

**Biological control of the olive fruit fly,
Bactrocera oleae (Rossi) in Israel**

Thesis

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**By
Arnon Tabic**

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Abstract

The Olive Fruit Fly, *Bactrocera oleae*, is a key pest in olive production throughout the world. The fly is commonly controlled using chemical insecticides and mass trapping techniques. Biological control of this pest, although studied and implemented intensively over the past 80 years, has had only limited success and has failed to provide desired levels of protection.

This study is aimed at improving environmentally sound control of the olive fly, with emphasis on biological control. To this end, I attempted to 1) describe the composition and phenology of the guild of parasitoid wasps attacking the fly's larvae in Israel, as well as the phenology of the fly itself; 2) determine possible limiting factors for biological control of the fly; and 3) attempt to enhance the biological control of the fly by removing those limiting factors in the orchard.

To achieve the first goal, parasitoids attacking *B. oleae* larvae were surveyed by collecting fruit samples on various dates and identifying the emerging insects. When no fruit was available, eclosion of the adult flies from the soil was monitored with emergence cages. Fruit infestation was characterized by two peaks, the first in July, and the second in October. At least five species of parasitoids were found to attack *B. oleae* larvae; the parasitoids belonged to the family Braconidae (*Psytalia concolor* and *Diachasmimorpha kraussi*) and the superfamily Chalcidoidea (*Eupelmus urozonus*, *Pnigalio mediteraneus* and *Cyrtoptex latipes*). While parasitism was high during the first infestation peak, it dropped sharply at the second peak, when only *P. concolor* was found. It is therefore suggested that a limiting factor for parasitoid activity is present during the fall. Adult flies were found to emerge from February until early April, a period during which fruit was absent, and they were thus forced to survive as adults for at least 3 months until the next season's fruit became available for reproduction. This emergence pattern could be used to optimize timing of treatments against the adults, such as mass trapping.

To address the second goal of the study, I examined the hypothesis that activity of olive parasitoids is limited by the amount of sugar available for adult feeding. First, a manipulative experiment in olive branch cages showed that *P. concolor* adults provided with honey survived longer than wasps held in control cages without honey. Second, the sugar profiles of flying individuals of *P.*

concolor collected in an olive orchard were examined using HPLC, and compared with profiles of laboratory control wasps that were starved or fed sugars ad libitum. Wasps in the orchard had low overall sugar content, similar to that of starved laboratory wasps. Glucose was the only sugar found at high levels in field-collected parasitoids, indicating either feeding on a glucose-rich source in the orchard, or alternatively, rapid glycogen metabolism to compensate for low sugar availability. Both approaches presented in this chapter supported the hypothesis that activity of parasitoid wasps is limited by low sugar availability in the orchard.

To attain the third goal of the study, I attempted to find a nectar-providing plant that could serve as a cover crop and support *P. concolor* sugar feeding. The effect of *Ricinus communis*, *Foeniculum vulgare* and *Medicago sativa* on wasp longevity was tested in the laboratory. *R. communis* appeared to enhance wasp longevity compared to a no-plant control. However, in an additional experiment in which wasps were either denied or permitted access to the extrafloral nectarines of *R. communis*, survival did not differ between the two treatments. The effect of *R. communis* survival therefore appears to involve mechanisms other than nectar provision.

The results of this study suggest that eclosion of adult flies occurs during the winter, and that parasitoid activity is limited by the amount of available sugar in the orchard. It therefore seems that efforts should be invested in i) pest control in the spring, when adult flies are already active, but fruit is not yet available for reproduction, and ii) supporting the activity of parasitoid wasps by providing sugar sources in the orchard.