fields, biotechnology, if used appropriately, has the potential of producing a quantum jump in our efforts at allelochemical based pest control. Three chapters are hence devoted to this possibility. Ramachandran (Chapter 18) provides a balanced review of the problems and prospects of using biotechnology in dealing with host plant resistance. Balakrishna (Chapter 19) provides a useful layman's (lay entomologist's ?) guide to transgenic plants and their potential for insect control. Rajendran and Venkatesan (Chapter 20) provide experimental data on the synergistic action of *Bacillus thuringensis* endotoxin and plant allelochemicals on two famous laboratory insects, *Heliothis armigera* and *Spodoptera litura*.

Not all insect chemical ecology need immediately suggest measures of insect control or pollination enhancement. There are fascinating areas of insect chemical ecology without immediate applied value and the editors have done well not to overlook them. Janaiah (Chapter 13) reviews information on scent glands of pentatomid bugs. Raman (Chapter 15) and Kant and Ramani (Chapter 16) deal with an altogether different, but especially fascinating area of plant-insect interaction namely, insect-induced galls. Raman's chapter brings out in amazing detail how gall inducing insects seem to have turned the table on the plants by injecting chemicals of their own making into plants in order to subdue them into accepting unwelcome visitors.

Ganeshiah and Kumar (Chapter 11) also present a study with perhaps no immediate application potential for insect control but, their chapter is clearly the most analytical and intellectually stimulating one in the book. Their starting point is their observation that adults of the whitegrub *Holotricha serrata* form clumps which are either unisexual or bisexual but there are more bisexual clumps and more clumps with equal numbers of males and females than expected by chance alone. Using the idea that both males and females release a pheromone which attracts males and females with different efficiencies, they show by computer simulation that a process of self organization can lead to the observed clumping patterns. This chapter also provides a simple introduction to the concept of self organization.

Having enjoyed this book immensely and having pointed out all its virtues, I must also enjoy the liberty of pointing out what I think are its shortcomings. Although it is the proceedings of a Symposium, it reads too much like a journal with independent articles, for my taste. The value of the book would have been greatly enhanced had the editors really edited all the chapters to bring them to a uniform style and level of technicality. This would of course have meant much more work for the editors and the authors and would probably have taken much longer to produce. But the most serious shortcoming, and one without excuse, is that none of the chapters has a summary or an abstract. Nevertheless, I strongly recommend this book, especially to students about to embark upon a career in entomology. Before recommending any book to students, I usually check to see it they can afford to buy it but, keeping with the prevailing culture of publishers, Oxford and IBH has failed to print a price on the book. The price is anybody's guess, more likely, it is nobody's guess as it is free to float with the times!

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