STUDIES ON THE PARASITOID, *Aganaspis daci* (WELD) (HYMENOPTERA: EUCOILIDAE) AND ITS HOST THE PEACH FRUIT FLY, *Bactrocera zonata* (SAUNDERS)

By

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B. Sc. Agric. Sci. (Plant Protection), Fac. Agric., Cairo Univ., ٢٠٠٦

THESIS

Submitted in Partial Fulfillment of the Requirements for the Degree of

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In

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(Economic Entomology)

Department of Economic Entomology and Pesticides
Faculty of Agriculture
Cairo University
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SUPERVISION SHEET

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Title of Thesis: Studies on the Parasitoid, *Aganaspis daci* Weld (Hymenoptera: Eucoilidae) and its Host the Peach Fruit Fly, *Bactrocera zonata*, Saunders (Diptera: Tephritidae).

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ABSTRACT

The present study dealt with certain ecological and biological aspects of the peach fruit fly, (PFF), *Bactrocera zonata*, (Saunders) (Diptera: Tephritidae), as well the biological aspects of its exotic parasitoid species, *Aganaspis daci* (Weld) (Hymenoptera: Eucoilidae), introduced from USDA-ARS, Honolulu, Hawaii, USA to be tested against the pest.

Field studies included a survey and seasonal abundance of PFF and its parasitoids in mango, guava and orange orchards in certain governorates in Egypt during ٢٠٠٨/٠٩ season, using sex pheromone traps and fallen fruit samples' collection. The greatest mean number of *B. zonata* was recorded in October on guava, and the lowest number was generally recorded in winter on orange. No specific indigenous parasitoids were found on *B. zonata* during the survey.

The morphological characteristics of the different stages of PFF and its parasitoid *A. daci* under laboratory conditions were described. Biological studies on *B. zonata* included; the durations of immature stages, longevity, ovipositional period, fecundity, survival rate, and sex ratio under constant laboratory conditions of ٢٥±١°C and ٥٤-٦٠٪ R.H.

Morphological characteristics of *A. daci* showed that the larva passed through four larval instars. The ١st instar larva appeared when the host pupa was formed and it acquires an eucoliform type. The ٣rd instar larva is hymenopteriform and in this instar, a transformation from endoparasitic to ectoparasitic behavior was observed. Biological studies on *A. daci* included; life cycle (٢-٣, ٢-٣, ١-٢, ١-٣, ٣-٥, ١-٣ and ١١,٢ days for egg, ١st, ٢nd, ٣rd, ٤th larval instars, pre-pupa, and pupa, respectively). Female and male average longevities were ١٨,٨±٠,١٥٢٧ and ١٧,٣±٠,٢١ days. Survival rate was ٤٤,٧ %. Sex ratio was ١: ١. Total number of eggs/ female averaged ٣٩,٥٧±١,٣. Non-mated females laid eggs that resulted in males only.

Key words: *Bactrocera zonata*, *Aganaspis daci*, survey, biology, morphology, biological control.

DEDICATION

I dedicate this piece of work to my family,
to whom I owe everything.

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INTRODUCTION

In Egypt, the cultivated area is about ٨,٤٨ million acres, of which fruit crops occupy١,٤ million acres. Fruits are important agricultural crops in Egypt, where they have a great contribution in the national economy through export and domestic consumption. Fruit crops are subject to attack by serious insect pest species (polyphagous and/or monophagous). Fruit flies are among the agricultural pests that have great economic importance. They include about ٤٠٠٠ species. Out of which ١٢٠٠ species belong to family Tephritidae. Most of these species are polyphagous and about ٤٠٪ of them attack several fruits while the rest attacks the flowers, stems, leaves and roots. Most of the fruit flies belong to ٥ genera. Genus *Bactrocera* is the greatest one which contains about ٥٠٠ described species. Many of the fruit flies are prevail in Egypt, causing losses for most of the fruit crops because their larvae feed inside the fruits, and damage them, in addition to the growth of fungi and infestation of secondary pests (dry fruits beetles), which cause more damage and reducing the quality of fruits and the non-suitability of them for consumption and marketing.

Several studies, conducted in different refer to the extent of fruit flies in terms of losses caused by these pests, which are estimated at millions of dollars, and the wide use of pesticides to control such pests, which increases production cost, contaminates the environment and reflect considerable dangers to public health. The most widespread fruit flies in Egypt are the Mediterranean fruit fly (Medfly) *Ceratitis capitata* (Wied.) spreads in most of the countries of the Mediterranean

basin, the peach fruit fly (PFF) *Bactrocera zonata* (Saund.) (spreads in Egypt and Mauritius at the level of the African continent), and the olive fruit fly, *Bactrocera oleae* (Gmelin.).

The peach fruit fly, *B. zonata*, is an invasive species, native to Southeast Asia. It was first recognized as a new pest of guava and mango in ١٩٩٨ in the northern region of Egypt. It is now a serious pest of fruits and some vegetables replacing the Mediterranean fruit fly, *C, capitata*, in most of the Egyptian governorates. PFF is one of the most dangerous species at present, because it is phytophagous and infests most of fruit crops in Egypt, causing losses of about ٣٧٥ million dollars annually (FAO reports).

PFF attacks a wide range of host plants including peach, guava, mango, date palm, apples, bitter gourd, okra, pomegranate, papaya, common fig, quince, sweet and bitter orange and possibly melons and water melons, in addition to numerous ornamentals. Apparently there is a considerable scope for the increase of the host range of PFF as it colonizes new environments.

The widespread of the pest in recent years, in most of the orchards all over the country, was attributed to its wide distribution, being polyphagous, most of its life cycle is spent inside the fruits, it attacks fruits near ripening, as well as the difficulty of differentiation between the symptoms of its damage and that caused by the immature stages of the Medfly.

Parasitoids are of potential effective for controlling fruit flies. The native parasitoids regulating the populations of fruit flies in Egypt, as well as those of African origin seem to be not compatible with

Bactrocera species of the Asian origin. African parasitoids that attack fruit flies do not have the co-evolutionary history with the new host *B. zonata*.

The pest problem of *B. zonata* in Egypt is a classical example of an invasive species that is accidentally moved from Asia to the African continent without its specific natural enemies. Therefore, the fly increased without check and became a serious pest. The release of new candidate parasitoids from the native region of this pest may be one of the control methods to reduce its populations to manageable levels. Thus, the introduction of Asian parasitoids from the native region of the pest to be established for help in suppressing the fly populations in Egypt was appears to be a logic approach.

Through the Egyptian-American collaborative project, "Non-toxic control of Peach Fruit Fly in Egypt" which was carried out during the period ٢٠٠٨-٢٠١١, some exotic parasitoids were imported from Asia through USDA, to provide an additional mortality against PFF. Among the parasitoid species imported for evaluation was *Aganaspis daci* (Weld) (Hymenoptera: Eucoilidae). The native area of this species is South-East Asia. The parasitoid was imported from Hawaii by Dr. Ahmed H. El-Heneidy to the DBC, PPR, ARC. to be tested. *A. daci* is a larval-pupal parasitoid of several species of genus *Dacus* (Diptera: Tephritidae) in Southeast Asia and Australia (Weld, ١٩٥١and Clancy *et al.*, ١٩٥٢). The parasitoid species was reared for several generations on *B. zonata* larvae under laboratory and quarantine conditions. The parasitoid was also introduced to Hawaii and successfully reared on *C. capitata* and *Bactrocera dorsalis* (Hendel) (Clausen *et al.*, ١٩٦٥).

Recently, it has been reared on the Medfly and released against that pest in France and Israel (Papadopoulos and Katsoyannos, ٢٠٠٣). Generally, there are insufficient data on the life cycle of *A. daci* and its biological control potential.

In an effort to evaluate the potential of this parasitoid species on *B. zonata* in Egypt, the present study was aimed and focused on the following:

- Estimating the rates of infestation with PFF in fruit orchards.
- Surveying parasitoid species associated with PFF in fruit orchards.
- Studying morphological and biological aspects of *B. zonata* under laboratory conditions.
- Studying morphological and biological aspects of the parasitoid *A. daci* under laboratory conditions.

REVIEW OF LITERATURE

١. *Bactrocera zonata*

a. Taxonomical Position *Insecta, Diptera, Tephritidae, Bactrocera zonata* (Saunders, ١٨٤١). This pest was identified as peach fruit fly (PFF) and/or guava fruit fly.

Synonyms *Dacus zonatus* (Saunders), *Dasyneura zonata (*Saunders), *Rivellia persicae (*Bigot).

Bactrocera maculigera Doleschall was previously listed as a synonym of *B. zonata*. White & Evenhuis (١٩٩٩) showed that it is unrelated.

White and Hancock (١٩٩٧) provided an electronic key to Asia-Pacific-Australasian *Dacus* and *Bactrocera*.

b. Phytosanitary categorization

EPPO (١٩٩٧), A١ action list no. ٣٠٢; EU Annex designation I /A١ (as *Dacus zonatus*).

c. Geographical distribution (CABI/EPPO,٢٠٠١, Distribution map) (Fig.١).

The genus *Bactrocera* was found principally in Asia, Australia and the islands of the pacific. Few species were found in Africa and only one species was recorded in southern Europe. *B. zonata* is one of the most harmful species of Tephritidae that cause a large amount of damage in Asia (Butani, ١٩٧٦ and Butani and Vertma, ١٩٧٧). It is a serious pest of peach, batsch and custard apple in India. Up to ٨٩,٥٠٪ of peach fruits were damaged by *B. zonata*. Also, mango and guava