COMPARATIVE STUDIES BETWEEN THE EFFICIENCY OF THE EGG PARASITOID, *TRICHOGRAMMA EVANESCENS* WEST. AND THE INSECTICIDAL APPLICATIONS AGAINST THE COTTON BOLLWORMS IN EGYPTIAN COTTON FIELDS

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ABSTRACT

Experimental trials to compare the efficiency of the egg parasitoid, *Trichogramma evanescens* West. with the insecticidal applications on the infestation with cotton bollworms; the pink bollworm, *Pectinophera gossypiella* (Saund.) and the spiny bollworm, *Earias insulana* (Boisd.) in cotton fields were carried out at Quesna district, Menoufia Governorate for two successive seasons 2002 and 2003. Three to four parasitoid releases were conducted during the growth flowering and boll formation stages. Generally, the parasitoid releases showed higher reduction in both infestations compared with the insecticidal treatments. Reduction percentages ranged between 17.2 and 54.98 %, when the parasitoid was released early during the flowering stage, meanwhile it attained 16.83 %, when released later during the boll formation growth stage. In the parasitoid release areas, number of insecticidal applications was reduced to almost the half and consequently, the costs were dropped by 2-2.5 folds. Also, cotton boll weight averaged 3.14 and 3.82 gm in the *T. evanescens* release and insecticide areas, respectively.

INTRODUCTION

Cotton occupies a prominent place in Egyptian agriculture and industry. Insects are the most destructive pests and the most important factor limiting the yield. To protect the crop from insect and mite pests, pesticides are still the most effective tool, but the wide use of chemicals has created several problems, e.g. development of pesticide resistance, secondary pest outbreaks, disturbance of natural balance between pests and their natural enemies and increased the pollution in the environment. Therefore, there is always a need to develop and implement Integrated Pest Management (IPM) programs for cotton pest control in Egypt.

Pink bollworm (PBW) *Pectinophera gossypiella* (Saunds.) (Lepidoptera: Glichiidae) is the key pest of cotton in Egypt, as indicated by the fact that 75 % of insecticide applications used on cotton are directed against PBW. Spiny bollworm (SBW) *Earias insulana* (Biosd.) (Lepidoptara : Noctuidae) is the most significant pest more or less in the southerly cotton growing areas, where it may be of equal importance to the PBW (Moawad *et al.* 1991).

Use of sex attractant pheromones, in integration with insecticides against PBW had been implemented for several years and showed acceptable results against the pests and on the other hand, for the favor of natural enemies' activity (El-Heneidy *et al.* 1987, Moawad *et al.* 1991 and Khidr *et al.* 1996).

Natural enemies' activity represents 65 % of the mortality factors against pest complex in cotton fields. Among certain natural enemies that are amenable to mass-production is the egg parasitoid *Trichogramma* spp. It parasitizes successfully eggs of

the cotton bollworms and drastically reduces their damage (Tuhan *et al.* 1987, Hassan and Guo 1991, Asifulla *et al.* 1998, Duny *et al.* 1998 and Mesbah *et al.* 2003).

The objective of this study is to compare the efficiency of using the native species of the egg parasitoid, *Trichogramma evanescens* West. with insecticides for the control of the bollworms in cotton fields.

MATERIALS AND METHOD

Experimental trials were carried out at Quesna district, Menoufia Governorate, as one of the hot spot areas of bollworms' infestation in the Delta for two successive seasons 2002 and 2003. An area of 2 feddans in season 2002 and 3 feddans in season 2003, cultivated with the recommended cotton variety Giza 89, was selected annually for experimentation. Experimental plots received regular cultural practices.

In 2002 season, the experimental plot was divided into two, one feddan each; (A) for *T. evanescens*, where it received 4 releases at flowering growth stage and plot (B) for insecticidal treatments, where it received 4 insecticidal applications, started late June depending upon the trap catches and/or the recommended infestation threshold level of (3 %).

In 2003 season, plot (A) was divided into two subplots A1 and A2, one feddan each, where *Trichogramma* releases were conducted also at flowering growth stage (A1) and at 1st cycle of green boll formation growth stage. The parasitoid was released at the rate of 150000 individual /release/feddan at 10-12 days intervals, started late June in plot (A) and subplot A1 in both seasons and by mid-July in subplot A2.

Trichogramma release dates were: 30/6, 10/7, 22/7 and 2/8/2002 at plot (A), 30/6, 10/7, 22/7 and 5/8/2003 at subplot A1 and 10/7, 22/7 and 5/8/2003 at subplot (A2).

The parasitoid used for releases was obtained from the mass-rearing unit at the Dept. of Biological Control, Plant Protection Research Institute, Agricultural Research Center, Giza, Egypt.

Subplot (B) was located at the insecticidal areas and was applied 3 times started mid-July. Two insecticidal applications followed the releases of *Trichogramma* at plot (A) in season 2002, while only one and two applications followed the parasitoid releases at subplots A1 and A2, respectively in season 2003.

The insecticides used in the experimental plot (B) and followed the *Trichogramma* releases in plot (A) in both seasons were:

1- Percal (Chloropyrifos), 48 % EC, 1 Litre/feddan
2- Pestbon (Chloropyrifos), 48 % EC, 1 Litre/feddan
3- Skib (Carbaryl), 85 % WP, 1.5 Kg/feddan
4- Sevin (Carbaryl), 85 %WP, 1.5 Kg/feddan
5- Cypercal (Cyparmethrin), 25 % EC, 300 ml/feddan
6- Summi Gold (Sfenvalerate), 20 % EC, 150 ml./feddan.

Insecticides were applied at 15-21 days intervals. Applied insecticides and date of treatments were: Percal and Cypercal on 18/8 and 29/8/2002, respectively at plot (A) and Percal, Cypercal, Percal and Sevin on 12/7, 31/7, 18/8 and 29/8/2002, respectively at plot (B). Correspondent insecticides and dates applied in season 2003 were: Skib on 13/8/2003 at subplot A1, Summi Gold and Skib on 1/8 and 13/8/2003, respectively at subplot A2, and Pestban, Summi Gold and Skib on 19/7, 1/8 and 15/8/2003, respectively at plot (B).

Samples of green bolls (100 bolls/sample) were collected weekly from both experimental plots, of *Trichogramma* and insecticides. Percentage of infestation was estimated by dissecting the green bolls at the same day of collection.

Beside the comparative efficiency among the proposed trials on cotton bollworms' infestation, the indirect benefits of saving chemical control costs and increasing the boll weight in the experiments were also estimated.

Obtained data were recorded and statistically analyzed using ANOVA statistical method.

RESULTS AND DISCUSSION

In the cotton season 2002, obtained results are summarized in Table (1). Earliest incidence of PBW and SBW was recorded on 24th July and 5th August 2002 at plot (A), while correspondent dates in plot (B) were 12th July and 17th August 2002, respectively. As shown in the table, total percentage of infestation with both bollworms was always significantly lower in the integration plot (A) than in the insecticidal plot (B). Respective reduction means attained 57 and 20 % during July and August, respectively and 17.2 % in the whole season.

Rates of infestation with PBW in plot (A) were lower by 57, 25, 43.9 and 40.4 % during the months of July, August, September and the whole season of 2002, respectively compared with the insecticidal plot (B). On the contrary, SBW did not appear during July; comparative rates of infestation were equal during August while they were 60 % higher at plot (A) compared with plot (B), during September (Table 1).

Highly significant differences were obtained in the PBW and total infestation rates between the *Trichogramma* and insecticidal application plots while SBW infestation rates were insignificant between both areas in season 2002.

In the cotton season 2003, obtained results are summarized in Table (2). Earliest incidence of PBW in the three experimental areas were on 23rd , 9th and 9th July 2003 at A1, A2 and (B), respectively, while earliest incidence of SBW was recorded in the three areas on 4th August 2003. As shown in (Table 2), total percentage of infestation with both bollworms; PBW and SBW was mostly lower in the two integrated subplots (A1 and A2) of plot (A) than that in the insecticidal plot (B). Reduction means of subplot A1 compared with the insecticidal plot (B) attained 82.3 % during July, 43.3 % during August and 55 % in the whole season. Respective reduction means of subplot A2 reached 18.6 % during July, 16.6 % during August and 16.8 % in the whole season. Also, highly significant differences were found in the percentage of reductions between the two subplots A1 and A2. Reduction means were 78.6 % during July, 32 % during August and 45.9 % in the whole season (Table 2).

Rates of infestation with PBW at subplot A1 were lower by 78.6 and 82.4 % than subplot A2 and plot (B), respectively during the month of July 2003. Correspondent values during August and in the whole season were 45 and 57.7 %, and 56.6 and 65.6 %, respectively. On the contrary, was the case of SBW which did not record during July 2003. Comparative rates of infestation reached 16.5 and 33.5 % higher at subplot A1 than at subplot A2 and plot (B), respectively. Also, it was higher by 20.4 % at subplot A2 compared with plot (B). In the total percentages of SBW infestation, subplot A1 was 16 % higher than subplot A2 while subplot A2 was 20.2 % higher than plot (B) (Table 2).

Statistical analyses showed also highly significant differences in the PBW and total infestation rates between the *Trichogramma* releases subplot A1 and the other

two treatments (subplot A2 and insecticidal application plot B), while SBW infestation rates were insignificant among the three areas in season 2003.

Chemical control costs included all application expenses and pesticides market prices. The costs were estimated at the end of each season. In the cotton season 2002, the estimated costs reached 74 and 172.25 L.E./feddan for 2 and 4 insecticidal applications at plots (A) and (B), respectively. In season 2003, the costs were 47, 73.5 and 104 L.E./feddan for 1, 2 and 3 insecticidal applications at subplots A1, A2 and plot (B), respectively. Use of *Trichogramma* in integration with insecticidal in plot (A) saved 57 % of the costs in season 2002, and 54.8 and 29.3 % for subplots A1 and A2 in season 2003.

Average weight of cotton seed boll collected from the experimental plots was estimated once at the end of season 2003. The average weight reached 3.14, 2.92 and 2.82 gm/boll in subplots A1, A2 and plot (B), respectively. Percentages of the increase in the boll weight, in the *Trichogramma* plots ranged between 3.4 – 10.2 %. These differences could be attributed to enhance of hybrid vigor resulted from cross pollination in the parasitoid release areas.

In conclusion, PBW incidence preceded SBW in all the experimental plots and in the two seasons of the study. PBW infestation increased towards the end of the season, particularly when the pesticide applications are stopped (mostly during September).

Release of the egg parasitoid, *Trichogramma* in integration with pesticides showed promising reductions in the rates of infestation with the cotton bollworms in cotton fields. Superior reduction, particularly in PBW infestation's rates was achieved by the early releases of *Trichogramma* at the flowering growth stage rather than that at the boll formation growth stage. The reduction in infestation's rates attained 57 and 82.3 % in seasons 2002 and 2003, respectively. Statistical analyses showed significant differences between the two applications of *Trichogramma*, at the flowering and boll formation growth stages in season 2003. Obtained results are in agreements with those of Mesbah *et al.* 2003.

Use of *Trichogramma* in integration with the use of insecticides, only when the rates of infestation exceeded the recommended economic threshold level (3 %) gave significant results regarding reduction in the rates of infestation (16.6 – 82.3 %), chemical application costs (29.3 – 57 %) and cotton boll weight (3.4 – 10.2%).

Obtained data confirmed that the use of *Trichogramma* was more efficient against PBW rather than SBW while the contrary took place in case of using the chemical control. These results may be due to the PBW larval behavior which bore early into the green bolls and spend most of the larval stage (destructive stage) hiding inside the bolls and away from the reach of insecticides. Mesbah *et al.* 2003 confirmed this phenomenon.

Timing of parasitoid releases seemed to be a critical factor in the success of such IPM programs. Obtained data showed that early use of *Trichogramma* at the flowering stage minimized the number of chemical application (to 1 and 2 against 4 and 3 in seasons 2002 and 2003), maintain the rate of infestation below the economic threshold and prolonged the insecticidal free period up to almost mid-August and that also led to enhance the role and abundance of the predators in cotton fields. El-Heneidy *et al.* 1997 and Mesbah *et al.* 2003 estimated the increase in the predatory

numbers in the *Trichogramma* release area compared with insecticidal applications area by 3 folds.

Further studies concerning the proper timing for *Trichogramma* releases against cotton bollworms in cotton fields are still needed.

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Table (1): Mean infestation percentages of the cotton bollworms in *T. evanescens* release and insecticidal application experimental plots in cotton fields at Quesna district, Menoufia Governorate, season 2002.

Sampling date	% Infestation					
	Plot A			Plot B		
	PBW	SBW	Total	PBW	SBW	Total
July, 12th	0.0	0.0	0.0	1.0	0.0	1.0
18th	0.0	0.0	0.0	1.0	0.0	1.0
24th	1.0	0.0	1.0	2.0	0.0	2.0
30th	2.0	0.0	2.0	3.0	0.0	3.0
Mean	**0.75**	**0.0**	**0.75**	**1.75**	**0.0**	**1.75**
Reduction %	57					
August, 5th	1.0	1.0	2.0	2.0	0.0	2.0
11th	2.0	0.0	2.0	2.0	0.0	2.0
17th	2.0	1.0	3.0	3.0	2.0	5.0
23rd	2.0	1.0	3.0	3.0	1.0	4.0
29th	2.0	0.0	2.0	2.0	0.0	2.0
Mean	**1.8**	**0.6**	**2.4**	**2.4**	**0.6**	**3.0**
Reduction %	20					
September, 4th	2.0	2.0	4.0	4.0	0.0	4.0
10th	2.0	3.0	5.0	3.0	2.0	5.0
Mean	**2.0**	**2.5**	**4.5**	**3.5**	**1.0**	**4.5**
General mean	**1.52**	**1.03**	**2.55**	**2.55**	**0.53**	**3.08**
Reduction %	17.2					

Plot A = *Trichogramma* + insecticidal applications.
Plot B = Insecticidal applications.

- *Trichogramma* release dates were: 30/6, 10/7, 22/7 and 2/8 at plot (A).
- Insecticidal applications were: Percal and Cypercal on 18/8 and 29/8 respectively at plot (A) and Percal, Cypercal, Percal and Sevin on 12/7, 31/7, 18/8 and 29/8, respectively at plot (B).

Table (2): Mean infestation percentages of the cotton bollworms in *T. evanescens* release and insecticidal application experimental plots in cotton fields at Quesna district, Menoufia Governorate, season 2003.

Sampling date	% Infestation								
	Plot A						Plot B		
	Plot A1			Plot A2					
	PBW	SBW	Total	PBW	SBW	Total	PBW	SBW	Total
July, 9th	0.0	0.0	0.0	3.0	0.0	3.0	1.0	0.0	1.0
16th	0.0	0.0	0.0	2.0	0.0	2.0	1.0	0.0	1.0
23rd	1.0	0.0	1.0	3.0	0.0	3.0	7.0	0.0	7.0
29th	2.0	0.0	2.0	6.0	0.0	6.0	8.0	0.0	8.0
Mean	**0.75**	**0.0**	**0.75**	**3.5**	**0.0**	**3.5**	**4.25**	**0.0**	**4.25**
Reduction %	**82.3**			**18.6**					
August, 4th	3.0	1.0	4.0	6.0	1.0	7.0	8.0	1.0	9.0
10th	5.0	3.0	8.0	8.0	2.0	10.0	10.0	0.0	10.0
17th	3.0	2.0	5.0	6.0	2.0	8.0	8.0	3.0	11.0
Mean	**3.67**	**2.0**	**5.67**	**6.67**	**1.67**	**8.34**	**8.67**	**1.33**	**10.0**
Reduction %	**43.3**			**16.6**					
General mean	**2.21**	**1.0**	**3.21**	**5.09**	**0.84**	**5.93**	**6.46**	**0.67**	**7.13**
Reduction %	**55**			**16.8**					

Subplot A1 = Release of *T. evanescens* at flowering stage.
Subplot A2 = Release of *T. evanescens* at green boll formation stage.
Plot B = Insecticidal applications.

- *Trichogramma* release dates were: 30/6, 10/7, 22/7 and 5/8 at subplot A1 and 10/7, 22/7 and 5/8 at subplot (A2).

- Insecticidal applications were: Skib on 13/8 at subplot A1, Summi Gold and Skib on 1/8 and 13/8, respectively at subplot A2, and Pestban, Summi Gold and Skib on 19/7, 1/8 and 15/8, respectively at plot (B).