

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

[29]

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### ABSTRACT

Larval parasitoids of the potato tuber moth, *Phthorimaea operculella* Zell. were surveyed in potato and tomato fields in Menofyia Governorate in 2003. Three species were found to attack *P. operculella* larvae infesting potato plants; the endoparasitoids, *Apanteles litae* var. *operculellae* Nixon and *Diadegma molliplum* 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. molliplum*, 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 solanaceae 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 litae* var.

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*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 locality, Menofya 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 height 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. moliplum* 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							
		<i>A. litae</i>		<i>D.moliplum</i>		<i>B.instabilis</i>		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 <sup>b</sup>		± 0.9 <sup>b</sup>		± 2.5 <sup>a</sup>		± 2.3
F values					10.76**				
LSD					3.67				

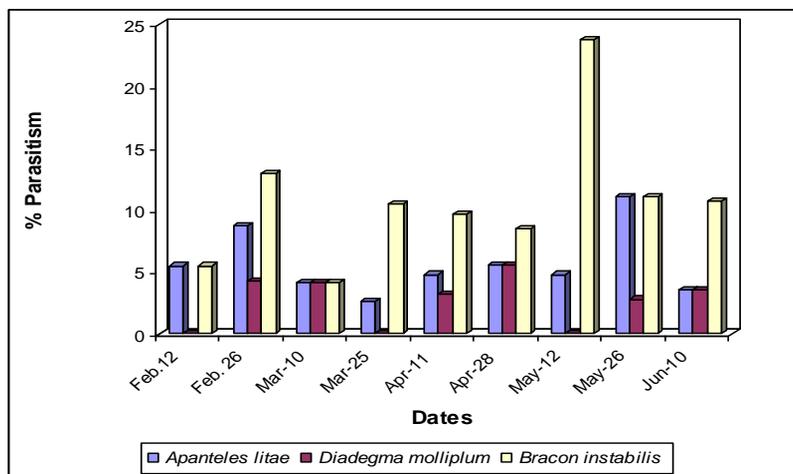


Fig. 1. Parasitism percentages by *Apanteles litae* var *operculellae*, *Diadegma moliplum* and *Bracon instabilis* on *Phthorimaea operculella* larvae infesting potato at Menofyia Governorate in 2003

### 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 a pest to be compared to the results 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 Menofyia 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.

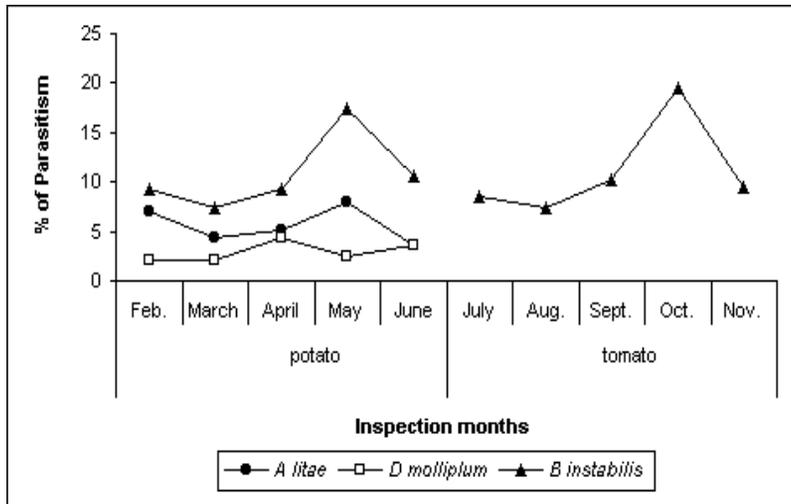
*operculellae* and *D. molliplum*. This claim is supported by the findings of **Abbas et al (1993)** who came to the same results. Also **Abbas and Hubeis (1999)** found that *P. operculella* larvae infesting tomato leaves were found to be parasitized by only *Bracon gelechia*, in Sultanate of Oman, but when infesting potato or eggplant leaves they were parasitized by *B. gelechia* 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 Menofyia 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 2<sup>nd</sup> 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 parsitized 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
October, 7	28	6	21.4
October, 21	28	5	17.8
Mean	28	5.5	19.6
November, 4	21	4	19.0
November, 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

## REFERENCES

- Abbas, M.S.T. (1981). *A Study on the Natural Enemies of the Potato-Tubermoth, Phthorimaea operculella Zell.* pp. 62-69. Ph.D. thesis, Faculty of Agriculture, Cairo, Egypt.
- Abbas, M.S.T. and M.M.A. Hubeis (1999). Natural enemies of major insect pests in Salalah, Sultanate of Oman. *Egypt. J. Agric. Res.*, 77(4): 1485-1497.
- Abbas, M.S.T.; N.A. Abou-Zaid and M.M. Megahed (1993). On the natural enemies of the potato tuber moth, *Phthorimaea operculella* in Egypt. *Egypt. J. Agric. Res.*, 71(4): 943-950.
- Abdel-Wahab, H.A.; F.E. El-Adl.; S.A. Ibrahim and M.E.R. El-Bouze (2002). Efficiency of certain materials against potato tuberworm, *Phthorimaea operculella* and its parasitoids with special regard to their residues. *The 2<sup>nd</sup> Intern. Conf. on I P M in Relation to Safe Agric. Produc. and Healthy Enviro.*, Giza, Egypt, pp. 117-125.
- Das, G.P.L.; E.D. Magnallona; K.V. Ramon and C.B. Adalla (1992). Effects of different components of IPM in management of the potato tuber moth in storage. *Agric. Ecosys. and Enviro.* 41(3): 321-325.
- Depnath, M.C. and B.K. Borah (2002). Record of natural enemies of potato tuber moth, *Phthorimaea operculella* in Assam. *Insect Environment*, 8(4): 161-162.
- Dominguez, J.I.; C.C. Lianderal and H.R. Nieto (2000). *Pristomerus spinator* (Hym.: Ichneumonidae), a parasite of the potato tuber moth. *Agrociencia*, 34(5): 611-617 (Cab Abst., AN: 20000508375).
- Gauld, I.D. (1980). Notes on an economically important species of *Temelucha* (Hym.: Ichneumonidae). *Bull. Ent. Res.*, 70(1): 43-47.
- Lloyd, D.C. (1972). Some South American parasites of the potato tuber moth. *Tech. Bull. Commonwealth Inst.* 15(2): 35-49.
- Odebiyi, J.A. and E.R. Oatman (1972). Biology of *Agathis gibbosa* Say, a parasite of the potato tuberworm. *Ann. Ent. Soc. Amer.*, 65(5): 1104-1114.
- Pucci, C.; A.F. Spanedda and E. Minutoli (2003). Field study of parasitism caused by endemic parasitoids and by the exotic parasitoid, *Copidosoma koehleri* on *Phthorimaea operculella* in Central Italy. *Bull. Insectology*, 56(2): 221-224.
- Salehi, L. and M.A. Keller (2002). Investigations on host finding behaviour of the two parasitoids of potato tuber moth in a flight tunnel. *J. Agric. Sci. Technology*, 4(3/4): 95-102.

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## طفيليات الطور اليرقى لفراشة درنات البطاطس فى حقول البطاطس والطماطم

[ ٢٩ ]

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الوحيد الذى يتطفل على يرقات فراشة درنات البطاطس التى تهاجم اوراق نبات الطماطم وبنسب تطفل تتراوح ما بين صفر، ٤، ٢١، ٤ % بمتوسط ١١، ٣ % . وكانت النسب المئوية للتطفل فى حقول البطاطس ٨، ١٠، ٦، ٥ ، ٦، ٢ % للطفليات : *D. molliplum* ، *A. litae* ، *B. instablis* على التوالي باجمالى نسبه تطفل تتراوح ما بين ١١ ، ٦، ٢٨ % وبمتوسط عام ١٩، ١ % .

تم حصر طفيليات الطور اليرقى لفراشة درنات البطاطس فى حقول البطاطس والطماطم التجريبية فى محافظة المنوفية خلال عام ٢٠٠٣ . وجد ٣ أنواع من الطفيليات التى تهاجم يرقات فراشه درنات البطاطس فى حقول البطاطس ، نوعين من الطفيليات الداخلية هما *Apanteles litae* Nixon var. *operculellae*، *Diadegma molliplum* hlmgrn ونوع واحد من الطفيليات الخارجية هو *Bracon instablis* . كما وجد ان النوع *Bracon instablis* هو

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أ.د مصطفى سيد الدكتوروى