

BOOK REVIEWS

SYMONDSON, W. O. C., AND J. E. LIDDELL (eds.) 1996. *The Ecology of Agricultural Pests. Biochemical Approaches*. Chapman and Hall, London. xiv + 517 p. ISBN 0-412-621909-8. Hardcover. \$138.95.

This symposium proceedings volume makes it clear that modern agricultural and medical entomologists had better learn some molecular genetic and biochemical methods. The book contains 21 chapters that illustrate the types of problems that can be resolved using some of the newer (and older) molecular techniques. Because the book also includes chapters on mosquitoes and tsetse flies, the title is somewhat misleading. The book should be, in fact, of interest to taxonomists, ecologists, and evolutionary biologists, as well as applied entomologists in both agricultural and medical/veterinary entomology.

The first chapter points out that agricultural pest management has changed dramatically in the past fifteen years. Because we no longer can rely primarily on pesticides to suppress pests, we must understand the pests' ecology, behavior, and diversity, as well as their population structure and dynamics. Frequently the role of natural enemies and their interactions with pests must also be understood if we are to effectively employ multitactic integrated pest management practices.

Many fascinating examples are provided that illustrate how biochemical and molecular genetic methods can be used. For example, Hemmingway et al. describe the efforts to identify mosquito species in the *Anopheles gambiae* species complex, to detect pesticide resistance status, to identify the source of the mosquito's blood meal, and to calculate the rate of infection of the mosquitoes with malaria parasites. In the Gambia, pyrethroid-impregnated bednets are being used for malaria control. The program depends on the mosquito vectors remaining susceptible to the pesticide. A sentinel site for monitoring pesticide resistance in mosquitoes was set up and molecular methods were used to discriminate between three morphologically indistinguishable sibling species, which are not all equally effective vectors of malaria. Bioassays also were conducted to detect low levels of resistance to pyrethroid, organophosphate, and carbamate pesticides among insects from the different sites. Sample mosquitoes were identified to species using the polymerase chain reaction (PCR) using species-specific ribosomal DNA primers.

A chapter by Hsiao unravels some of the interactions between "the alfalfa weevil", *Hypera postica* (Gyllenhal), its *Wolbachia* endosymbionts, and its parasitoids. There has long been confusion about the species status of this insect in the USA. The alfalfa weevil invaded the USA on three different occasions and the different populations were identified as "western", "Egyptian", and "eastern" populations and given different species names. Strain hybridization, cytogenetic analysis, and allozyme analysis had previously indicated that all North American populations are strains of the same species. More recent analyses of mitochondrial DNA and nuclear ribosomal DNA by the PCR and by DNA sequencing confirmed the earlier conclusion and led to estimates of the relatedness of the three strains and to diagnostic markers for distinguishing between them. The DNA sequence data suggested the origins of the populations in the USA based on comparisons with sequences from weevils from Egypt, Europe, and China.

Another mystery was cleared up by using molecular methods to examine the reproductive incompatibility between North American weevil strains. Giemsa staining, immunoblotting, and PCR analyses demonstrated that the western strain contains a rickettsia-like endosymbiont (*Wolbachia*) while the eastern and Egyptian weevil

strains do not. The western strain could be made compatible with these two strains by eliminating the *Wolbachia*.

The *Wolbachia* story has implications for classical biological control efforts against the alfalfa weevil in North America. Again molecular methods have provided an answer to a puzzling problem. One parasitoid, *Bathyplectes curculionis* (Thomson), became established and effective as a natural enemy of the western weevil strain, but is ineffective against the Egyptian and eastern weevils because most of its eggs are encapsulated, which prevents the development of the parasitoid. The parasitoid *Microctonus aethiopoidea* Loan became established in the eastern USA and is effective there, but it has failed to establish in regions where the western weevil occurs. The failure of *M. aethiopoidea* to develop normally in the western weevil is due to the presence of *Wolbachia*. The *Wolbachia* provide protection to the western weevil against the parasitoid. Hsiao concluded that these results reconfirm the importance of matching biotypes of pests and parasitoids in classical biological control programs. The interactions between alfalfa weevil strains, *Wolbachia*, and parasitoids are surprisingly complex and suggest that studies such as this could aid in developing more effective pest management programs.

The development of insecticide resistance is both an evolutionary and practical problem. Daly and Trowell show how DNA-based methods or immunological techniques can allow one to examine a broad range of problems including separating sibling *Heliothis* species, detecting and monitoring resistant individuals, and monitoring the distribution of resistance genes in populations. They also point out that the molecular methods will not replace the more imprecise bioassay techniques, because bioassay tests are quick to devise and are relatively independent of the mechanism of resistance. Daly and Trowell conclude that "Development of molecular techniques to monitor resistance, though costly, will be justified for some major insect pests of agriculture, livestock and human health."

More than a third of the book, 8 of 21 chapters, is devoted to using immunological or electrophoretic approaches to understanding arthropod predation and parasitism. Greenstone reviews "Serological analysis of arthropod predation: past, present and future", Stuart and Greenstone describe a method "Serological diagnosis of parasitism: a monoclonal antibody-based immunodot assay for *Microplitis croceipes* (Hymenoptera: Braconidae)", Symondson and Liddell contribute "Polyclonal, monoclonal and engineered antibodies to investigate the role of predation in slug population dynamics", Liddell and Symondson describe "The potential of combinatorial antibody libraries in pest-predator relationship studies", Sigsgaard describes "Serological analysis of predators of *Helicoverpa armigera* Hübner (Lepidoptera: Noctuidae) eggs in sorghum-pigeonpea intercropping at ICRISAT, India: a preliminary field study", Hagler and Naranjo describe "Using gut content immunoassays to evaluate predaceous biological control agents: a case study", Sunderland reports on "Progress in quantifying predation using antibody techniques". Finally, Solomon, Fitzgerald and Murray report on "Electrophoretic approaches to predator-prey interactions".

While this book includes many entomological problems, ranging from brown planthoppers to tsetse flies and mosquitoes, it also includes a chapter on risk analysis of a microsporidium, *Nosema pyrausta* (Paillot), as a control agent of European corn borer, *Ostrinia nubilalis* (Hübner), and a chapter on identifying the genetic basis of resistance to the aphid *Brevicoryne brassicae* in wild brassica plants.

If you want to learn about biochemical and immunological techniques for evaluating interactions between pests, their hosts, their predators and other organisms, their population genetics, dynamics and systematics, this book provides some useful case studies and discussions of the virtues and limitations of the different methods. Discussions include an analysis of the benefits and detriments of enzyme electrophoresis,

polytene chromosome analysis, various DNA analysis methods [ribosomal DNA analysis by the polymerase chain reaction (PCR), DNA dot blots, DNA fingerprinting, DNA sequencing, nuclear and mitochondrial DNA analysis, restriction fragment length polymorphism (RFLP), random amplified polymorphic DNA polymerase chain reaction (RAPD-PCR), microsatellite analysis], biochemical assays for insecticide resistance detection, and immunological assays.

The book is not a manual that will provide details of methods, nor is it an introductory text. If you want to learn how to use the methods described, then other sources will have to be consulted. This book does provide abundant examples of the value of using molecular methods to solve problems of interest to applied entomologists as well as an entry into the published literature.

All graduate students beginning entomological careers should read this book. If they are not already convinced that molecular and biochemical approaches provide useful tools for entomologists, this book **should** convince them that any graduate student in entomology who graduates without learning at least the basics of the PCR will be seriously handicapped.

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