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Editorial

True Bugs (Heteroptera): Chemical Ecology of Invasive and Emerging Pest Species

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True bugs (order Hemiptera; suborder Heteroptera; about 40,000 species) are increasing in importance as pests because of international commerce, insecticide resistance, range expansion due to global warming, and immunity to genetically modified crops (GMOs). Haematophagous bugs suck blood from humans and other animals, and phytophagous species are crop pests. Damage caused by plant bugs (Miridae) and stink bugs (Pentatomidae) is escalating everywhere GMOs have been adopted, not only because bugs are unaffected by the *Bt*-endotoxins used to transform crops, but also because the advent of no-till agriculture with herbicide-resistant GMO crops leaves debris and fallen seeds favoring infield survival of bugs. Resurgences of phytophagous bugs has also occurred in crops treated for mating disruption for control of primary pests such as codling moth, with a consequent decrease in pesticides that used to incidentally control bugs. Finally, adoption of GMOs has dramatically reduced insecticide usage, facilitating establishment of invasive species such as the brown marmorated stink bug (BMSB) (*Halyomorpha halys*) that is currently wreaking havoc in many parts of the United States.

For this Special Issue we have broadened the scope of chemical ecology to include recent advances in heteropteran endocrinology, genetic research, symbionts, electronic pest detection, acoustic communication, and parasitoid host searching, as well as more mainstream investigations of semiochemicals and their use for trapping and monitoring pest species. In all, this compilation includes 17 manuscripts, with authors from nine countries.

The issue includes semiochemical-related articles on species from seven heteropteran families. T. Yasuda and H. Higuchi describe the sex pheromones of two plant bug (Miridae) species, and their use for monitoring these rice pests in Japan. A. González et al. and G. Martins et al. report original semiochemical pheromone and allomone research on a "rare" bug native to Australia, *Thaumastocoris peregrinus* (Thaumastocoridae), which is now ravaging eucalypt plantations in Brazil and Uruguay. R. A. Laumann et al. identified the female-produced attractant pheromone of a South American bean pest, *Neomegalotomus parvus* (Alydidae), and A. Khrimian et al. identified the male-produced attractant pheromone of an Australian fruit-spotting bug (*Amblypelta lutescens lutescens*) from the alydid sister family, Coreidae. G. Manrique and M. Lorenzo report on investigations of the chemical signals used between male and female triatomine bugs (Reduviidae: Triatominae), vectors of *Trypanosoma cruzi*, the protozoan etiological agent of Chagas' disease in the Americas. N. Singh et al. studied the interactions between carbon dioxide, heat, and chemical lures in attracting the bed bug, *Cimex lectularius* (Cimicidae), which is resurging as a nuisance pest worldwide. There are five manuscripts involving stink bug (Pentatomidae) communication. (1) T. C. Leskey et al. report on the impact of the invasive BMSB (*H. halys*) in mid-Atlantic fruit orchards in the United States, based upon traps baited with the aggregation pheromone

(methyl (*2E,4E,6Z*)-decatrienoate) of the Asian pentatomid (*Plautia stali*) to which BMSBs are powerfully attracted. (2) N. Endo et al. documented age-related and individual pheromone variation in males of another pentatomid exhibiting pheromonal cross-attraction in Japan, *Piezodorus hybneri*. (3) P. G. Tillman and T. E. Cottrell reported results of a 2-year on-farm experiment in the southeastern United States using a trap crop with pheromone-baited traps to suppress *Euschistus servus* in cotton. (4) C. C. A. Silva et al. studied substrate vibrations, the close-range acoustic communicative modality common to pentatomids and other bugs, that are produced by males and females of the South American stink bug, *Edessa meditabunda*. (5) D. C. Degenhardt et al. described their research on an electronic nose ("E-nose") for monitoring stink bug feeding in cotton as a guide for management decisions.

The Special Issue also includes five review papers on aspects more or less related to mainstream heteropteran chemical ecology. E. Conti and S. Colazza thoroughly review the chemical ecology of egg parasitoids associated with true bugs. I. Hurwitz et al. review the amazing paratransgenic "vaccination" of Chagas' disease vectors against transmission of *T. cruzi*; and S. S. Prado and T. D. Zucchi summarize the host-symbiont interactions of heteropteran pests, especially plant pests, and discuss the potential for managing these pests via manipulation of their symbionts. J. M. C. Ribeiro et al. provide a detailed insight into the sialomes (i.e., the salivary gland transcriptomes) of bloodsucking Heteroptera. Finally, T. Kotaki et al. present details of their discovery of a novel juvenile hormone (JH) from the pentatomid, *P. stali*, containing a second epoxide moiety (methyl (2*R*,3*S*,10*R*)-2,3;10,11-bisepoxyfarnesoate: JHSB3). Overall, we believe that this Special Issue highlights most current aspects of semiochemical-related research on true bugs.

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