LARVAL PARASITOIDS OF THE POTATO TUBER MOTH
Phthorimaea operculella IN POTATO AND TOMATO FIELDS

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ABSTRACT

Larval parasitoids of the potato tuber moth, Phthorimaea operculella Zell. were surveyed in potato and tomato fields in Menofiya Governorate in 2003. Three species were found to attack P. operculella larvae infesting potato plants; the endoparasitoids, Apanteles litae var. operculellae Nixon and Diadegma molliprum Hlmgrn. and the ectoparasitoid, Bracon instabilis Marshal. Meanwhile, only B.instabilis was found to attack the larvae infesting tomato leaves. Percentages of parasitism in potato fields averaged 10.8, 5.6 and 2.6 % by B.instabilis, A.litae and D.molliprum, respectively. The total percentages of parasitism by the three species ranged from 11.0 to 28.6 % with an average of 19.1 % in potato field, while it ranged in tomato fields from 0.0 to 21.4 % with an average of 11.1 % by B. instabilis.

Keywords: Potato tuber moth, Phthorimaea operculella, Parasitoids, Tomato

INTRODUCTION

The potato tuber moth, Phthorimaea operculella is a cosmopolitan serious insect pest in many tropical and subtropical areas and causes considerable losses in potato production (Das et al 1992). Its importance has increased in the last few decades because of the great increase of the area planted with the solanaceeous crops. Beside potato plants, P.operculella infests also potato tubers, tomato and eggplant leaves as well as some fruits (Abbas et al 1993).

Larvae of the potato tuber moth are subjected to attack by different parasitoid species in many countries, i.e. Apanteles subandinus and Orgilus leoidus in Iran (Salehi & Keller, 2002), Diadegma pulchripes and Sympiesis viridula in Italy (Pucci et al 2003), Cotesia sp. and Bracon sp. in India (Depnath & Borah, 2002), Temelucha minuta in Australia (Gauld, 1980), Microplitis minutalis in Argentina (Lloyd, 1972), Pristomerus spinator in Mexico (Dominguez et al 2000), Agathis gibbosa in USA (Odebiyi & Oatman, 1972), Apanteles litaev var.
operculella, Diadegma molliplum and Bracon instabilis in Egypt (Abbas et al 1993).

The present investigation deals with a survey of parasitoids of P. operculella larvae in potato and tomato fields. The natural role of such parasitoids as biocontrol agents against the experimental insect a pest was estimated as percentages of parasitism.

MATERIAL AND METHODS

A survey of parasitoids of the potato tuber moth, P. operculella was carried out in 2003 in potato fields (from February to June) and in tomato fields (from July to November) at Al-Shuhada localtiy, Menofiya Governorate. Potato and tomato leaves as well as tomato fruits were carefully examined biweekly for infestation by P. operculella larvae. The infested leaves and fruits were picked up, kept in paper bags and transferred to the laboratory. Larvae of P. operculella were removed from the leaves and fruits and reared in glass jars (11 cm in hight and 6 cm in diameter and covered with pieces of cotton-cloth (10 larvae / jar). Each jar contained 10 larvae, the larvae were provided with fresh potato or tomato leaves as food at 3-day interval until pupation or emergence of parasitoids. The parasitoids emerged from larvae and / or pupae were kept, individually, in glass vials (7 x 2 cm) stoppered with pieces of cotton-wool until emergence of adults which were identified and percentages of parasitism by each species were estimated. Also, the formed pupae of P. operculella were kept in similar vials until emergence of moths and/or the appearance of any larval-pupal parasitoids. It should be noted that larval parasitization by the ectoparasitoid Bracon spp. is easily recognized as such parasitized larvae are completely paralyzed by the parasitoid female and harbour, externally, the eggs or larvae of the parasitoid.

RESULTS

Larval parasitoids of P. operculella and percentages of parasitism

a. In potato fields (February – June).

The study revealed that larvae of the potato tuber moth infesting potato leaves were found to be parasitized by the following three species of hymenopterous parasitoids, i.e. Apanteles litae, operculellae Nixon (Fam. Braconidae) Diadegma molliplum Hlmgren. (Fam. Ichneumonidae) Bracon instabilis Marshal (Fam. Braconidae)

The first two species are endoparasitoids, whereas the third one is an ectoparasitoid.

Percentages of parasitism in larvae of P. operculella by A. litae ranged from 2.6 to 11.1 % with an average of 5.5 %. The peak of parasitism (11.1 %) was noticed on May, 26, while these percentages by D. molliplum ranged from 0.0 to 5.6 % with an average of 2.6 %. The peak of parasitism (5.6 %) was noticed on April, 28. Percentages of parasitism by B. instabilis ranged from 4.2 to 23.8 % with an average of 10.8 %. The peak of parasitism (23.8 %) was noticed on May, 12.

The total percentages of parasitism by the three parasitoids species on P. operculella larvae ranged from 11 %, on February 12, to 28.6 %, on May 12, with an average of 19.1 %, Table (1) and Fig., (1).
Table 1. Percentages of Parasitism by *A. litae*, *D. molliplum* and *B. instabilis* on *P. operculella* larvae infesting potato plants at Menofyia Governorate in 2003 (summer season)

| Dates of inspection | No.of collected larvae | Parasitism (%) by the indicated parasitoids |
|---------------------|------------------------|--------------------------------------------|
|                     |                        | *A. litae* | *D. molliplum* | *B. instabilis* | Total |
|                     |                        | No. | %  | No. | %  | No. | %  | No. | %  |
| February, 12        | 18                     | 1   | 5.5| 0   | 0.0| 1   | 5.5| 2   | 11.0|
| February, 26        | 23                     | 2   | 8.7| 1   | 4.3| 3   | 13.0| 6   | 26.0|
| Mean                | 20.5                   | 1.5 | 7.1| 0.5 | 2.15| 2   | 9.25| 4   | 18.5|
| March, 10           | 48                     | 2   | 4.2| 2   | 4.2| 2   | 4.2| 6   | 12.5|
| March, 25           | 38                     | 1   | 2.6| 0   | 0.0| 4   | 10.5| 5   | 13.1|
| Mean                | 43                     | 1.5 | 4.4| 1   | 2.05| 3   | 7.35| 5.5 | 12.8|
| April, 11           | 62                     | 3   | 4.8| 2   | 3.2| 6   | 9.7| 11  | 17.7|
| April, 28           | 71                     | 4   | 5.6| 4   | 5.6| 6   | 8.5| 14  | 19.7|
| Mean                | 66.5                   | 3.5 | 5.2| 3   | 4.4| 6   | 9.1| 12.5| 18.7|
| May, 12             | 42                     | 2   | 4.8| 0   | 0.0| 10  | 23.8| 12  | 28.6|
| May, 26             | 36                     | 4   | 11.1| 1  | 2.8| 4   | 11.1| 9   | 25.0|
| Mean                | 39                     | 3   | 7.9| 0.5| 1.4| 7   | 17.45| 10.5| 26.8|
| June 10             | 56                     | 2   | 3.6| 2   | 3.6| 6   | 10.7| 10  | 17.9|
| Mean                | 56                     | 2   | 3.6| 2   | 3.6| 6   | 10.7| 10  | 17.9|
| Average             | 43.8                   | 2.4 | 5.5| 1.2| 2.6| 4.7 | 10.8| 8.4 | 19.1|
| ± s.e.              | ± 7.8                  | ±1.2 b| ±0.9 b| ± 2.5 a| ± 2.3 |
| F values            | 10.76**                |    |    |    |    |    |    |    |    |
| LSD                 | 3.67                   |    |    |    |    |    |    |    |    |

Fig. 1. Parasitism percentages by *Apanteles litae var operculellae*, *Diadegma molliplum* and *Bracon instabilis* on *Phthorimaea operculella* larvae infesting potato at Menofyia Governorate in 2003
b. In tomato fields (from July to November).

Larvae of *P. operculella* infesting tomato leaves were found to be parasitized by only the ectoparasitoid, *B. instabilis*. Percentages of parasitism ranged from 0.0 to 21.4 % with an average of 11.1 %. The peak of parasitism (21.4 %) was noticed on October, 7, Table (2).

However, no parasitoids were found to attack *P. operculella* larvae infesting tomato fruits in the nine samples of larvae collected from tomato fruits during the course of this study.

**DISCUSSION**

The aim of this investigation is to survey the parasitoids` species which attack the larvae of the potato tuber moth, *P. operculella* and estimate their role against such pests. The obtained results are compared with those obtained 25 years ago by Abbas (1981). The present study revealed that *P. operculella* larvae infesting potato leaves were found to be attacked by three species of parasitoids; *A. litae var. operculellae*, *D. molliplum* and *B. instabilis*. This result is in agreement with that reported by Abbas et al. (1993) who obtained the same parasitoids from larvae infesting potato plants in Menofia and Giza Governorates. However, Abdel-Wahab et al. (2002) obtained only the two species; *A. litae var. operculellae* and *D. molliplum* from *P. operculella* larvae infesting potato plants in Giza Governorate.

Our study also indicates that only *B. instabilis* attacks *P. operculella* larvae when infest tomato leaves. This fact could be interpreted that tomato plants are not attractive to both *A. litae var. operculellae* and *D. molliplum*. This claim is supported by the findings of Abbas et al. (1993) who came to the same results. Also Abbas and Hubeis (1999) found that *P. operculella* larvae infesting tomato leaves were found to be parasitized by only *Bracon gelechiae*, in Sultanate of Oman, but when infesting potato or eggplant leaves they were parasitized by *B. gelechiae* and *Apanteles* sp.

Concerning the role of each species of parasitoids as natural biocontrol agent against *P. operculella* larvae in potato fields, the ectoparasitoid, *B. instabilis* is superior among the three obtained parasitoids.

The average percentage of parasitism by such a species (10.8 %) was almost 2-fold and 5-fold compared to *A. litae var. operculellae* (5.5 %) and *D. molliplum* (2.6 %), respectively. The total percentage of parasitism by the three species averaged 19.1% (ranged from 11 to 28.6 %). In tomato fields, *B. instabilis* had a considerable role against the potato tuber moth infesting tomato leaves, where (average percentage of parasitism was 11.1%), while *A. litae var. operculellae* and *D. molliplum* were absent. Abbas et al. (1993) found that the total percentages of parasitism by *A. litae var. operculellae*, *D. molliplum* and *B. instabilis* on *P. operculella* larvae averaged 28 % in 1978 and 38 % in 1979 in potato fields and 8.8% in 1979 in tomato fields in Menofiya Governorate. Also, Abdel-Wahab et al. (2002) reported that the population of *B. instabilis* was higher about 10-fold more than *A.litae var. operculellae* in potato fields and the peak of parasitism on *P. operculella* larvae reached 60.1 and 69.8 % in the 2nd third of April in 1999 and 2000, respectively.
Table 2. % Parasitism by *B. instabilis* on *P. operculella* larvae infesting tomato plants at Menofyia Governorate in 2003 (winter season)

| Date      | No. of collected larvae | No. of parasitized larvae | Parasitism % |
|-----------|-------------------------|---------------------------|--------------|
| July, 27  | 35                      | 3                         | 8.6          |
| August, 13| 47                      | 3                         | 7.0          |
| Aug., 27  | 51                      | 4                         | 7.8          |
| Mean      | 49                      | 3.5                       | 7.4          |
| Sept., 9  | 62                      | 5                         | 8.1          |
| Sept., 22 | 32                      | 4                         | 12.5         |
| Mean      | 47                      | 4.5                       | 10.3         |
| Oct., 7   | 28                      | 6                         | 21.4         |
| Oct., 21  | 28                      | 5                         | 17.8         |
| Mean      | 28                      | 5.5                       | 19.6         |
| Nov., 4   | 21                      | 4                         | 19.0         |
| Nov., 16  | 15                      | -                         | 0.0          |
| Mean      | 18                      | 2                         | 9.5          |
| Average   | 35.4                    | 3.7                       | 11.1         |
| ± s.e.    | ± 5.8                   | ± 0.6                     | ± 2.2        |

Fig. 2. Percentages of parasitism on *Phthorimaea operculella* larvae infesting potato and tomato at Menofyia Governorate in 2003.
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The study included the collection of larval parasitoids of potato tuber moth (Plutella xylostella) developing in potato and tomato crops in the governorate of Menoufia. Two species of internal parasitoids: Apanteles litae Nixon var. operculellae and Diadegma molliplum were found in potatoes and tomatoes. The external parasitoid was Bracon instablis Nixon var. hlmgrn.

The highest percentage of parasitization was recorded in potatoes with 10.8% for D. molliplum, 6.1% for A. litae, 2.7% for B. instablis, and 20.7% for A. operculellae. The total percentage of parasitization was 38.6%.

The highest percentage of the parasitoids achieved 13.3% in potatoes. The total percentage of the parasitoids achieved 21.4% in tomatoes, with a maximum of 31.9% for B. instablis. The total percentage of parasitization was 12.1% in tomatoes.

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