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Proper Timing and Number of Releases of the Egg parasitoid, *Trichogramma evanescens* West. for Controlling the Cotton Bollworms in Egyptian Cotton Fields

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ABSTRACT

Experimental trials to choose the proper timing and number of releases of the egg parasitoid, *Trichogramma evanescens* West. for controlling the cotton bollworms; the pink bollworm, *Pectinophera gossypiella* (Saund.) and the spiny bollworm, *Earias insulana* (Boisd.) in Egyptian cotton fields were carried out at three locations in middle of the Delta; Quesna and Berket El-Sabh districts, Menoufia Governorate and Zagazig district, Sharkia Governorate during the cotton season 2003. Two to four parasitoid releases were conducted during the flowering and boll formation growth stages. Generally, the parasitoid releases showed significant reductions in the percentages of bollworms' infestation comparing with the insecticidal application areas (the control) at the same working sites. The reduction ranged between 48.6 to 56.5 % and 16.4 to 21.7 % when the parasitoid was released early during the flowering stage and few weeks later during the boll formation growth stage, respectively. In the parasitoid release areas, number of insecticidal applications was reduced to almost the third and consequently, the costs were dropped by 29.3 to 36 %. Also, cotton boll weight averaged 3.14 and 2.82 gm in the *T. evanescens* release and insecticide treated areas, respectively.

Key Words: Cotton, Bollworms, *Trichogramma evanescens*, Releases, Timing, Egypt.

INTRODUCTION

Cotton is one of the field cash crops in Egypt. Insect pests are the most serious and important limiting factors of cotton production. The heavy use of insecticides has created many problems. The pesticides are not only expensive to purchase and apply but also their use has led to target pest resurgence, secondary pests outbreaks, development of pesticide resistant pest strains, disturbance of natural balance between pests and their natural enemies, poisoning of workers and contamination of the environment. For all these reasons there is always a need to develop and implement an Integrated Pest Management (IPM) program for cotton in Egypt.

The pink bollworm (PBW), *Pectinophora gossypiella* (Saunds.) (Lepidoptera: Gelechiidae) is the key pest of cotton in Egypt, 75 % of insecticides use on cotton is directed against this pest. The main period of infestation on cotton occurs between July and September. The Economic Threshold Level (ETL) is 3-5 percent infestation of green bolls. Insecticides are applied at 15-to 21 day intervals, a total of three to four applications usually being sufficient to control the pest. Yield losses vary, from 4-7 percent in years of light infestation up to 30 percent in untreated cotton. The spiny bollworm (SBW), *Earias insulana* (Boisd.) (Lepidoptera: Noctuidae) is the most significant as a pest, more or less in the southerly cotton growing areas, where it may be of equal importance to the PBW. SBW usually competes with PBW when both species are existed in the same field (Moawad *et al.*, 1991).

Natural suppression of insect pests form a major component in crop fields, more than 65 % mortality of the cotton pests is due to the action of various natural enemies. The role of natural enemies in controlling cotton pests is becoming increasingly recognized and as one of the IPM options. In Egypt, insecticide applications are minimized on cotton between May and early July to conserve and enhance populations of parasitoids and predators of the cotton pests (El-Heneidy *et al.*, 1987).

Among certain natural enemies that are amenable to mass-production are the egg parasitoids, *Trichgramma* spp. They successfully parasitize eggs of the cotton bollworms and drastically reduce their damage (Tuhan *et al.*, 1987 and Duyn *et al.*, 1998). In the frame of IPM, the utilization of bio-agents has been seen to reduce the cost of protection by at least 65 % and increase the efficiency of pest suppression (Kogan 1998 and Khidr *et al.*, 2003). However, in most crop production systems, the number of caterpillar eggs destroyed by naturally occurring populations of *Trichogramma* is sometimes not sufficient to prevent the pest from reaching damaging levels.

Trichogramma evanescens West. is the most common, native and widely distributed egg parasitoid species in several field, vegetable and fruit crops in Egypt. Besides, it has been recorded in different Egyptian habitats. The parasitoid species has been used successfully for controlling; the lesser sugar-cane borer in sugar-cane fields (El-Heneidy *et al.*, 1991), the corn borers in maize fields (El-Mandarawy *et al.*,

2004), the lepidopterous pests on the fruit trees; olive, apricot and peach (Hegazi, *et al.*, 2004), and the cotton bollworms, PBW and SPW in cotton fields (Mesbah *et al.*, 2003 and Khidr *et. al.*, 2003)

The present study is a continuation of evaluating the efficiency of the native parasitoid species, *T. evanescens* releases against the cotton bollworm eggs in Egyptian cotton fields for choosing proper timing and number of efficient releases.

MATERIALS AND METHODS

Experimental trials were carried out at three locations in middle of the Nile Delta, as one of the hot spot areas of bollworms' infestation; at Quesna and Berket El-Sabh districts, Menoufia Governorate and Zagazig district, Sharkia Governorate in the cotton season 2003. An area of 3 feddans in each location, cultivated with the recommended cotton variety Giza 89, was selected for experimentation. Experimental plots received regular cultural practices

In each location, the experimental area was divided into two main plots (A) and (B), 2 and 1 feddan, respectively. The plot (A) was further divided into 2 subplots (A1) and (A2), one feddan each, where *Trichogramma* releases were conducted at flowering growth stage (A1) and at 1st cycle of green boll formation growth stage (A2). The parasitoid was released 3-4 times in plot (A), at the dosage rate of 150000 wasps/release/feddan, at 10-12 day intervals, started by mid-June in subplot (A1) and by mid-July in subplot (A2).

The plot (B), which located at the insecticidal areas, about 500 m apart from the *Trichogramma* plots, was applied 3-4 times, started early July depending upon the trap catches and/or exceeding the recommended bollworms' infestation ETL of (3%). One to two insecticidal applications followed the releases of *Trichogramma* at subplots (A1) and (A2), respectively.

The insecticides used in the three locations, in the experimental plots (B), and/or followed the *Trichogramma* releases in plot (A) were:

1- Pestbon (Chloropyrifos), 48% EC, 1 Litre/feddan
2- Skib (Carbaryl), 85% WP, 1.5 Kg/feddan
3- Sevin (Carbaryl), 85%WP, 1.5 Kg/feddan
4- Cypercal (Cyparmethrin), 25% EC, 300 ml/feddan
5- Summi Gold (Sfenvalerate), 20% EC, 150 ml./feddan.
6- Summi Alpha (Sfenvalerate), 5% EC, 600 ml./feddan
7- Calical (Carbaryl), 85% WP, 1.5 Kg/feddan

Insecticides were applied at 15-21 day intervals started from the 1st week of July at Berket El-Sabh and Zagazig and by mid-July at Quesna district.

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

$$\text{Percentages of infestation} = \frac{\text{No. of infested bolls}}{\text{Total no. of collected bolls}} \times 100$$

Beside the evaluation of the efficiency of *Trichogramma* releases among the proposed trials against cotton bollworms, the indirect benefits of saving chemical control costs and checking the boll weight in the experimental trials were also estimated.

The parasitoid was obtained from the mass rearing unit of the Dept. of Biological Control, Agricultural Research Center, Giza, Egypt.

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

RESULTS AND DISCUSSION

Obtained results are summarized in Table 1 and Fig. 1. Earliest incidence of PBW and SBW was recorded by late June and late July at plot (A), while correspondent dates in plot (B) were mid-July and early August 2003, respectively. Bollworms' infestation increased towards the end of the season to reach its maximum during September. As shown in the table, percentage of bollworms' infestation was generally lower in the

Trichogramma plot (A) than in the insecticidal plot (B) at the three locations, particularly in subplot (A1), where the *Trichogramma* was released early during the cotton flowering stage.

Table (1): Monthly mean percentages of cotton bollworms' infestation at the experimental cotton plots at Quesna and Berket El-Sabh (Menoufia Governorate) and Zagazig (Sharkia Governorate) in cotton season 2003.

District/ Month	Quesna			Berket El-Sabh			Zagazig		
	A1	A2	B	A1	A2	B	A1	A2	B
June	1.0	1.75	2.0	1.5	1.5	2.5	1.0	2.5	2.75
July	0.75	3.5	4.25	0.3	1.3	1.5	1.4	2.6	4.0
August	5.67	8.34	10	1.3	2.5	2.8	3.0	3.2	3.8

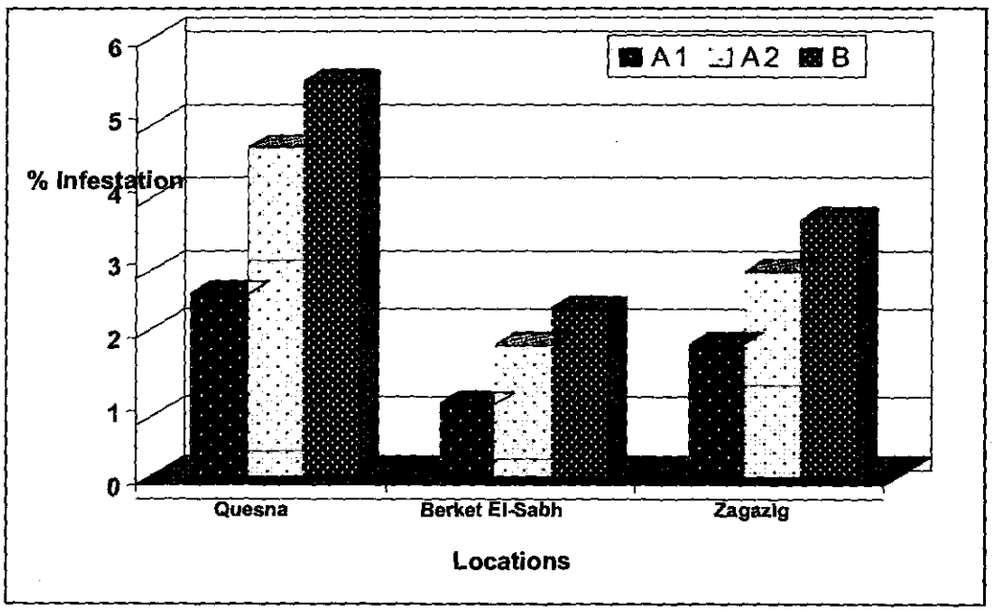

Fig. (1): Total means of cotton bollworms' infestation at the experimental cotton plots at Quesna and Berket El-Sabh (Menoufia Governorate) and Zagazig (Sharkia Governorate) in cotton season 2003.

Generally, bollworms' infestation at Quesna, Menoufia was relatively higher than those in the other two districts (Table 1 and Fig. 1). Total reduction means of bollworms' infestation at subplot (A1) compared with the insecticidal plot (B) attained 54.4 % at Quesna, 56.5 % at Berket El-Sabh, and 48.6 % at Zagazig. Respective means at *Trichogramma* subplot (A1) compared with *Trichogramma* subplot (A2) were 45.5, 44.4 and 35.7 %, respectively. Also, respective reduction means of infestation at *Trichogramma* subplot (A2) compared with the insecticidal plot (B) reached 16.4, 21.7 and 20 % in the three locations, respectively.

As concluded from the data:

- Release of *Trichogramma* early during the cotton flowering stage (subplot A1) showed highly significant differences in the percentage of reductions compared with both the late release of the parasitoid, during the boll formation growth stage (subplot A2), ranged between 35.7 and 45.5 % as well the insecticidal application area (plot B), ranged between 48.6 and 56.5 %, respectively (Table 1 and Fig. 1).
- Release of *Trichogramma* early during the cotton flowering stage (subplot A1) using 4 releases, maintained the bollworms' infestation below the ETL up to mid-August and only one chemical application was needed to complete the season.

- Release of *Trichogramma* during the cotton boll formation growth stage (subplot A2) requested 2-4 parasitoid releases but also 2-3 chemical applications were applied within the intervals of the parasitoid releases to protect the bollworms' infestation from exceeding the ETL. At Zagazig, Sharkia, 3 chemical treatments were applied while only 2 were applied in the other two districts of Menoufia.
- Statistical analysis showed highly significant differences in the PBW and total infestation rates between the *Trichogramma* releases subplot (A1) and the other two treatments (*Trichogramma* subplot A2 and insecticidal application plot B), while SBW infestation rates were insignificant among the three areas.

Chemical control costs included all application expenses and pesticides market prices. 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. The continued use of *Trichogramma* in plot (A) saved 36 and 29.3% at subplots A1 and A2.

Average weight of cotton boll collected from the experimental plots was estimated once at Quesna district. 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. 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 combination 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 ranged between 48.6 and 56.5 %. Statistical analysis showed significant differences between the two applications of *Trichogramma*, at the flowering and boll formation growth stages. Obtained results are in agreements with those of Mesbah *et al.*, 2003 and Khidr *et al.*, 2003.

The continued use of *Trichogramma* and the insecticides, only when the rates of infestation exceeded the recommended ETL (3%) gave significant results regarding reduction in the rates of infestation (16.6–82.3%), chemical application costs (29.3–36%) 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 and Khidr *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 the early use of *Trichogramma* at the flowering stage minimized the number of chemical application (to 1 and 2 against 3-4), maintain the rate of infestation below the ETL and prolonged the insecticidal free period up to almost mid-August and 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 large scale studies concerning the use of *Trichogramma* releases against cotton bollworms in Egyptian cotton fields are still needed.

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التوقيت المناسب وعدد مرات إطلاق طفيل البيض *Trichogramma evanescens* West. لمكافحة ديدان اللوز فى حقول القطن المصرية

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أجريت عدة تجارب لإختيار التوقيت المناسب وعدد مرات إطلاق طفيل البيض *Trichogramma evanescens* West. لمكافحة دودة اللوز القرنفلية *Pectinophera gossypiella* (Saund.) ودودة اللوز الشوكية *Earias insulana* (Boisd.) فى حقول القطن المصرية فى ثلاث مناطق بوسط الدلتا هى قويسنا، وبركة السبع، محافظة المنوفية، والزقازيق، محافظة الشرقية وذلك خلال موسم القطن ٢٠٠٣. تم إطلاق ٢-٤ إطلاقات من الطفيل وذلك أثناء مرحلتى التزهير وتكوين اللوز. بصفة عامة، أعطى إطلاق الطفيل خفض معنوى فى نسب الإصابة بديدان اللوز مقارنة بمناطق استخدام المبيدات فى نفس مواقع العمل. تراوحت نسب الخفض فى الإصابة بديدان اللوز بين ٤٨٠٦ – ٥٦٠٥ % و ١٦٠٤ – ٢١٠٧ % عند إطلاق الطفيل مبكرا أثناء مرحلة التزهير وبعد عدة أسابيع متأخرا فى مرحلة تكوين اللوز، على التوالى. بلغ الخفض فى عدد مرات استخدام المبيدات فى مناطق إطلاق الطفيل حوالى النصف وبالتالى انخفضت تكاليف المكافحة الكيماوية بنسب تراوحت بين ٢٩٠٣ – ٣٦ %. وأيضا بلغ متوسط وزن اللوزة ٣٠١٤ و ٢٠٨٢ جرام فى مناطق إطلاق الطفيل واستخدام المبيدات، على التوالى.