PREFACE

Most insect parasitoids are related to two insect orders, Diptera and Hymenoptera, some having a specific host while others have a vast host range. As such, the opening chapter of *Parasitoids: Biology, Behavior and Ecology* discusses the influence of host preference and host specificity in biological control programs and their role in different biological control methods.

The behavioral responses of parasitoids can determine the efficiency of a parasitoid species to control host pests. The functional response is one of the most important behavioral responses. The authors show that type II functional response is more common than the other types (I, III, IV and V) of functional response for most parasitoid species. In some research, type III functional response was also reported for parasitoids.

The closing study hypothesized that conditioned parasitoids will parasitize more target hosts compared with individuals without prior conditioning. In conditioning experiments, females of the wasp *Trichogramma cacoeciae*, a generalist egg parasitoid, oviposited in *Lobesia botrana* eggs while exposed to *L. botrana*'s synthetic sex pheromone. Contrary to the hypothesis, this treatment failed to increase the parasitism rate in a subsequent exposure to the conditioned olfactory cue.

Chapter 1 - Most insect parasitoids are related to two insect orders including Diptera and Hymenoptera, where some of them have a specific

host while others have a vast host range. Parasitoids with more than one host species are called oligophagous or polyphagous parasitoids in which host species preference is diverse. On the contrary, parasitoids with host specificity are called monophagous parasitoids which have a high degree of ecological compatibility. Host preference is the most important behavioral characteristic in parasitoids which is influenced by different factors such as host species, host stage, host size, host densities, and intraguild predation. In addition, there are various biotic and abiotic factors involved in determining both host preferences and host specificity by parasitoids within the host selection process which are divided into chemical and physical parameters. The examples include plant volatiles, host habitat, host odors, host movement, sound, and environment color. In any case, host preference and specificity may affect host population growth rate and host-parasitoid population dynamics. To succeed in biological control programs, understanding the parasitoid host preferences and specificity is necessary as they affect mass rearing protocols and can facilitate the explanation of the outcomes observed in the field. Therefore, both host preference and host specificity seem to play an important role in biological control. The current chapter discusses the influence of host preference and host specificity in biological control programs and their role in different biological control methods (importation and augmentation).

Chapter 2 - The behavioral responses of parasitoids can determine the efficiency of a parasitoid species to control host pest. The functional response is one of the most important behavioral responses in natural enemies. The relationship between host densities and the attack rate of parasitoids is described as functional response. The ability of parasitoids to find and parasitize the host plays a fundamental role in shaping the ecology of host-parasitoid interactions. The type of functional response and values of its parameters including searching efficiency (a) and handling time (Th) may be related to parasitoid success in biological control program. The literature review showed that type II functional response is more common than the other types (I, III, IV and V) of functional response for most parasitoid species. In some researches, type III functional response was also reported for parasitoids. In type III functional response, there is

direct density dependence relationship; it means that the capability of parasitoids increases with increasing host density at lower host densities. But in type II functional response, parasitism rate of parasitoid decreased monotonically with increasing host densities. Unexpectedly, in most cases, the type of functional response does not have clear relationship with the efficiency of parasitoids. The searching efficiency and handling time have direct effect in determining the success of natural enemies. A lower handling time and higher searching efficiency in parasitoids imply that higher numbers of hosts can be parasitized in a given time interval. The results of functional response are not ignorable in biological control program, but the authors also suggest the investigation of other parameters of parasitoids so as to reach best decision about the efficiency of parasitoids as biological control agents.

Chapter 3 - Mating disruption and augmentation of natural enemies are common sustainable approaches to agricultural pest management. However, neither method is sufficient: the effectiveness of mating disruption, based on saturating the environment with the pest's synthetic sex pheromone, is reduced in small plots and at high pest densities. Augmentation of natural enemies is often limited by their tendency to abandon release sites and search for alternative prey. Can mating disruption and augmentative biocontrol be integrated, by conditioning parasitoids to the sex pheromone of the target pest before release in pheromone-treated plots? The authors hypothesized that conditioned parasitoids will parasitize more target hosts compared with individuals without prior conditioning. In conditioning experiments, females of the wasp *Trichogramma cacoeciae* (Trichogrammatidae: Hymenoptera), a generalist egg parasitoid, oviposited in *Lobesia botrana* (Torticidae: Lepidoptera) eggs while exposed to *L. botrana's* synthetic sex pheromone. Contrary to the authors' hypothesis, this treatment failed to increase the parasitism rate in a subsequent exposure to the conditioned olfactory cue. To test whether the wasps' innate response to the pheromone masked the conditioning effect, rum extract, a volatile that is foreign to the parasitoid's natural environment, was used as the Conditioned Stimulus. Here again, conditioning did not increase later parasitism rates. These results indicate

that *T. cacoeciae* may lack the ability for associative learning of odors. Parasitoids vary widely in learning abilities and responses to host-related cues. This high variability, even among *Trichogramma* species, suggests that the conditioning failure in *T. cacoeciae* might be species-specific. The proposed method therefore merits testing in additional host-parasitoid systems.