

STREPSIPTERA (INSECTA) AS BIOLOGICAL CONTROL AGENTS

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ABSTRACT. Strepsiptera (Insecta), often referred to as “stylops,” are curious entomophagous parasitoids of cosmopolitan distribution. They are curious not only for their biology but also for their host-parasitoid relationships. Stylops parasitize members of seven insect orders (Thysanura, Blattodea, Mantodea, Orthoptera, Hemiptera, Hymenoptera, and Diptera). Strepsiptera have only two free-living stages: that of the small, active adult winged male and that of the first instar larva. The adult males have prominent compound eyes, elegantly branched antennae, “halter-like” fore-wings, and fan-shaped hind wings. They are short-lived (two hours), they do not feed, and a breeding flight is their sole mission. With the exception of the family Mengenillidae, the bizarre adult females are neotenic. Female Mengenillidae pupate outside their host, while female Stylopidae remain permanently endoparasitic; therefore, one must look for the host to find Stylopidae females. Strepsipteran females produce viviparous first instar larvae, which emerge via the brood canal opening or opening of the apron in the cephalothorax of the endoparasitic female.

Of the seven orders and 34 families parasitized by stylops, some are pests of crops. In South and Southeast Asia, *Elenchus japonicus* Esaki and Hashimoto parasitizes the planthoppers *Nilaparvata lugens* Stål and *Sogatella furcifera* Horváth, which spread viruses of the rice plant. In India, *Halictophagus palmae* Kathirithamby and Ponnamma parasitizes *Proutista moesta* (Westwood), a vector of pathogens affecting coconuts, oil palm, and araca nuts. In Mexico, *Halictophagus naulti* Kathirithamby and Moya-Rayozao parasitizes the corn leafhopper (*Dalbulus* sp.). In Papua New Guinea, female *Stichotrema dallatorreanum* Hofeneder is a parasite of the long-horned grasshoppers *Sexava nubila* Stål, *Segestes decoratus* Redtenbacher, and *Segestidea novaeguineae* (Brancsik) (Orthoptera: Tettigoniidae). The last two species are severe pests of oil palm, and the strepsipteran *S. dallatorreanum* keeps them in check on the main island of Papua New Guinea. *Segestidea defoliaria defoliaria* (Uvarov) and *Segestidea gracilis gracilis* (Willemse) cause severe defoliation of oil palm in West New Britain and New Ireland Provinces respectively, but were not parasitized by *S. dallatorreanum*.

Infectivity trials were conducted in Oro Province between 1996 and 1997 with the tettigoniid *S. defoliaria defoliaria*, and it was found that the stylops *S. dallatorreanum* can successfully parasitize this pest. Since 2000 parasitized (stylopized) *S. defoliaria defoliaria* have been released monthly in the fields in West New Britain Province, and since 2001 the same is true of *S. gracilis gracilis* in New Ireland. No surveys have been conducted so far, since the life cycle of the strepsipteran lasts for 6 months. However, several sightings of neotenic females of *S. dallatorreanum* have been reported, indicating that the strepsipteran has undergone at least one generation in the field in the infected hosts. Strepsiptera may be good biological control agents, as the stylopized host is morphologically and physiologically affected.