ADVANCES IN INSECT CHEMICAL ECOLOGY

Chemical signals mediate all aspects of insects' lives and their ecological interactions. The discipline of chemical ecology seeks to unravel these interactions by identifying and defining the chemicals involved, and by documenting how perception of these chemical mediators modifies behavior and, ultimately, reproductive success.

Chapters in this volume consider how plants use chemicals to defend themselves from insect herbivores; the complexity of floral odors that mediate insect pollination; tritrophic interactions of plants, herbivores, and parasitoids, and the chemical cues that parasitoids use to find their herbivore hosts; the semiochemically mediated behaviors of mites; pheromone communication in spiders and cockroaches; the ecological dependence of tiger moths on the chemistry of their host plants; and the selective forces that shape the pheromone communication channel of moths.

Each review is written by an internationally recognized expert and presents descriptions of the chemicals involved, the effects of semiochemically mediated interactions on reproductive success, and the evolutionary pathways that have shaped the chemical ecology of arthropods.

Professors RING CARDÉ and JOCELYN MILLAR are both based in the University of California at Riverside. Between them, they have written over 300 articles on chemical ecology and have co-edited six books.

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Edited by
RING T. CARDÉ AND JOCELYN G. MILLAR
University of California at Riverside, USA

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Contributors

John T. Arnason
Faculty of Science, University of Ottawa, ON KIN 6N5, Canada

Ring T. Cardé
Department of Entomology, University of California, Riverside,
CA 92521 USA

William E. Conner
Department of Biology, Wake Forest University, Winston-Salem,
NC 27109, USA

Tony Durst
Faculty of Science, University of Ottawa, ON KIN 6N5, Canada

César Gemeno
Department of Entomology, North Carolina State University, Raleigh,
NC 27695, USA
Current address: Departamento de Producción Animal y Ciencia Vegetal,
Universidad de Lleida, Lleida 25198, Spain

Gabriel Guillet
Faculty of Science, University of Ottawa, ON KIN 6N5, Canada

Kenneth F. Haynes
Department of Entomology, University of Kentucky, Lexington,
KY 40546, USA

Yasumasa Kuwahara
Division of Applied life Sciences, Graduate School of Agriculture,
Kyoto University, Sakyo-ku, Kyoto 606-8502, Japan

Jocelyn G. Millar
Department of Entomology, University of California, Riverside, CA 92521, USA

Robert A. Raguso
Department of Biological Sciences, University of South Carolina, Columbia, SC 29208, USA

Coby Schal
Department of Entomology, North Carolina State University, Raleigh, NC 27695, USA

Stefan Schulz
Institut für Organische Chemie, Technische Universität Braunschweig, Hagenring 30, D-38106 Germany

Ted C. J. Turlings
Institute of Zoology, University of Neuchatel, 2007 Neuchatel, Switzerland

Felix Wäckers
Netherlands Institute of Ecology, N100-CTO Heteren, the Netherlands

Susan J. Weller
Department of Entomology, J. F. Bell Museum of Natural History, University of Minnesota, St Paul, MN 55108, USA

Preface

In contrast to other animals, humans sense their world chiefly by vision, sound, and touch. We have, in general, a remarkably undeveloped sense of smell, and so it is not surprising that we fail to appreciate how important chemical signals are in the lives of other organisms. Chemical signals and cues serve insects in numerous ways, including sexual advertisement, social organization, defense, and finding and recognizing resources. Chemical ecology seeks to identify these chemicals and to establish how they affect an organism's behavior, physiology, and interactions with other organisms. As the techniques to identify fully the structures of natural products have become increasingly sophisticated and powerful, the amounts of natural products needed for characterization have diminished, and the number of identified compounds that mediate behavioral and physiological interactions has proliferated. Our understanding of precisely how organisms employ such chemical information, however, continues to lag behind our ability to characterize the chemicals involved. It is also clear that the discoveries to date represent a miniscule sampling of the multitude of insect species that use information conveyed by chemical signals and cues.

These reviews are designed to provide in-depth overviews and syntheses of defined areas in the chemical ecology of insects and their closely related arthropods. The topics covered in this volume include: chemical defenses of plants against insect herbivores; floral odors mediating insect pollination; how parasitic wasps use odors emitted by herbivores and the plants on which they are feeding to find their herbivore hosts; semiochemicals of mites; pheromones of spiders; pheromones of cockroaches; the intricate defensive and pheromonal relationships between arctiid moths and chemicals from their host plants; and the selective forces that structure moth communication by pheromones. The perspective of these reviews ranges from proximate issues – what are the chemicals and their functions – to ultimate questions – how might evolutionary processes influence these chemical messages?

We also intend that this volume will represent the first in a series focussed on the chemical ecology of insects, both from the point of view of career practitioners of chemical ecology such as ourselves, and for those scientists whose studies lead them into some aspect of chemical ecology as a part of a broader study. By far the largest part of what we know of chemical communication between organisms has come about as the result of studies on insects, and there is every reason to believe that this trend will continue for the foreseeable future. Therefore, in addition to being intrinsically interesting and fascinating systems to study, semiochemical research with insects has played a fundamental role in the development of knowledge and understanding of olfaction and taste. Insects have been key players in all aspects, from the deciphering of the chemical messages, through the integration and processing of chemical signals in the brain, to the neural outputs resulting in a particular behavioral or physiological event, and, finally, to the development of hypotheses and theories of how these communication systems have evolved. Rapid progress is being made in all of these areas, and so it seems fitting that selected topic areas be reviewed and summarized in an ongoing series of volumes.

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