ON THE PARASITOID COMPLEX OF *PIERIS RAPAE* LARVAE ON CABBAGE PLANTATION

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Abstract

The ichneumonid, *Hyposoter ebeninus* was found to be the sole larval parasitoid of *Pieris rapae* in cabbage plantations in Menofyia Governorate. Percentages of parasitism on larvae collected during August – December ranged between 40.5 and 90 % with an average of 63 % in 1996 and between 58.3 and 90.6 % with an average of 67.6 % in 1997. The peaks of parasitism were recorded in September in both seasons. The eulophid hyperparasitoid, *Baryscapus galactopus* was found to parasitize last instar larva of *H. ebeninus* inside its host *P. rapae* larva.It continues its development and emerges from the host`s cocoon . Percentages of parasitism by such a hyperparasitoid on cocoons of *H. ebeninus* collected from cabbage plantations averaged 23.8 % (range 0.0 – 51.5 %) in 1996 and 21.8 % (range 0.0 – 48.7 %) in 1997. The mean total developmental period of *B. galactopus* (from egg to adult) was 25.2 ± 2.1 days at 23± 1 °C and 19.7 days ± 1.5 days at 27± 1 °C. The number of adults emerged from a single host cocoon collected from cabbage plantations ranged from 6 to 22 with an average of 19.4. Adults of *B. galactopus* were found to make 1 – 6 holes in the wall of the host cocoons to get out.

INTRODUCTION

The cabbage worm, *Pieris rapae* is considered one of the most destructive insect pests infesting cabbage, turnip and cauliflower worlwide. The larva was found to be attacked by the two braconid species; *Cotesia (Apanteles) glomeratus* (Hassan, 1976; Ikawa and Okabe, 1984; Jones, 1987; Nealis, 1983) and *Cotesia (Apanteles) rubecula* (Corrigan, 1982; Nealis, 1985 ; Yang, 1985) as well as the ichneumonid *Hyposoter ebeninus* (Isakuva and Molseeva, 1966 ; Kilincer, 1982).

In Egypt, the insect was found to distribute in most Governorates causing considerable damage to all cruciferous plants. The insect was found to be attacked by different parasitoids including the egg parasitoid, *Trichogramma buesi* (Abbas, 1989), the larval parasitoid, *Hyposoter ebeninus* (Abbas and Hassanein, 1989; Ibrahim et *al.* (1996) and the pupal parasitoids, *Brachymeria femorata* and *Pteromalus puparum*

El-Ghadri, 1937; Kamal, 1937 ; Abbas and El-Dakroury, 1985; Ragab, 1992; Ibrahim *et al.* 1996).

The present investigation deals with the parasitoid complex of *P. rapae* larvae infesting cabbage. Percentages of parasitism by the parasitoids obtained are given.

MATERIALS AND METHODS

Percentages of parasitism: The present study was carried out in a private cabbage plantation in Menofyia Governorate during two successive growing seasons; August – December, 1996 and 1997. Cabbage plants were inspected biweekly and the larvae of P. rapae together with the cocoons of its parasitoid, Hyposoter ebeninus were collected and transferred to laboratory. The larvae were reared on cabbage leaves until pupation or the formation of the cocoon of its parasitoid . Rearing took place in glass vials, 11x5 cm, stoppered with pieces of cotton-wool (one larva / vial).

It should be noted that the last larval instar of the parasitoid *H. ebeninus* consumes all contents of the host larva except the integument so that it could be seen clearly through the integument. While spining a black cocoon by the parasitoid full-grown larva, the host s integument is disrupted forming white stripes around the cocoon. Such cocoons as well as those collected from cabbage plantations were kept, individually, in glass vials, 7x2 cm, until emergence of adult *H. ebeninus* or adults of hyperparasitoids. Percentages of parasitism by *H. ebeninus* and by the hyperparasitoid were calculated. Speciemens of the hyperparasitoid were sent to Museum of Natural History, U.K. for identification.

Biological notes on the hyperparasitoid.

- Host preference: Each of 25 last instar larvae of the parasitoid, *H. ebeninus* (inside larvae of *P.rapae*) together with a newly formed cocoon of such a parasitoid were confined in a glass vial, 7 x 2 cm, stoppered with a piece of cotton – wool. A mated female of the hyperparasitoid was introduced into each vial and kept for 24 hrs. The exposed hosts were then removed and kept, individually, in similar glass vials until emergence of adult parasitoids or hyperparasitoids.

-Total developmental period: The total developmental period of the hyperparasitoid (from egg to adult) was estimated. 50 parasitized *P. rapae* larvae, containing the last instar larvae of *H.ebeninus* were exposed, individually, to a mated female of the hyperparasitoid in a glass vial for 24 hrs. Ten exposed hosts were then dissected to make sure that they were parasitized (containing the hyperparasitoid eggs) and the rest were kept until emergence of adult hyperparasitoids.

The study was carried out at 23 ± 1 °C and 27 ± 1 °C with 60 – 70 % R.H.

- Number of hyperparasitoids emerged from a single host.

Cocoons of *H.ebeninus* collected from cabbage plantations were kept, individually, in glass vials until emergence of adult parasitoids or hyperparasitoids. The number of hyperparasitoids emerged from each cocoon was recorded. In addition, the number of holes made by adult hyperparasitoids to emerge from the cocoon was counted.

RESULTS

Nomencluture: The hyperparasitoid was identified as *Baryscapus galactopus* Ratzeberg (Hymenoptera : Eulophidae) by Mr. L. Rogers who kindly mentioned that this hyperparasitoid has been treated in literature under a variety of names including *Tetrastichus rapo*, *T.galactopus* and *T.microgastri* .

Percentages of parasitism on *P.rapae* larvae.

Data presented in Table 1 and illustrated in Figs.1&2 show that % parasitism on *P.rapae* larvae by *H.ebeninus* in 1996 started with 40.5 % in August (34 parasitized larvae out of 84 larvae collected). It reached 90 % in September (54 parasitized larvae out of 60 collected) and then fluctuated until reaching 63 % in December (66 parasitized larvae out of 101 collected). The total number of *P.rapae* larvae collected during August – December was 538 and out of which 339 (63 %) were parasitized.

In 1997, % parasitism started with 58.3 % in August (14 parasitized larvae out of 24 collected). It reached a peak of 90.6 % in September (29 parasitized larvae out of 32 collected) and then fluctuated until reaching 64.3% in December (54 parasitized larvae out of 84 collected). The total number of *P.rapae* larvae collected during August – December was 374 and out of which 253 (67.6 %) were parasitized.

Percentages of hyperparasitism on *H.ebeninus*.

Data presented in Table 2 and illustrated in Figs.3 & 4 show that no prasitism on *H.ebeninus* by the hyperparasitoid, *B.galactopus* could be found in all parasitoid `s cocoons collected during August and September in 1996 and 1997. The number of parasitized cocoons during October through December ranged from 4 (in October) to 38 (in November) in 1996 representing 3.8 and 47.5 %, respectively. The total number of *H.ebeninus* cocoons collected during October – December was 319 and out of which 76 (23.8 %) were parasitized. In 1997, the numbers of parasitized cocoons varied from 7 (in October) to 38 (in November) representing 17 and 48.7 %, respectively. The total number of *H.ebeninus* cocoons collected during October – December was 220 and out of which 48 (21.8 %) were parasitized.

Biological notes on *B.galactopus*.

-Host preference.

It was found that females of the hyperparasitoid, *B.galactopus* attacked and parasitized the last larval instar of *H.ebeninus* inside the host larva (*P.rapae*). 22 *H.ebeninus* cocoons, out of the 25 exposed last instar larvae gave rise to adults *B.galactopus*. In contrast, all exposed newly formed cocoons gave rise to *H.ebeninus* adults.

-Total developmental period.

The mean total developmental period of *B.galactopus* (from egg to adult) was 25.2 ± 2.1 days (range 21 – 28 days) at 23 ± 1 °C and 19.7 + 1.9 days (range 17 – 22 days) at 27 ± 1 °C .

-Number of hyperparasitoids emerged from a single host.

The number of adults *B.galactopus* emerged from a single cocoon of *H.ebeninus* collected from cabbage plantations averaged 19.4 (range 6 – 26). The number of holes made by adult hyperparasitoids to get out of the cocoon varied from one to six / cocoon and the hole measured 0.5 mm (0.4 – 0.7) diameter. It should be noted that the hole made by adult *H.ebeninus* to get out of the cocoon measured 2.0 mm (1.8 - 2.3)diameter.

DISCUSSION

The total number of *P.rapae* larvae collected from cabbage plantations in 1996 was 538 and out of which 339 larvae (63 %) were parasitized by *H.ebeninus*. The respective number collected in 1997 was 374 and out of which 253 larvae (67.6 %) were parasitized. Such results indicate that the parasitoid, *H.ebeninus* has a considerable role as a limiting factor for the populations of *P.rapae* in Egypt. Ibrahim et al. (1996) came to the same conclusion and mentioned that rates of parasitism by *H.ebeninus* on larvae of *P.rapae* averaged 51.4 % in 1989 and 49.6 % in 1990.

The present study revealed, in the first time in Egypt, that the hyperparasitoid, *B.galactopus* was found to parasitize *H.ebeninus* larva inside its host, *P.rapae* larva. This hyperparasioid was reported to attack larval parasitoids of *P.rapae* worldwide ; *Cotesia (Apanteles) glomeratus* (Avci & Ozbec, 1990; Gaines and Kok, 1999; Nealis, 1983; McDonald and Kok, 1991), *Cotesia (Apanteles) rubecula* (Gaines and Kok, 1999; McDonald and Kok, 1992, Nealis, 1985) and *H.ebeninus* (Isakuva&Molseeva, 1966 & Kilincer, 1982).

Rates of parasitism by *B.galactopus* on *H.ebeninus* averaged 23.8 % in 1996 and 21.8 % in 1997. Thus, *B.galactopus* may limit the role of *H.ebeninus* as a promising natural biocontrol agent against *P.rapae* in Egypt. Similarly, Saskaya and Via (1999) reported

that *B.galactopus* was found to parasitize 30 % of *P.rapae* larval parasitoid, *Cotesia glomeratus.* In contrast, Cameron and Walker (2002) mentioned that *B.galactopus* did not appear to limit the establishment of the introduced *C.rubecula* in NewZealand.

Our study showed also that *B.galactopus* female attacked the last larval instar of *H.ebeninus* inside the host larva only before forming the cocoon. The thickness and hardness of the cocoon' s wall may form a barrier for the female' s ovipositor to go through. However, Nealis (1983) reported that *B.galactopus* was found to attack its hosts, *C.glomeratus* and *C.rubecula* while they were larvae in their host, *P.rapae* although free-living cocoons of *C.glomeratus* might also be attacked.

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Table 1. Percentages of parasitism by *H. ebeninus* on *P.rapae* larvae collected from cabbage fields in 1996 – 1997

Month	1996			1997		
	No.of larvae collected	No. of parasitized larvae	Parasitism %	No.of larvae Collected	No.of parositized larvae	Parasitism %
August	84	34	40.5	24	14	58.3
September	60	54	90.0	32	29	90.6
October	133	105	78.9	77	65	84.4
November	160	80	50.0	157	91	58.0
December	101	66	65.3	84	54	64.0
Total	538	339	63.0	374	253	67.6

Table 2. Percentages of hyperparasitism by *B. galactopus* on *H.ebeninus* cocoons collected from cabbage fields in 1996 – 1997

Month	1996			1997		
	No.of larvae collected	No. of parasitized larvae	Parasitism %	No.of larvae collected	No.of parositized larvae	Parasitism %
August	14	-	0.0	8	-	0.0
September	54	-	0.0	43	-	0.0
October	105	4	3.8	41	7	17.0
November	80	38	47.5	78	38	48.7
December	66	34	51.5	50	3	6.0
Total	319	76	23.8	220	48	21.8

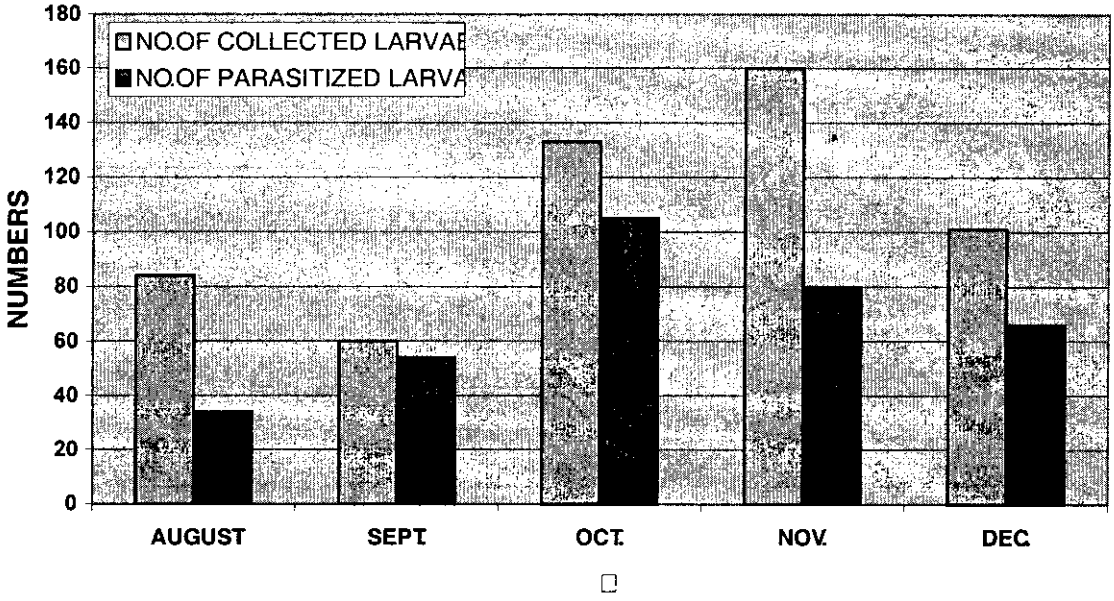

Fig.1. NO.OF COLLECTED *P.rapae* LARVAE AND NO.OF PARASITIZED ONES(BY *H.ebeninus*) IN 1996 SEASON.

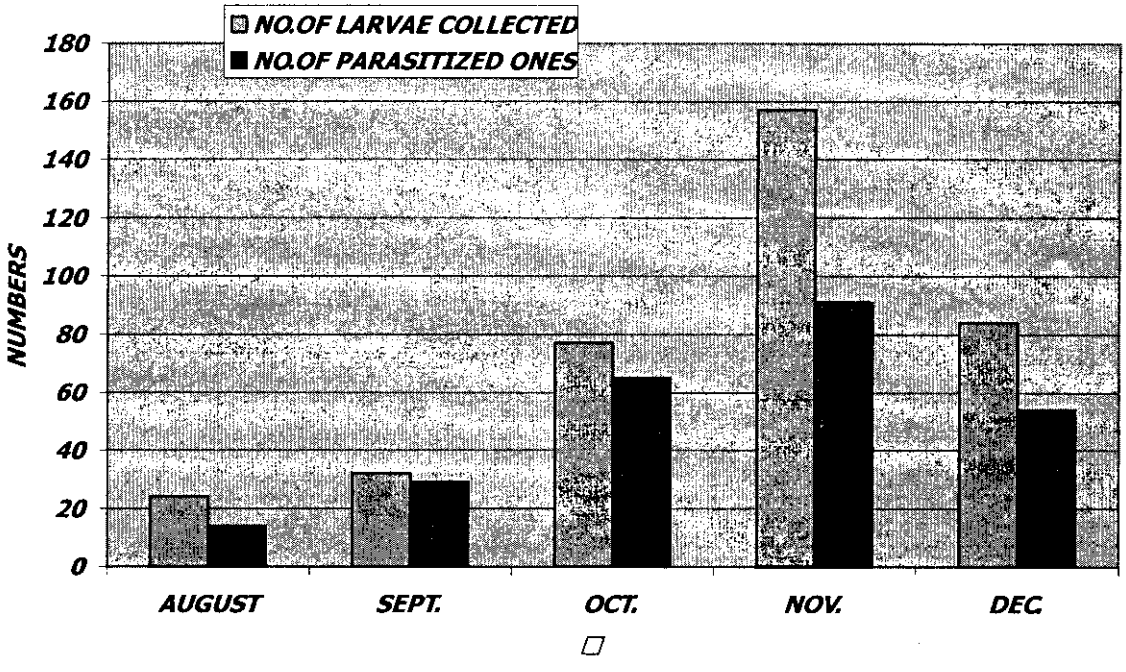

Fig.2. NO.OF COLLECTED *P.rapae* LARVAE AND NO.OF PARASITIZED ONES (BY *H. ebeninus*) IN 1997 SEASON.

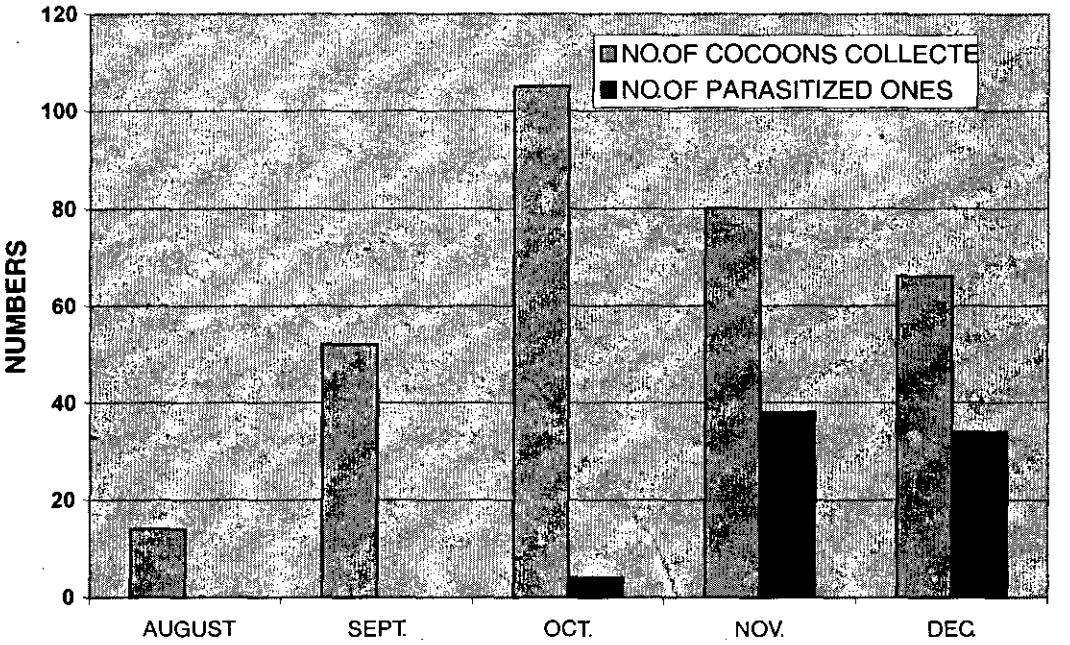

Fig.3. NO.OF COLLECTED COCOONS OF *H.ebeninus* AND NO.OF PARASITIZED ONES (BY THE HYPERPARASITOID, *B.galactopus*) IN 1996 SEASON.

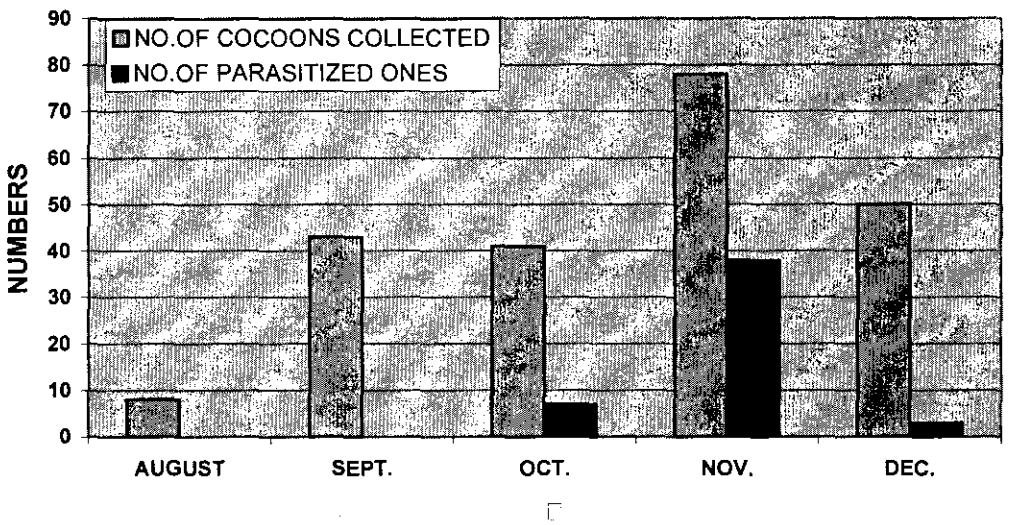

Fig.4. NO.OF *H.ebeninus* COCOONS COLLECTED AND NO. OF PARASITIZED ONES (BY *B.galactopus*) IN 1997 SEASON.

دراسة عن طفيليات يرقات أبو دقيق الكرنب

محمد سمير توفيق عباس

معهد بحوث وقاية النباتات – مركز البحوث الزراعية– الدقى – الجيزة – مصر

وجد أن الطفيل هيبوسوتر إيينينس هو الطفيل الأولى الوحيد الذي يتطفل على يرقات أبو دقيق الكرنب فى مزارع الكرنب بمحافظة المنوفية . تراوحت نسب التطفل على اليرقات التي تم جمعها خلال الفترة من أغسطس إلى ديسمبر بين ٤٠,٥ % ، ٩٠ % (بمتوسط ٦٣ %) فى سنة ١٩٩٦ ، بين ٥٨,٣ % ، ٩٠,٦ % (بمتوسط ٦٧,٦ %) فى سنة ١٩٩٧ .

وقد وجد من الدراسة أن هذا الطفيل يتعرض لهجمات الطفيل الثانوي بارى سكابس جلاكتوبس والذي يتطفل عليه في العمر اليرقى الأخير داخل يرقة أبو دقيق الكرنب .

وقد تراوحت نسب التطفل على هذا الطفيل الأولى بين صفر % ، ٥١,٥ % (بمتوسط ٢٣,٨ %) خلال الفترة من أغسطس إلى ديسمبر ١٩٩٦ ، وبين صفر % ، ٤٨,٧ % (بمتوسط ٢١,٨ %) خلال نفس الفترة عام ١٩٩٧ .

تستغرق دورة حياة هذا الطفيل الثانوي (من البيضة حتى خروج الحشرة الكاملة) ٢٥,٢ يوما على درجة حرارة ٢٣م ، ١٩,٧ يوما على درجة حرارة ٢٧م . ويبلغ عدد أفراد الطفيل الثانوي التي تتربى على فرد واحد من الطفيل الأولى ٦ – ٢٢ (بمتوسط ١٩,٤) فردا