

Evaluation of the Number of Releases of the Egg Parasitoid, *Trichogramma evanescens* West. in Suppressing the Spiny Bollworm, *Earias insulana* (Boisd.) Infestation in El-Farafra Cotton Fields, New Valley Governorate, Egypt

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ABSTRACT

Five and six releases of *Trichogramma evanescens* West. were applied at El-Amal village and El-Masraf localities, respectively in El-Farafra, New Valley Governorate, Egypt, to evaluate their efficacy in suppressing the spiny bollworm *Earias insulana* (Boisd) infestation during 2004 cotton season. 22 *Trichogramma* cards were prepared and distributed in cotton fields to produce 17600 adult females in 2 waves/feddans/release. No significant differences were found between the two rates in suppressing bollworm infestation or in crop yield. The five *Trichogramma* releases presented 76.92% final mean reduction in boll infestation compared with 83.97% resulted from the six releases. Cotton yield loss was 13.17% in the five releases field compared with 12.05% in the six releases one. Accordingly five *Trichogramma* releases were economically and more acceptable to be used in El-Farafra cotton fields.

Key words: *Trichogramma evanescens*, number of releases, cotton, El-Farafra, Egypt.

INTRODUCTION

New Valley Governorate locates in the southwestern part of the Egyptian western desert. It has three main depressions called El-Farafra, El-Dakhla and El-Kharga Oases parallel to the Nile valley and far from the west direction by about 200 to 300 Km. El-Farafra Oasis irrigation system depends on ground (limited source) water, agricultural extension of cotton crop is strongly advocated due to its moderate water supplement. Decision makers in the Egyptian Ministry of Agriculture banned all conventional insecticides from use in the New Valley Governorate to be a chemical free zone; consequently biological control strategy is one of the safe solutions to limit harmful side effects of agricultural insecticides.

Aphis gossypii Glovet, *Pectinophora gossypiella* Saund., *Earias insulana* (Boisd.), *Nezara viridula* L., *Eusarcotis ventralis* West. and *Graptostethus servus* F. were recorded attacking cotton bolls in El-Farafra cotton plantations (Abdel-Rahman *et al.*, 2007). Abd El-Hafez and Nada (2000) studied the distance between the release points and found that increasing the distance between the release points and the target host decreased the capacity of parasitism by the emerged parasitoids. During 2003 and 2004 cotton seasons, *Trichogramma evanescens* West. dependant control program with five biweekly releases successfully declined the total larval populations of the spiny bollworm, *Earias insulana* (Abd El-Rahman *et al.*, 2008).

The present study aimed to study the effect of

number of *Trichogramma* releases in suppressing the spiny bollworm infestation in El-Farafra cotton fields.

MATERIALS AND METHODS

I- Study sites

The present study was conducted in El-Farafra Oasis during 2004 cotton growing season, at two localities; El-Amal village (located in El-Kefah region) and El-Masraf area (located in El-Lew'a Sobeh village). Each area was three feddans (feddan = 4200 m²) for *Trichogramma* release. Another cotton field of two feddans, without *Trichogramma* releases was considered as untreated check area. The release area was far from the control by about 3 Km. Each field was divided into four plots representing four treatment replicates. Cotton variety Giza 83 was sown on April 20th. Regular conventional agricultural practices were normally performed in all experimental plots.

II- Releasing the egg parasitoid, *Trichogramma evanescens* Westwood

T. evanescens egg parasitoid cards (envelops) were prepared and released in an inundative manner as described by Abd El-Rahman *et al.* (2008). The first appearance of a male moth in pheromone trap gave an indication of the beginning of female ovipositional season, which must be urgently combined with the distribution of *Trichogramma* cards (Hassan, 1982). At El-Amal village, five *Trichogramma* releases in biweekly intervals were practiced starting from June 26th until August 24th.

The six *Trichogramma* releases at El-Masraf locality started from June 26th till September 7th in 12 days intervals. Releases were applied into the field inside thick paper envelopes (8 x 12 cm). Distances between releasing points were 14 m and started 7 m from the edges of the field. Accordingly, 22 envelopes were needed per feddan. Each envelope contained two ages of parasitized eggs (1 and 3 days before adult emergence) to produce two waves each of 400 adult female wasps. That produced 17600 adult females /feddan/release.

Evaluation of *Trichogramma* releases and their effects on crop yield were estimated as previously described by Abd El-Rahman *et al.*, (2008). Random samples, each of 100 green bolls were weekly collected from treated and untreated check (control) fields. The loss in crop yield was determined using El-Saadany *et al.* (1975) equations. T-test was used to compare between the two releasing rates (Snedcor 1966).

RESULTS AND DISCUSSION

During the whole study period, SBW, *E. insulana* was the major cotton pest with minor representation of *P. gossypiella*. Accordingly, larval stage of *E. insulana* was considered at the subsequent results whereas that of *P. gossypiella* was stated upon its appearance.

1- Effect on boll infestation

a. Five *Trichogramma* releases in El-Amal village locality

Before the onset of *Trichogramma* releasing program on June 26th (Table 1), the collected cotton boll samples from all experimental areas were free from bollworms' infestation. The first release of *Trichogramma* was made on June 26th. Seven days

later (the 2nd inspection), two small young larvae were recorded in cotton boll samples from *Trichogramma* treated plot, while those of control plot were 4 larvae (3 young and 1 medium) achieving 50 % infestation reduction. According to the proposed program, treated area received the second *Trichogramma* release on July 11th. The SBW population increased in control samples to reach 8 larvae opposing to one medium sized larva in *Trichogramma* samples, showing 87.5% reduction in cotton boll infestation as a result of *Trichogramma* release. Upon applying the 3rd release on July 25th, *Trichogramma* was able to decrease SBW population by 75 % than control. At the following inspection dates and up to the end of the season (mid. Sep.), the number of infested bolls increased in the untreated plots showing 50 larvae in the last inspection date (Sep. 8th) as compared with only 12 larvae in the treated field (Table 1 and Fig 1). By the end of the season, the total number of larvae detected all over the season in the five *Trichogramma* releases field samples was 63 SBW larvae opposing to 346 larvae in the untreated one giving 77.17% whole mean reduction in infestation.

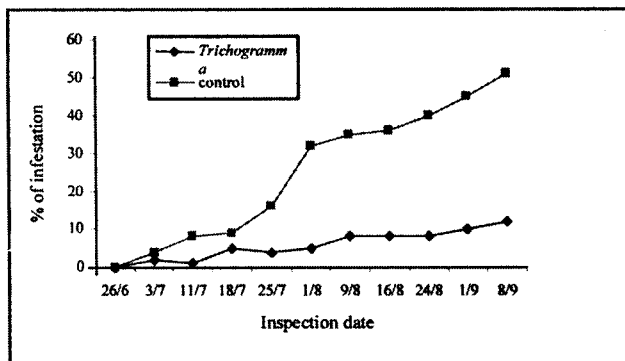
This result was confirmed as in Fig. (2) when the percent infestation reduction was plotted against the inspection dates as a more or less linear trend was achieved parallel to the x axis. This means that released parasitoid successfully caused an equilibrium status with the pest population and effectively suppressed cotton boll infestation across the whole season.

b. Six *Trichogramma* releases in El-Masraf locality

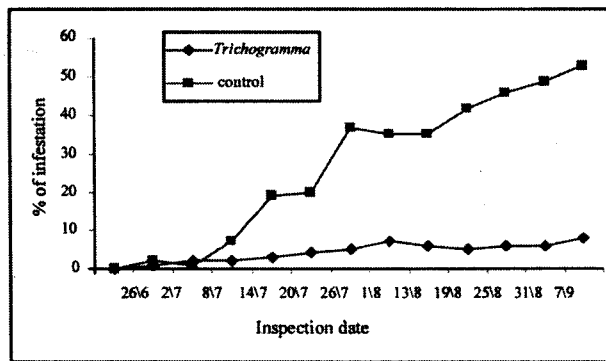
Comparable to the results obtained in El-Amal village field (received 5 *Trichogramma* releases), the same trend was achieved in El-Masraf locality (received 6 releases) where *Trichogramma* was

Table (1): Efficiency of five releases of *Trichogramma evanescens* on suppressing *E. insulana* infestation at El-Amal village, El-Farafra Oasis. (Larval content/ 100 cotton bolls)

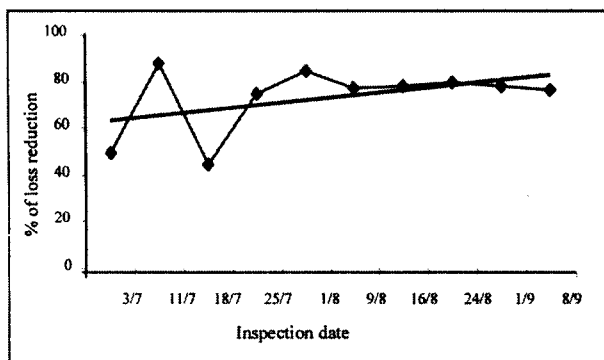
No. of releases	Inspection date	Treated				Untreated				% Reduction
		Small	Medium	Large	Total	Small	Medium	Large	Total	
1 st	26/6	0	0	0	0	0	0	0	0	---
	3/7	2	0	0	2	3	1	0	4	50.00
2 nd	11/7	0	1	0	1	5	2	1	8	87.50
	18/7	3	1	1	5	4	3	2	9	44.44
3 rd	25/7	2	2	0	4	9	4	3	16	75.00
	1/8	2	1	2	5	12	11	9	32	84.38
4 th	9/8	3	2	3	8	10	13	12	35	77.14
	16/8	2	3	3	8	14	10	11	35	77.14
5 th	24/8	3	3	2	8	12	12	15	39	79.49
	1/9	4	3	3	10	12	18	15	45	77.78
	8/9	5	3	4	12	14	17	19	50	76.00
Total		26	19	18	63	95	91	87	273	76.92
Mean					5.73				24.82	



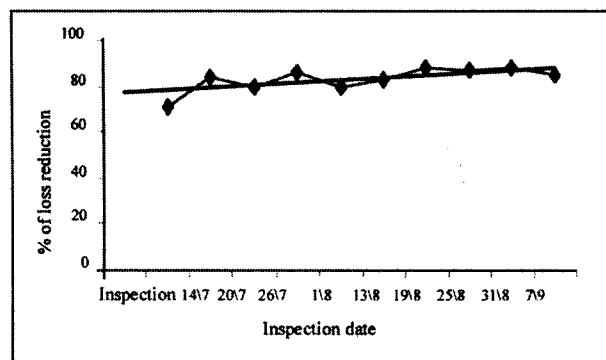
El-Amal village locality



El-Masraf locality

Fig. (1): Efficiency of *T. evanescens* releases in suppressing infestation with spiny bollworm.

El-Amal village locality



El-Masraf locality

Fig. (2): General trend of the efficiency of *T. evanescens* on the percent of crop losses.

effectively able to reduce the pest population. In *Trichogramma* releases, 55 SBW larvae were detected opposing to 346 larvae (343 SBW and 3 small PBW) in control one. So, *T. evanescens* was able to reduce the total infestation to be less than one sixth of that of control giving 84.1% whole mean reduction in infestation.

The graphical representation of inspection dates versus the percent of infestation reduction (Fig. 2) had a linear trend more or less parallel to the x axis, i.e. populations of spiny bollworm neither eradicated nor outbreaked but a status of balance was established between them and augmented parasitoid.

2- Loss assessment in crop yield.

a. Five *Trichogramma* releases in El-Amal village locality.

To confirm the efficacy of *Trichogramma* based program in suppressing population built up of SBW, crop loss assessment within both treated and control areas was considered. Data presented in Table (3) show that the overall number of cotton bolls in both treated and control plots were 1546 and 1554 bolls/100 plants, respectively. The respective total numbers of opened locks were calculated as 4230 and 3498 locks. The calculated total healthy locks were 3737.73 and 2320.98, respectively. Percentage of crop losses was estimated as 13.17% in

Trichogramma field, opposing to 50.71 % in the control one. i.e. crop loss percentage in the treated area was reduced by about one fourth of its value in the control one.

b. Six *Trichogramma* releases in El-Masraf locality

Table (3) represents the loss in cotton yield in the field received six *Trichogramma* releases in El-Masraf locality. At the end of *Trichogramma* release, the percent of cotton crop losses was 12.05% opposing to 51.26 % in the untreated plot that is about one fourth of its value in the control treatment.

Loss assessment in crop yield in the two cotton fields was used to compare the efficacy of the 5 and 6 *Trichogramma* releases (fig. 3). Although the five *Trichogramma* releases in the cotton field at El-Amal village gave 76.92% final mean reduction in boll infestation compared with 83.97% for the six releases at El-Masraf area (Tables 1 and 2). Statistical analysis showed no significant difference between most of the examined boll categories (Table 4). The number of 2/3 opened bolls was the only boll category significantly higher in El-Amal village with 220 bolls (14.23% of the total examined bolls) compared with 152 bolls (9.67%) in El-Masraf area. The full opened bolls and the 1/3 and the 2/3 opened ones were the effective boll categories in

Table (2): Efficacy of six releases of *Trichogramma evanescens* on suppressing *E. insulana* infestation at El-Masraf locality, El-Farafra Oasis (Larval content/ 100 cotton bolls).

No. of releases	Inspection date	Treated				Untreated				% Reduction
		Small	Medium	Large	Total	Small	Medium	Large	Total	
1 st	26/6	0	0	0	0	0	0	0	0	---
	2/7	1	0	0	1	2	0	0	2	50.00
2 nd	8/7	2	0	0	2	1	0	0	1	100.00
	14/7	0	2	0	2	3	2	2	7	71.43
3 rd	20/7	0	1	1	3	7	5	7	19	84.21
	26/7	2	1	1	4	8	5	7	20	80.00
4 th	1/8	2	2	1	5	10	12	15	37	86.49
	7/8	3	2	2	7	12	13	10	35	80.00
5 th	13/8	2	2	2	6	8	13	13	34	82.35
	19/8	2	1	2	5	11	14	16	41	87.80
6 th	25/8	2	1	3	6	15	13	18	46	86.96
	31/8	3	1	2	6	16	17	16	49	87.76
	7/9	4	3	1	8	11	19	22	52	84.62
Total		24	16	15	55	104	113	126	343	83.97
Mean					4.23				26.38	

Table (3): Loss assessment in cotton yield as affected by *T. evanescens* releases. (Total bolls/ 100 plants)

Parameter	Five releases		Six releases	
	<i>Trichogramma</i>	Control	<i>Trichogramma</i>	Control
Total number of bolls in sample	1546	1554	1572	1666
Number of full opened bolls	1028	434	1112	490
Number of bolls 1/3 opened	110	366	138	454
Number of bolls 2/3 opened	220	298	152	336
Number of non opened bolls	136	388	126	334
Number of green bolls	52	68	44	52
% of full opened bolls	66.49	27.93	70.74	29.41
The expected number of green bolls which will be opened	34.58	18.99	31.125	15.29
Total full opened bolls	1062.58	452.99	1143.12	505.29
Number of actually opened bolls	1245.91	773.66	1290.46	880.63
Total number of opened locks*	4230	3498	4338	3996
Number of healthy locks	3737.73	2320.98	3871.37	2641.88
% of losses	13.17	50.71	12.05	51.26

* Total number of opened locks = (Total number of bolls – Number of non opened bolls) X 3

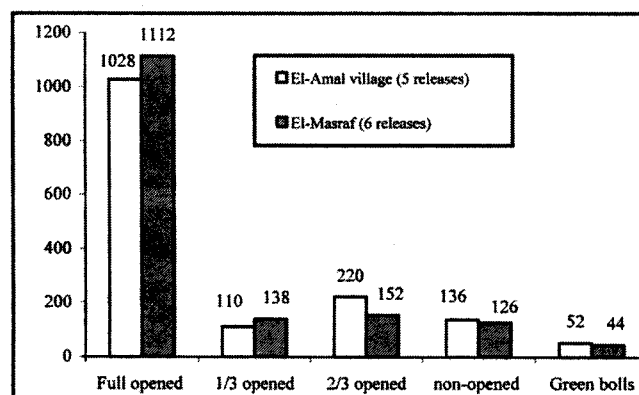
Fig. (3): Effect of different *T. evanescens* releasing rates on the categorized cotton bolls.

Table (4): Effect of different releasing rates on the categorized cotton bolls.

No. of releases	Total bolls	Number of matured bolls				Number of green bolls	% of loss
		Full opened bolls	1/3 opened bolls	2/3 opened bolls	non-pened bolls		
5 releases	1546	1028 (66.49%)	110 (7.12%)	220 (14.23%)	136 (8.80%)	52 (3.36%)	13.17
6 releases	1572	1112 (70.74%)	138 (8.78%)	152 (9.67%)	126 (8.02%)	44 (2.80%)	12.05
T test	NS	NS	NS	S	NS	NS	

* Numbers between packets represented the percentage of each boll category from the total bolls.

S = Significant

NS = Not Significant.

determining the losses in cotton yield. There was no significant difference between the two treatments in their full and 1/3 opened bolls. 1028 full opened bolls (66.49%) and 110 one third open bolls (7.12%) were found in the five releases field, while 1112 full opened bolls (70.74%) and 138 one third open bolls (8.78%) were obtained from the other treatment. These findings were reflected in the comparable percentages of cotton crop loss in the two fields as it was 13.17% in the five releases field compared with 12.05% in the six releases one which proved that no significant difference was found between the two treatments in suppressing bollworm infestation or in their negative effect in crop yield in El-Farafra cotton fields. Accordingly, five *Trichogramma* releases were more economically acceptable to be used in El-Farafra cotton fields than the six releases. These findings were in accordance with those of Brad and Nathaniel (2004) who found that releasing *Trichogramma* with high rate might not be the best use of funds because released wasps did not significantly increase egg mortality, so low release rates may be the most cost effective method as comparable net benefits was attained by using medium or high releasing rates. In harmony, Smith (1996) stated that, high rates of parasitoid releases were not always the case of better parasitism. El-Heneidy *et.al.* (2004) in middle of the Delta, Egypt, found that four parasitoid releases reduced cotton bollworms infestation by 56.5% when they were conducted during the flowering stage. In the parasitoid release areas, number of insecticidal applications was reduced to almost the half. One cotton boll weight averaged 3.14 and 2.82 gm in the *T. evanescens* release and insecticide areas, respectively.

REFERENCES

- Abd El-Hafez, Alia and M. A. Nada 2000. Augmentation of *Trichogrammatoidea bactrae* Nagaraja in the IPM programs for control of pink bollworm, *Pectinophora gossypiella* (Saund.) in Egypt. Beltwide Cotton Conf., Cotton Insect Research and Control Conference, 1009-1014
- Abd El-Rahman, A.G.; Baraka, M. Refaie; Bahira, M. El-Sawaf; Alia, M. Abd El-Hafez and A. I. Imam 2007. Estimation of arthropod composition of El-Farafra Oasis cotton plantations. a- Survey of cotton arthropods harbored El-Farafra cotton plantations. The Second International Conference of Economic Entomology, 8-11 Dec., 2007, Cairo, Egypt.
- Abd El-Rahman, A. G.; Alia M. Abd El-Hafez; Bahira M. El-Sawaf, Baraka M. Refaie and A. I. Imam (2008). Efficacy of the Egg Parasitoid, *Trichogramma evanescens* West. in Suppressing Spiny Bollworm, *Earias insulana* (Boisd.) Infestation in El-Farafra Cotton Fields, New Valley Governorate, Egypt, Egypt, J. Biological Pest Control, 18(2), 2008, 265-269
- Brad, S. and P. Nathaniel 2004. Evaluations of different releases rates of *Trichogramma pretiosum* against *Helicoverpa armigera* eggs in sorghum and cotton. 11th Australian Cotton Conf. Proc., 10 -12 August.
- El-Heneidy, A. H., A. A. Khidr, A.M. Matter, A. B. Abdel-Halim and M. E. Hegab 2004: Proper timing and number of releases of the egg parasitoid, *Trichogramma evanescens* West. for controlling the cotton bollworms in Egyptian cotton fields. 1st. Arab Conference of Applied Biological Pest Control, Cairo, Egypt, 5-7 April 2004.
- El-Saadany, G. B.; M. F. El-Sharawy and A. El-Refaei 1975. Determination of the loss in cotton yield as being affected by the pink bollworm, *Pectinophora gossypiella* (Saund.) and the spiny bollworm, *Earias insulana* (Boisd.). Z. ang. Entomol., 79 (4): 357-360.
- Hassan, S. A. 1982. Mass production and utilization of *Trichogramma*. Results of some research projects related to the practical use in the Federal Republic of Germany. In: Les Trichogrammes, Ier Symposium International, Antibes, France. Les colloques de I, INRA 9: 213-218.
- Smith, S. M 1996. Biological control with *Trichogramma*: Advances, successes, and potential of their use. Annu. Rev. Entomol, 41: 1-32.
- Snedcor, G. W. 1966. Statistical Methods, 5th Ed. The Iowa State University Press, Ames. Iowa. USA, pp. 534.