

STUDIES ON SOME ECOLOGICAL AND BIOLOGICAL OBSERVATIONS OF THE PARASITIDS, *Apanteles* SPP. (HYMENOPTERA: BRACONIDAE) ON THE HAWAIIAN BEET WEBWORM, *Hymenia recurvalis* FAB. (LEPIDOPTERA: PYRALIDAE) AT FAYOUM DISTRICT

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ABSTRACT

The present work was carried out at Fayoum district to study ecological and biological observations on the parasitoids, *Apanteles* spp which associated with the Hawaiian beet webworm, *Hymenia recurvalis* Fab. during two seasons (2006/2007 and 2007/2008). Results showed that the parasitoids were recorded parasitizing on 2nd instar larvae of this insect pest.

The Hawaiian beet webworm and its parasitoids, *Apanteles* spp. (*Apanteles hymeniae* Wilknsn and *A. marginiventris* Creeson) had one peak extended from first season until the end of December during the two successive seasons of study. *Apanteles marginiventris* was reared under laboratory conditions (25 ± 1 °C and 70 ± 5 % R.H.). Longevity of males and females averaged 3.90 and 6.30 days. Mean number of eggs laid was 15.10 eggs / female. Total duration of immature stages was 16.0 ± 0.23 days

Keywords: Hawaiian beet webworm, *Hymenia recurvalis*, *Apanteles* spp, biology and ecology

INTRODUCTION

Hawaiian beet webworm, *Hymenia recurvalis* Fab. is a major pest on spinach, *Amaranthus* spp. It also attacks many other crops and weeds. Larvae of *H. recurvalis* usually fed on exposed situations although they sometimes webbed or rolled leaves. Biological control is one of the important methods in an integrated control programs. Parasitoids are among the principal agents and limiting biotic factors affecting pest population densities. The *Apanteles* spp were more common than the other parasitoids larvae of *H. recurvalis* (Singh, 1960)

Peter and Balasubramanian (1984) showed that larvae of *H. recurvalis* and its parasitoids, *Apanteles* spp were collected from *Amaranthus* sp. from June to August in India.

In Egypt, this pest was recorded for first time in 2001 at El-Fayoum district on sugarbeet plantation (Hussein, 2001). On the other hand, El-Gendi *et al.* (2003) and Hussein & Abd El- Gayed (2008) reported that *H. recurvalis* is the most dangerous defoliators of sugarbeet plants, spinach and some weeds at El- Fayoum district.

However, scanty information has been paid to the seasonal abundance of *H. recurvalis* and their associated parasitoids and effect of certain climatic factors. Therefore, the present study was designed to study seasonal abundance of beet webworm and its parasitoids, effect of certain

climatic factors on the populations of both insect pest and its parasitoids and some biological aspects of the parasitoid, *A. marginiventris* under laboratory conditions.

MATERIALS AND METHODS

A. Stock culture:

1-Insect pest:

Infested sugarbeet leaves with *H. recurvalis* larvae were collected from the field in El-Hadka village, El-Fayoum district) and kept in glass jars (20 cm dia. x 30 cm ht.). The introduced leaves for these larvae were washed and dried carefully. The jars were covered with muslin and held in position by rubber bands. The jars were daily cleaned and fresh sugarbeet leaves were provided for larvae until pupation. The pupae were collected and placed in chimney glass cages until moths emergence. The emerged adults were separated to female and male for mating. The eggs were incubated until hatching and reached to 2nd instar larvae (El-Gendi *et al.*, 2006; Hussein & Abd El- Gayed, 2008).

2- The parasitoids, *Apanteles* spp:

Cocoon of the parasitoids were collected from the field. The collected parasitoids were preserved in vials containing 70% ethanol and 5% glycerin, additional to prepared mounting slide specimens were used for identification. The parasitoids were identified to the species levels by the taxonomic keys according to Chou, (1979).

The newly emerged adults of *Apanteles marginiventris* were reared on 2nd instar larvae of *H. recurvalis* in Petri dish 10 cm., provided with dropetes of 10 % sugar solution and 10 changed daily hosts. These infested larvae were placed in clean Petri dishes containing of leaflet of sugarbeet (as host of larvae) and incubated under laboratory conditions until emergence of parasitoid adults.

B. Ecological studies:

Seasonal fluctuations of the main parasitoids (*A. marginiventris* and *A. hymeniae*) and larvae of *H. recurvalis* were conducted at Fayoum district during two plantations of sugarbeet through two successive seasons, 2006/2007 and 2007/2008. The first plantation was cultivated in mid August, while the second plantation was cultivated in mid September. The samples (10 plants / 10 days intervals) were taken after twenty days from cultivation.

Specimens were placed in paper bags and transferred to the laboratory for inspection. The number of *H. recurvalis* larvae and the cocoons of the parasitoid, *Apanteles* spp. were recorded.

Temperatures (°C) and relative humidity (% R.H.) during the period of study were obtained from the Bulletin of Agricultural Meteorology, Ministry of Agriculture, Egypt for studying correlation between these climatic factors and the population of larvae of *H. recurvalis* and its associated parasitoids, *Apanteles* spp.

C. Biological aspects:

The life cycle of the parasitoid, *A. marginiventris* was studied under laboratory conditions ($25\pm 1^{\circ}\text{C}$ and $70 \pm 5\%$ R.H.). Ten couples of newly emerged adults were reared on 2nd instar larvae of *H. recurvalis*. Each pair was kept in Petri dish 5 cm., provided with dropetes of 10 % sugar solution and 5 larvae were changed daily. The pre- oviposition, oviposition, and post-oviposition periods of adults and fecundity of females were recorded. Newly infested larvae of host were transferred individually in sterilized Petri dishes (5 cm) until transferred to pupae of the parasitoids. Twenty larvae were used as replicates. Observations were daily done to determine the duration of larval and pupal stages (Abd El-Gayed, 2004).

D- Statistical analysis:

The obtained data were statistically analyzed by simple correlation and regression for ecological studies and calculated the standard error for biological studies according to Senedecor and Cochran (1980).

RESULTS AND DISCUSSION

1- Ecological studies:

Survey studies indicated that two species of hymenopterous parasitoids (*Apanteles hymeniae* Wilkinson and *A. marginiventris* Creeson) belong to family Braconidae. These results are in agreement with those obtained by Narayanan *et al.* (1957); Singh & Parshad (1970); Boling & Pitre (1970); Chaudhary & Kapil, (1977); Kunnalaca & Mueller (1979); Chou (1979); Peter & Balasubramanian (1984) and Sourakov & Mitchell (2008) in India.

The numbers of *H. recurvalis* larvae and its associated parasitoids, *Apanteles* spp on sugarbeet leaves from 2006 to 2008 are illustrated in Figures (1) and (2).

First season 2006/2007:

The obtained data on the population density of *H. recurvalis* larvae during 2006/07 season (first plantation) showed that the larvae were abundant throughout the months from September to December. The highest number of larvae (40 larvae/10 plants) was recorded during the 4th week of September, while the lowest one (2 larvae/10 plants) noticed during the 2nd week of December. Fluctuations in the population density indicated that one activity period occurred during first plantation in, Figure (1).

Data illustrated in Figure (1) indicated that the parasitoids of *H. recurvalis* larvae during 2006/07 season (first plantation) were abundant throughout a period activity of the pest (from September to December). Fluctuations of population density showed one occurrence period, Fig (1). This period observed during the period from 2nd week of September to the 4th week of November, while its peak was noticed during the 2nd week of October (19 parasitoids/10 plants).

Data of the 2nd plantation showed that *H. recurvalis* larvae were abundant throughout the period extended from October to December during 2006/07 season (Figure 1). The highest number of *H. recurvalis* larvae. (22

larvae/10 plants) were recorded during the 4th week of October, while the lowest number (3 larvae/10 plants) were noticed during the 1st week of December.

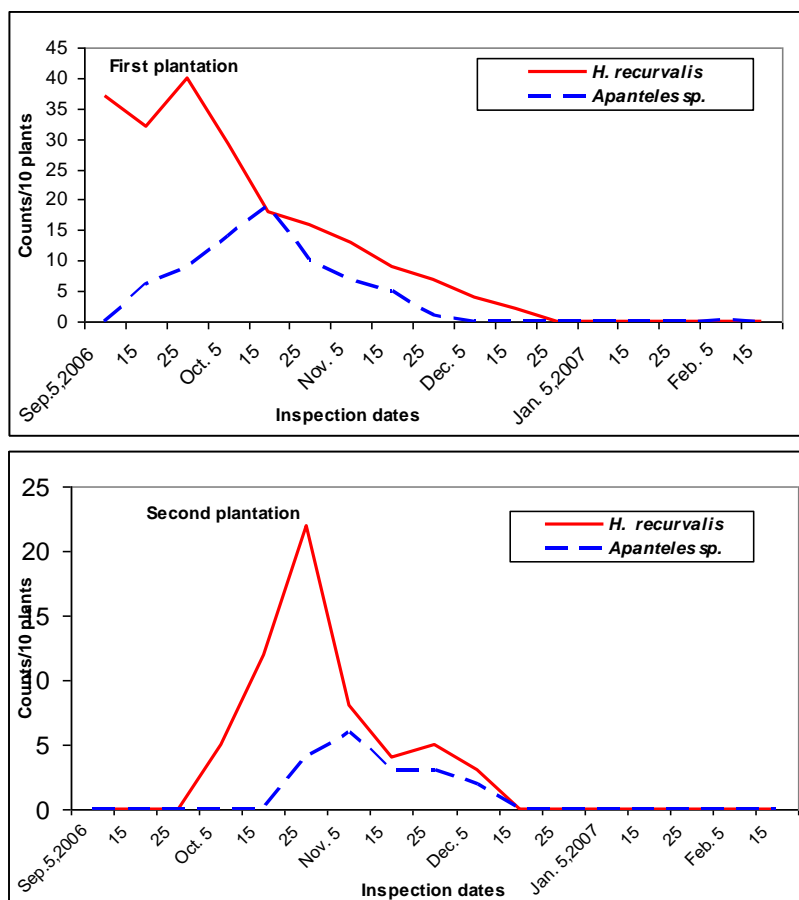


Fig. (1): Seasonal abundance of *H. recurvalis* and its associated parasitoids, *Apanteles* spp on sugarbeet during,2006/2007 season at Fayoum district.

Data presented in Fig (1) showed that *H. recurvalis* parasitoids during 2006/07 season (second plantation) were abundant from 4th week of October to 1st week of December, the fluctuations of population density detected one occurrence period was recorded.

Simple correlation between certain climatic factors and *H. recurvalis* parasitoids during the 1st plantation showed a highly significant correlation with all activity periods. On the other hand, simple correlation was a significant with relative humidity. But, in the 2nd plantation, simple correlation was insignificant with climatic factors. Simple correlation between certain

climatic factors and population of *H. recurvalis* showed a highly significant correlation with min temperature, a significant with max. temperature and relative humidity, but insignificant with climatic factors in the 2nd plantation (Table 1).

Table (1): Correlation coefficient between certain climatic factors and populations of *H. recurvalis* and *Apanteles* spp. on sugarbeet during 2006/2007 and 2007/2008 seasons at Fayoum district.

Climatic factors	1 st plantation				2 nd plantation			
	r	Slope (b)	Y Int.(a)	P and sign of significant	r	Slope (b)	Y Int.(a)	P and sign of significant
<i>H. recurvalis</i>, 2006/2007 season								
Min. Temp.	0.581	1.822	-13.57	0.0065**	0.382	0.623	-0.903	0.3980
Max. Temp.	0.846	1.430	-25.18	0.0162*	0.634	0.859	-14.92	0.1264
Relative humidity	-0.640	-1.322	87.97	0.0218*	-0.728	-0.934	60.86	0.0637
<i>Apanteles</i> spp.								
Min. Temp.	0.478	1.581	-15.67	0.0014**	-0.326	-0.171	5.129	0.4750
Max. Temp.	0.515	1.300	-27.33	0.0020**	-0.223	-0.097	5.207	0.6304
Relative humidity	-0.660	-1.001	64.69	0.0442*	0.230	0.094	-2.728	0.6205
<i>H. recurvalis</i>, 2007/2008 season								
Min. Temp.	0.902	1.577	-7.847	0.0001**	0.826	1.711	-10.49	0.0032**
Max. Temp.	0.832	1.095	-16.29	0.0004**	0.844	1.268	-21.27	0.0023**
Relative humidity	-0.542	-1.845	119.10	0.0469*	-0.542	-1.933	123.26	0.1051
<i>Apanteles</i> spp.								
Min. Temp.	0.228	1.634	-12.61	0.0003**	0.723	0.602	-4.687	0.0182*
Max. Temp.	0.350	1.225	-23.74	0.0001**	0.797	0.483	-9.631	0.0057**
Relative humidity	-0.168	-2.041	126.38	0.0380*	-0.608	-0.872	53.441	0.0621

* Significant ** Highly significant

Second season 2007/2008:

As shown in figure (2), the populations of the parasitoid species took the same trend of season 2006/2007, i.e., the parasitoid populations began to appear during the end of September until first December (after 20 days from appearance of the pest, *H. recurvalis*) and the population in first plantation higher than the second one.

The populations fluctuated to record one activity period. The peak (20 individuals /10 plants) was recorded in end of October (17.0 min. temp., 34.9 max. temp. and 56.7 % RH) and decreased gradually until the first of December neither pest nor parasitoids were observed from mid December until end of plantation (end February).

The population of the parasitoids, *A. marginiventris* and *A. hymeniae* were lower than 1st plantation and associated with activity period of *H. recurvalis* larvae. The peak (10 cocoons /10 plants) was recorded in the same activity period of first plantation in end of October (17.0 min. temp., 34.9 max. temp. and 56.7 % RH) then decreased gradually until first of December Also no individuals were observed this period until end of plantation.

Generally, the relationship between the population of *H. recurvalis* larvae , associated parasitoids, *Apanteles* spp. and temperature were highly

significant in the 1st and 2nd plantations. While the relationship between the population of the *H. recurvalis* & its parasitoid and relative humidity were a significant, but in the 2nd plantation were insignificant (table 1).

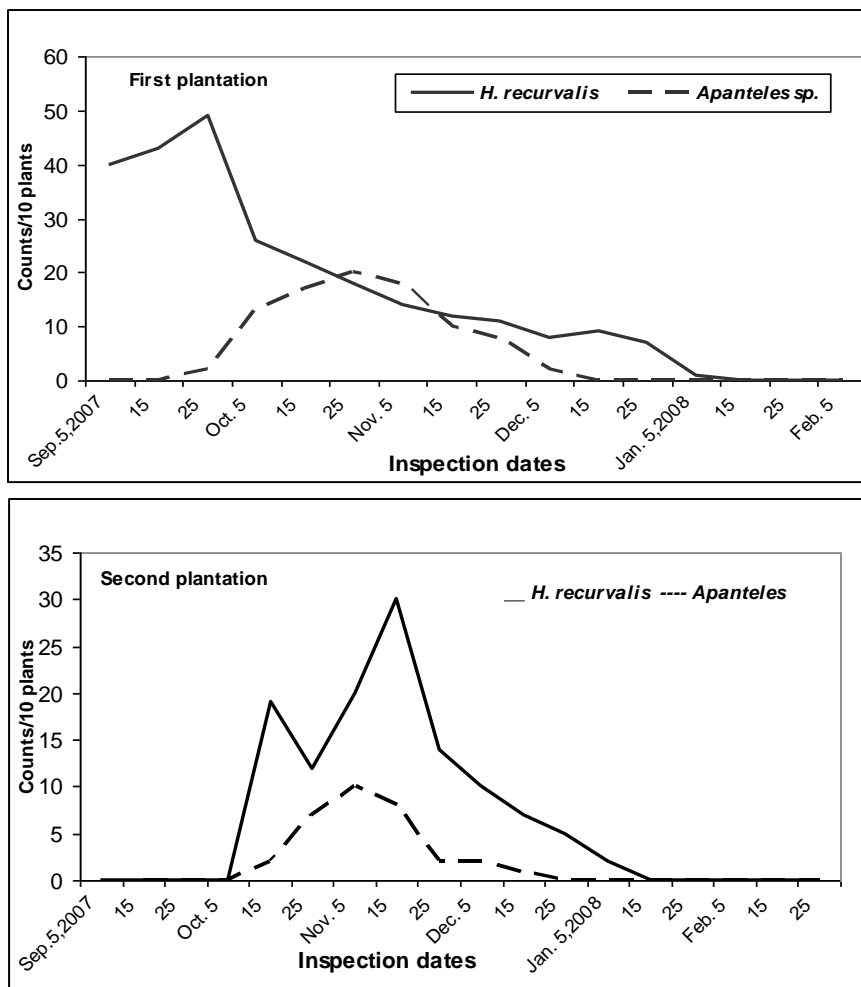


Fig. (2): Seasonal abundance of *H. recurvalis* and its associated parasitoids, *Apanteles* spp on sugarbeet during, 2007/2008 season at Fayoum district.

The above mentioned results are in agreement with those obtained by Narayanan *et al.* (1957); Boling & Pitre (1970); Singh & Parshad (1970); Chaudhary & Kapil (1977) and Sourakov & Mitchell (2008) in India they mentioned that the parasitoids, *Apanteles* spp were associated with 2nd larvae of *H. recurvalis* during the period extended from July to September and no observed after November.

In addition, in same region, Peter & Balasubramanian (1984) found that larvae of *H. recurvalis* collected from *Amaranthus* sp. from June to August and the percentage of parasitism by *Apanteles* spp. was the highest population (11.0%) compared with other parasitoids.

2. Biological aspects:

Durations of immature stages:

Table (2) showed that the egg incubation period ranged between 2-4 days to recording the mean, 2.6 ± 0.12 days. The larval stage of the parasitoid, *A. marginiventris* has four instars. The total duration of larval stage lasted 8.3 days. Pre pupal stage had one day only in all replicates, while the pupation externally in white cocoon and the pupa ranged between 5-10 days. The mean total durations of immature stages was 16.0 ± 0.23 days. The longest period was 19.0 but the shortest one was 13.0 days. The sex ratio (σ : ρ) were 1.7:1.

Table (2): Hatchability, durations (in days) of the immature stages and sex ratio of *A. marginiventris* when, reared on 2nd instar larvae of *H. recurvalis* under laboratory conditions .

Observation	Incubation Period	Larvae	Pre pupae	Pupae	Total	Sex ratio
Mean	2.6	8.3	1	7.5	16.0	1.7:1 σ : ρ
\pm S.E	0.12	0.18	0.00	0.27	0.23	
Range	2-4	7-11	-	5-10	13-19	

Adult longevity:

Adult Stage:

Data in table (3) demonstrate that the pre-oviposition, oviposition and post-oviposition periods were 1.20 ± 0.11 , 3.10 ± 0.02 and 1.20 ± 0.10 days, respectively. Female longevity was longer than that of male, as it was 6.30 for female and 3.90 days for male. The mean total deposited eggs / ρ was 15.10 ± 0.21 eggs. The mean number of eggs /day/ ρ was 3.7 ± 0.12 .

Biological studies on the biology of this parasitoid species are rare or nil. In this respect, Singh & Parshad (1970) in India, recorded this parasitoid as primary endoparasite on 2nd instar larvae of *H. recurvalis* and found that the life cycle lasted 10-12 days, the adult lived 3-4 days and no eggs laid in November. Recently in the same region, Sourakov & Mitchell (2008) reared the parasitoid, *A. marginiventris* on young larvae of *H. recurvalis* at 25°C and found that this parasitoid complete its development from egg to adult in 13.0 days and the cocoon took 7-10 days.

Table (3): Adult longevity (day) and fecundity of *A. marginiventris* when reared on 2nd instar larvae of *H. recurvalis* under laboratory condition.

Observation	Oviposition periods / day			Female longevity	Male longevity	Number of eggs
	Pre oviposition	Oviposition	Post oviposition			
Mean	1.20	3.10	1.20	6.30	3.90	15.10
\pm S.E	0.11	0.02	0.10	0.14	0.16	0.21
Range	1-2	3-4	1-2	2-8	2-5	5-19

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بعض الدراسات البيئية والملاحظات البيولوجية على طفيل الابنتيلس (غشائية الأجنحة : براكونيدي) وحشرة هاواى الناسجة لأوراق البنجر هيمنيا ريكورفالس (حشفية الأجنحة : بيريليدي) في منطقة الفيوم
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تم إجراء هذه الدراسة بمحافظة الفيوم لدراسة بعض الملاحظات البيئية والبيولوجية لطفيليات الابنتيلس والمصاحبة لحشرة هاواى الناسجة لأوراق البنجر هيمنيا ريكورفالس خلال موسمي 2006 /2007 و 2007/2008 ولقد اظهرت النتائج التي تم الحصول عليها الاتي .
ظهر الطفيل على العمر اليرقي الثاني للحشرة . وكان لحشرة هاواى الناسجة لأوراق البنجر والطفيل المصاحب لها قمة واحدة من بداية الموسم وحتى شهر ديسمبر خلال موسمي الدراسة .
وبتربية الطفيل الابنتيلس مارحنيقترس تحت درجات حرارة 1 ± 25 م° و 5 ± 70 % رطوبة نسبية وجد أن فترة حياة الذكور والاناث سجلت 3.9 و 6.3 يوما على التوالي . وسجل مقدار ماتضعه الانثى الواحدة من بيض بحوالي 15.1 بيضة / انثى . كما سجلت فترة حياة الاطوار الغير كاملة حوالي 0.23 ± 16 يوم.

قام بتحكيم البحث

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