

Abstract

In nature, inter- and intraspecific competitive interactions can occur between two or more female parasitoids foraging for hosts (=extrinsic competition) and multiple larvae competing for the host resources within the same individual host (=intrinsic competition). Knowledge and understanding of these interactions are important in biological control programs for selection of effective bio-control agents and management strategy to avoid conflict amongst exotic and native natural enemies.

Here, I evaluated the foraging strategies and intrinsic competitive interactions amongst three endoparasitoids, the solitary *Meteorus pulchricornis* (Wesmael), and the two gregarious *Cotesia kariyai* (Watanabe) and *Cotesia ruficrus* (Haliday) in their common host, *Mythimna separata* (Lepidoptera: Noctuidae). Furthermore, defense mechanisms employed by competing parasitoids to eliminate their competitors were also investigated during multiparasitism.

During host foraging, both *M. pulchricornis* and *C. kariyai* were able to discriminate between unparasitized host larvae and from 4-7 day-old host larvae post-oviposited by conspecific and heterospecific wasps. On the other hand, super- and multiparasitism occurred even the host larvae were 2-day post-parasitized. However, once the parasitoids within hosts are at larval stage (1st and 2nd instar), super- and multiparasitism were avoided in the two-choice test, but the latter often occurred in the multiple-choice experiment. Host discrimination abilities may have been based on plant volatile signals incurred from damaged plants and internal mechanisms from 4-7 post-parasitized hosts.

The outcome of intrinsic competition amongst three parasitoid species was affected by the host stage at which multiparasitism occurred and time interval of oviposition. *M. pulchricornis* and *C. kariyai* were found to be both generally superior over *C.*

ruficrus, although in some cases the latter species out-competed *C. kariyai* in multiparasitized L3 host when ovipositing first.

The competitive advantages of two superior species were found to be attributed by their mandibles and wasp-associated factors. *MpVLP* alone (or with venom) has exhibited unfavorable to the development of *Cotesia* species. Similarly, *CkPDV* plus venom showed detrimental to *M. pulchricornis* progeny.

Remarkably, the two gregarious parasitoids were able to share host resources enabling both species to occasionally emerge from multiparasitized host larvae especially when the time interval between the first and second attacks was short. However, cumulative brood sizes of both species were generally less than when *C. kariyai* and *C. ruficrus* developed alone.

Moreover, low survival rate of *C. ruficrus* was occurred when singly parasitized the L5 host larvae due to hemocyte encapsulation but significantly increased once multiparasitized with *C. kariyai*. *CkPDV* plus venom was found to inhibit hemocyte encapsulation resulting to survival of *C. ruficrus* species. Thus, these results suggest that these wasp-associated factors may play an important role in the displacement and coexistence in interspecific competitive interactions amongst parasitoids.