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SEASONAL ACTIVITY OF THE ECTOPARASITOIDS *Exeristes roborator* (F.)AND *Parasierola* SP. AS BIO-AGENTS AGAINST THE DIAPAUSING PINK BOLLWORM LARVAE.

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ABSTRACT

The present investigation was carried out at Aga district (El-Dakhalia Governorate) during 2005/2006 and 2006/2007 seasons to evaluate the seasonal activity of the ectoparasitoids; *Exeristes roborator* (F.) and *Parasierola* sp. on the diapausing pink bollworm (PBW), *Pectinophora gossypiella* (Saunders) larvae.

Studies on the factors causing mortality among the diapausing pink bollworm. *P. gossypiella* larvae indicated that *E. roborator* (Fam., Ichneumonidae) and *Parasierola* sp. (Fam., Bethylidae) were mainly observed associated with the (PBW) larvae.

The total mortality fluctuated considerably from one month to another during diapausing period. The key factor analysis suggested that *E. roborator* exhibited a positive density- dependent responses. However, Key –values of *E. roborator* were more correlated with the host density than the other mortality factors. On the contrary, the parasitoid *Parasierola* sp. showed no density dependent response.

Predatism by the predacious mites and natural mortality are in most cases able to cause high percentage of mortality at all host population level, but no density-dependent responses to increase host populations have been recorded.

INTRODUCTION

The pink bollworm, *Pectinophora gossypiella* (Saunders) is the most important pest attacking the cotton, *Gossypium barbandense* in Egypt. In Egyptian cotton fields, *P. gossypiella* cause the greatest part of cotton yield losses (Amin *et al*., 2001). This pest causes great reduction in the quantity and quality of the yield; however they attacking squares and bolls. Bolls developed from rosette flowers had fewer seed and less lint than those developed from healthy flowers (Attique *et al*., 2004). More than 64% of bolls developed from rosette flowers were shed, whereas, 8-10% were shriveled on one side and the rest were normal.

The larvae spend late autumn, winter and early spring in a diapausing state inside the cotton seeds or dry bolls in heaps on land or on tops of farmer's houses. The emerging moths are considered as the source of the initial infestation of the new cotton crop.

In the last few years, the Ministry of Agriculture aims to minimize the use of insecticides and maximize the use of natural enemies in the integrated pest management programs, to encourage the natural enemies and increase its role under field condition (Tantawy *et al*., 2002).

The rates of mortality among the diapausing larvae were studied in Egypt by Hosny & Metwally (1974), Tawfik & El-Sherif (1974), Abul-Nasr *et al*. (1978) and Barrania (1997). The impact of indigenous natural enemies on pink bollworms populations is not well understood. The ichneumonid wasp, *Exeristes roborator* which is a polyphagous ectoparasitoid against several pests provid an opportunity for significant reduction in PBW larvae (Talebi *et. al.* ,2005). Also, the bethylid parasitoid, *Parasierola* sp. is an important parasitoid on diapausing PBW on larvae (Hekal, 1974 and 1990).

Biological characteristics as well as density dependent response (i.e. tendency to aggregate where host density is highest) and killing power (i.e. k-value of mortality) are highly considered for the successful insect parasitoids (Abdel-Kareim, 2002) as biological control agents. Therefore, the aim of the present investigation is to evaluate these characteristics of the previously mentioned parasitoids.

MATERIALS AND METHODS

1- Sampling program

To evaluate the seasonal activity of the insect parasitoids, *Exeristes roborator* (Fam., Ichneumonidae) and *Parasierola* sp. (Fam., Bethylidae) on the pink bollworm, *Pectinophora gossypiella* (Saunders) during diapausing period, samples of dry cotton bolls were collected from cotton plants in the field and sticks heaped on farmer houses at Aga district, Dakhalia Governorate.

Samples of 300 dry bolls were collected from cotton plants during September – October, and among layers of cotton sticks on farmer houses every 15 days through a period from October till April during two successive seasons (2005/2006 and 2006/2007).

Evaluating the role of the parasitoids:-

To estimate the role of the parasitoids and the other mortality factors acting on pink bollworm diapausing larvae, each larva was investigated under stereomicroscope. Larvae were recorded as living, dead predated (involved parasitic mite individuals) and parasitized with living parasitoids.

To determine the parasitoid species, each sample was maintained in a Petri dish (10 cm in diameter), containing a piece of moistened cotton wool. The emerged parasitoids were collected and identified.

The percentage of parasitism (Par. %), predatism (Pre. %) and diseased insects (Dis. %) were calculated according to the formula of Abd El-kareim et al. (2005):-

$$\text{Par., Pre. or Dis. \%} = \frac{\text{par., pre. or dis.}}{N + D} \times 100$$

Where, par., pre., and dis. are the number of parasitized, predeceased and / or diseased individuals, respectively, while, N and D are the number of living and all dead PBW larvae.

For examination of predaceous mites associated with PBW larvae, samples of dry bolls were spread over a muslin cloth in Berlese / Tullgren funnel in 3 cm deep layers. The samples were kept for 24 hours below a 60-Watt electric lamp. The mites were collected in Petri dishes (6 cm diam. x 1.5 cm deep) smearing its sides with a layer of Vaseline and citronella oil to prevent individuals from escaping.

Collected mites were kept in Nesbitt's solution few hours for cleaning them. Nesbitt's solution is a powerful clearing agent and is prepared as : Chloral hydrate, 40gm. + distilled water, 25ml. and hydrochloric acid 2.5ml. The mounting of mites was carried out on glass slide by putting the mite individuals in Hoyer's medium (dist. H2O 50ml., Arabic gum, 30gm., chloral hydrate 200gm and glycerin 20ml.) according to Krantz (1978), and covering the mites with glass cover. The slides were gently heated to stretch mite individuals and hast cleaning process, and then they were put for three days on an electric hot plate at 45ºC.

The density- dependent response was determined twice during November 2006 (at the beginning of diapausing period) and March 2007(at the end of diapausing period). Samples of dry bolls were collected from cotton sticks kept on tops of seven farmer's houses. Each sample consisted of 500 dry bolls from each building roof. The numbers of diapausing larvae inside collected bolls were recorded for each building roof in the laboratory. Then the infested bolls were kept in glass tubes until emergence of parasitoid adults, which were counted for each species, and the rate of parasitizm was calculated for all samples.

RESULTS AND DISCUSSION

1-Seasonal activity of the parasitoids.

In the present study, two species of ectoparasitoids; *Exeristes roborator* (F.) (Fam., Ichneumonidae) and *Parasierola* sp. (Fam., Bethylidae) were mainly found to attack *Pectinophora gossypiella* (Saunders) diapausing larvae.

As shown in Figure (1a and b) rates of parasitism on *P.gossypilla* are very low during September – December,and increase gradually to reach the highest values during March-April. This may be attributed to hibernation of the parasitoid, *E. roborator* in the prepupal stage during the winter months ; November –January (Hafez et. al. 1969). So, this may be one of the causes of its low efficiency against resting larvae. .On the other hand, Abbas and **EL-Deeb (1993)** mentioned that the rates of parasitism on *P. gossypilla* are very low during September and October, and increase gradually in winter during storage of cotton stalks in the villages. They illustrated that the parasites can easily reach their host after dryness and opening of cotton bolls.

By plotting the values of K for each parasitoid against the logarithm of the density of the host, the regression analysis indicated that K-values of *E. roborator* were relatively more correlated with the host density than *Parasierola* sp.. So, mortality caused by *E. roborator* among diapausing period of *P. gossypiella* larvae had a relatively adverse effect as host density increase, except that of *Parasierola* sp..

These effects could be represented by the following submodels:

E. roborator : During November (2006): K-value= 0.48 - 0.25Log N (R^2=0.794)

During March (2007) : K-value= 2.00 - 0.61 Log N (R^2 = 0.213)

Parasierola sp. During November (2006):K-value =0.09 - 0.03Log N(R^2= 0.025)

During March (2007) : K-value = 0.14 + 0.09 Log N (R^2 = 0.597)

From this mathematical formula, the potential of these parasitoids during diapausing period under natural conditions could be determined.

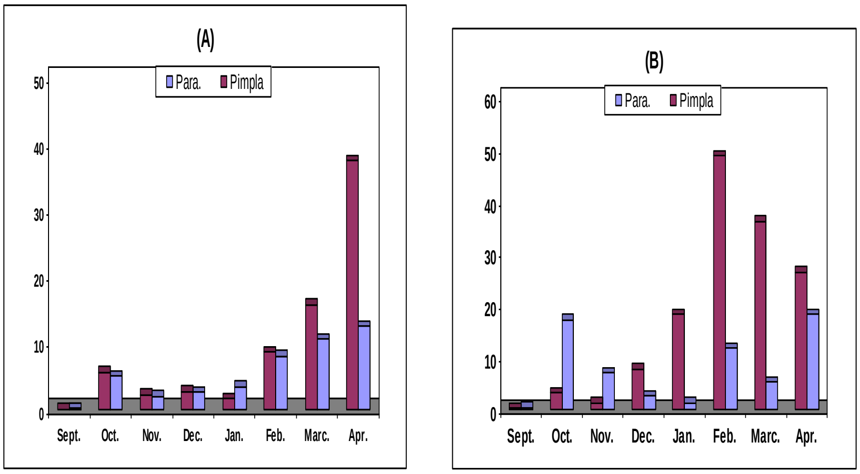
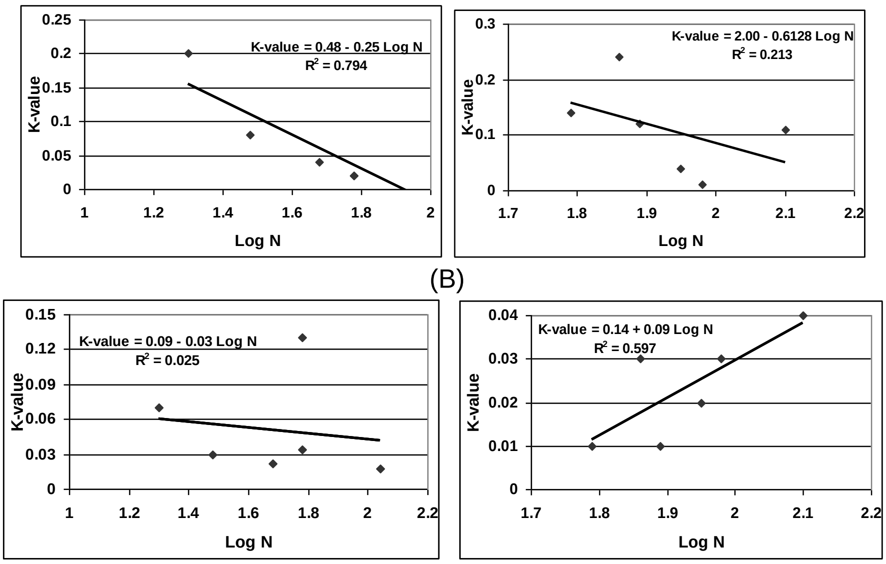


Figure 1: Mortality percentages caused by the ectoparasitoids, *E. roborator* and *Parasierola* sp. on diapausing *P.gossypilla* larvae during two successive seasons; 2005/2006 (A) and 2006/2007 (B).

Density dependent response:

The density-dependent response was determined for both parasitoids at different host densities (Figure2).

(A)



2005/2006 **2006/2007**

Figure (2 a and b): The relation between host density (Log N) and Killing power (K-value) of *E. roborator* (A) and *Parasierola* sp. (B) during November 2006 and March /2007.

Killing power (k-value) of the parasitoids.

The k-values for the following submortalities acting on *P. gossypiella* diapausing larvae were calculated:

k_0 = mortality caused by the predaceous mites and unknown mortality.

k_1 and k_2 = mortality caused by the ectoparasitoids *E. roborator* and *Parasierola* sp. While, k_3 = pathogenic bacteria (*Bacillus thuringinesis*)

Key values of the different mortality factors acting on *P. gossypiella* diapausing larvae indicated that mortality represented by k_1 is the key factor mainly causing changes in population from month to another.

The analysis of the factor contributing to *P. gossypiella* diapausing larvae illustrated that the determining key factor on the basis of visual correlation or the regression coefficient of k=values was k_1 (mortality caused by the ectoparasitoid *E. roborator*). According to Abul-Nasr *et al*.(1978), the ectoparasite *E. roborator* was found to attack more of *P. gossypilla* larvae in comparison with *Parasierola* sp.

During the course of study, two predaceous species of mites belong to order Mesostigmata (Fam., Phytoseiidae) were observed on *P. gossypiella* larvae namely, *Eusius suitalis* (A. H.) and *Thphlodromips swirskii*. The data represented in Tables (1 and 2) indicated that mortalities caused by the predaceous mites and natural mortality (k_0) were relatively higher than those caused by the other mortality factors. Similar results were obtained by Farrag (1976) and Abul-Nasr *et.al*.(1978).

Table (1) : Key factor analysis for *Pectinophora gossypiella* diapausing larvae during 2005/ 2006 season.

Months (2005/2006)	**K-value**				
	Total	**k_0**	**k_1**	**k_2**	**k_3**
Sept.	0.168	0.57	0.00	0.01	0.051
Oct.	0.119	0.056	0.025	0.022	0.016
Nov.	0.122	0.071	0.010	0.009	0.032
Dec.	0.105	0.035	0.012	0.011	0.047
Jan.	0.135	0.023	0.007	0.015	0.090
Feb.	0.149	0.054	0.039	0.036	0.02
Mar.	0.205	0.072	0.075	0.048	0.01
April	0.382	0.090	0.204	0.058	0.03

Table (2) : Key factor analysis for *Pectinophora gossypiella* diapausing during 2006/2007 season.

Months 2006/2007	**K-value**				
	Total K	**k_0**	**k_1**	**k_2**	**k_3**
Sept.	0.104	0.039	0.01	0.023	0.032
Oct.	0249	0.062	0.095	0.082	0.010
Nov.	0.211	0.090	0.065	0.031	0.025
Dec.	0.136	0.068	0.035	0.011	0.022
Jan.	0.146	0.020	0.088	0.030	0.008
Feb.	0.393	0.038	0.291	0.054	0.010
March	0.268	0.048	0.195	0.023	0.002
April	0.411	0.059	0.244	0.088	0.02

Graphs of the four terms show the main cause of population change. The mortalities k_1 is relatively high and changes in its values are significant when compared with those of k_0 and k_3, it is clear that change in k_1 mainly accounts for the changes in total mortality K, both the amount and direction of change in k_1 and K are very similar. From this we conclude that mortalities, which measure as k_1 is the key factor causing population change.

With respect to mortality caused by the pathogenic bacteria, *Bacillus thuringiensis* (k_3) was relatively low and changes of k_3 values did not concide with changes of K-values (Fig.3).

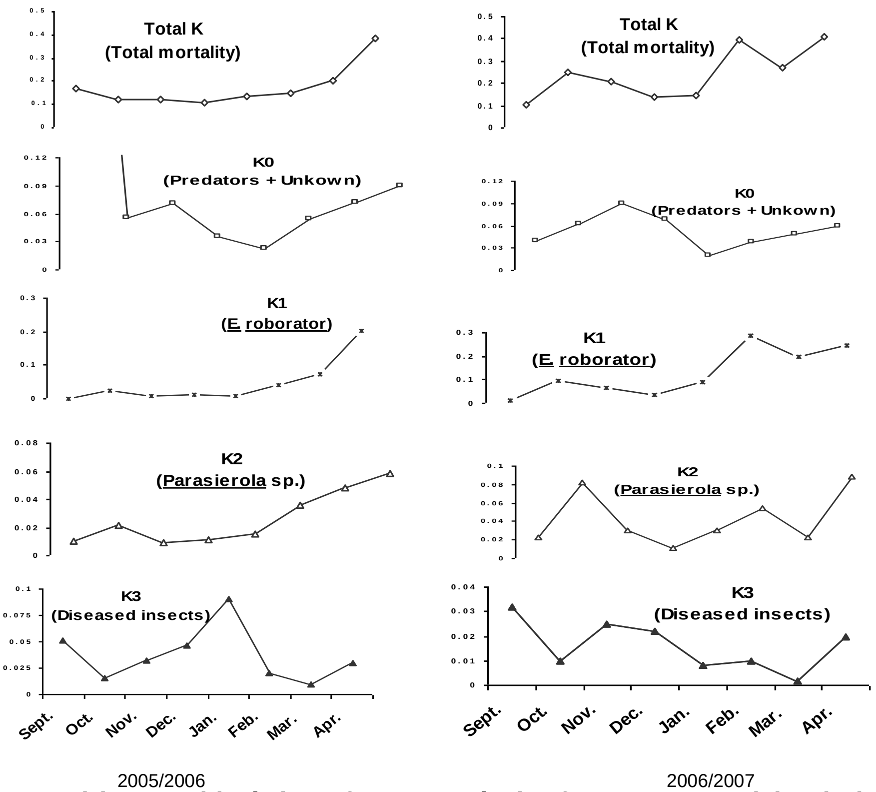


Figure (3): Graphical key factor analysis for *P. gossypiela* during 2005/2006 and 2006/2007 seasons (k_0 = predaceous mites and natural mortality, k_1 = *E. roborator*, k_2 = *Parasierola* sp., and k_3 = pathogenic bacteria).

Neither graphical nor regression analysis showed a density relationship in any of the k-values other than k_1 (mortality caused by the ectoparasitoid, *E. roborator*). So, in the integrated pest management programe, the parasitoid, *E. roborator* can be use as biological control agent against the cotton bollworm. However, it recorded relatively high killing power and exhibited a tendency to aggregate where host density is highest.

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النشـاط الموسـمى للطفيليـات خارجيـة التطفـل *Exeristes roborator* و *Parasierola* sp. كعوامل حيوية ضد يرقات دودة اللوز القرنفلية الساكنة .

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تم في هذا البحث دراسة النشاط الموسمى لكل من الطفيل *Exeristes roborator* والطفيل *Parasierola* sp. على يرقات دودة اللوز القرنفلية خلال فترة السكون ابتداء من شهر سبتمبر حتى شهر أبريل أثناء موسمى ٢٠٠٥/٢٠٠٦ و ٢٠٠٦/٢٠٠٧ مركز أجا محافظة الدقهلية.

وقد أوضحت الدراسة أن نشاط الطفيلين بصفة عامة كان يزداد تدريجيا خلال فترة السكون و وصل لأقصى نشاط له خلال فبراير – أبريل.

وبدراسة عوامل الموت المختلفة التى تؤثر على تعداد دودة اللوز القرنفلية أثناء موسم السكون خلال موسمين متتالين فقد أوضحت الدراسة ما يلي:-

1. أن الطفيل *E. roborator* كان عامل الموت الرئيسى حيث كانت التذبذبات فى قيمته تتلازم مع التغيرات فى قيم الموت الكليه (K) .
2. أبدي الطفيل *E. roborator* استجابة موجبة تجاه التغير في كثافة العائل.
3. كان للعامل k_0 (المفترسات الأكاروسيه والموت الطبيعى) تأثير واضح على نسبة الموت الكلية إلا أن التغير فى قيمته لا تتلازم مع التغيرات فى قيم K الكليه .