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Controlling *Pectinophora gossypiella* and *Earias insulana* in Cotton Filed by the 12th Generations of *Trichogramma evanescens* Reared in Normal Conditions in the Laboratory

Mohamed, S.M. Salem
Plant Protection Research Institute, Agriculture Research Center, Dokki, Giza, Egypt
*****E-Mail : Salem.Mohamed@arc.sci.eg

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ABSTRACT

A field trial was done at 2018-2019 cotton seasons to evaluate the parasitoid of *Trichogramma evanescens* (Westwood) local strain which rearing for 12th generation under normal conditions in the laboratory; compared with the conventional insecticide applications profenofos (organophosphorus compound); for controlling the two pests pink bollworm, *Pectinophora gossypiella* (Saund.) and spiny bollworm, *Earias insulana* (Boisd.) on infested cotton green bolls. The real control effect (pest population and infestation reductions percentages) by *T. evanescens* was determined through the weekly infestation level of green cotton bolls comparing with the control. When *T. evanescens* was released in comparison with profenofos insecticide treatment, caused more reduction of pink and spiny bollworms infestation when used as 3&5 cards than profenofos comparing with untreated at two seasons, respectively. Pest control by releasing *T. evanescens* levels was relatively lower as 1 card parasitoid than 3 as well as 5 cards. Also, the infestation reduction was high when this parasitoid was releasing in cotton earlier in the season without any other control agents.

The obtained results show that the release of *T. evanescens* to control pink and spiny bollworms is biologically effective and could be used as an important agent in integrated pest management programs.

INTRODUCTION

In Egypt, up to now the pink and spiny bollworms considerable the major pests of cotton, the infestation in cotton by two pests increasing day-by-day (Naranjo, 1993). The two pests' lays eggs on squares, flowers and green bolls where the destructive larvae of pink or spiny bollworm usually devour flower buds, bolls and seeds therein (Kandil, 2001)

The increase in used the chemical insecticides for controlling insect pests on cotton plants resulted in many side effects such as; pollution in the air, increase pesticide residues in agriculture crops and their products to residue toxicity on crops, in addition, pest resistance to various classes of pesticides. The excessive use of pesticides, particularly those with long residual effects, has caused several harms to the natural balance between pests and their natural enemies (Amr and Marei, 2001).

There are a growing necessity and interest in the use of biological control agents in cotton fields for the management of insect pests. The integrated pest management control

program (IPM) program in cotton fields when the parasitoid (trichogrammatid egg parasites) released in combination with insecticides or released only become worldwide against many lepidopterous especially the pink and spiny bollworms pests(Hassan, 1994).

In our studies, used three different developmental stages of *Trichogramma evanescens* in each field release card, it's important for controlling the many lepidopterous especially the pink and spiny bollworms pests and/ or on several key crops (Newton, 1993, Abd El-Hafez *et al.*, 2007, Abd El-Hafez *et al.,* 2002 and Shalaby *et al.,* 2002 and Ahmad *et al.,* 2005 and Dannon *et al.,* 2010). The parasitoid, *T. evanescens* used successfully for controlling the pink and spiny in cotton fields not only in Egypt but also in many other countries (El-Nemaky, 2012 and Darwish *et al.,* (2017). Also, Niño María *et al.,* (2011): Efficiency of three species of the genus Trichogramma for the control of *Spodoptera frugiperda*, *Copitarsia decolora* and *Physalis peruviana* crops. In addition, Chlnna Babu Naik (2019) released the trichogrammatid egg parasites in the cotton field for the management of *Pectinophora gossypiella* (Saund).

The objective of this study was conducted to evaluate the efficacy of role the parasitoid local strain, *T. evanescens* for Management the *P. gossypiella* and *E. insulana* bollworms infestation, when used at the early season as 1, 3 & 5 cards parasitoid releasing comparing with profenofos (or ganophosphorus compound) application and untreated plot area.

MATERIALS AND METHODS

Experiments Laboratory:

1.Stock culture hosts or parasite was carried out under laboratory condition of Bollworm Department Research, in the Department of Plant Protection Research Institute, Agriculture Research Center (ARC), Table 1. The tested insect hosts were laboratory-reared for experiments were carried out at 25±1°C, and relative humidity, 65±5 %.

2. Rearing Technique Hosts And Parasitoid:

2.1. *Sitotroga cerealella* (laboratory strain):

The stock culture of angoumois grain moth, *Sitotroga cerealella* (Oliv.) eggs; it was reared by the method described by El-Sharkawy (2020) which was a modification of Hassan (1995). The eggs were used as laboratory factitious host for the species of *T. evanescens* parasitoid, Table 1.

2.2. The culture of *P. gossypiella* (Saunders) and *E. insulana*, eggs used in this experiment was obtained from laboratory rearing on an artificial diet that was previously described by (Amer 2015), for several generations away from any contamination with insecticides, Table 1.

2.3.Mass Rearing Parasite Technique:

For mass rearing the parasitoid; *S. cerealella* eggs < 24 hr old were glued to paper cards (10x15 cm.) and exposed to *T. evanescens* adults in glass jars (2-liters capacity) provided with 10% sucrose solution for the adult parasite nutrition and covered with cloth-wrapped cotton kept in position by a rubber band. The egg sheets were renewed daily to avoid super-parasitism and the parasitized egg sheets were kept in clean glass jars.

Table 1: English and bionomical name experimental insect used.

English name	Bionomical name	Family	Order
Pink Bollworm	*Pectinophora gossypiella* (Saunders)	Gelechiidae	Lepidoptera
Spiny Bollworm	*Earias insulana* (Boisduval)	Noctuidae	Lepidoptera
Angoumois grain moth	*Sitotroga cerealella* (Oliv.)	Gelechiidae	Lepidoptera
Parasitic Wasp	*Trichogramma evanescens* Westwood	Trichogrammatidae	Hymenoptera

Prepared the *Trichogramma evanescens* Card For Field Application:

The release *Trichogramma evanescens* card consists of thick paper (6 x 8cm) folded to make a closed container of 4 x 6 cm. (about 500 parasitoids/ each). Each vial contained three ages of parasitized eggs, (1, 3 & 5 days before emergence) and was glued in this container; so parasitoid adults could emerge in three waves, every other day. Thus, the total number of parasitoids/cards was about 1500 parasitoids. The emergence of parasitoid's waves begins within 12-24 h after release and continues through six days, this is the first generation rearing in normal weather conditions in the laboratory, this considers the first generation reared in normal conditions in the laboratory, more than 80 % of this 1st generation can't surviving in normal conditions but less 20 % of this generation continues to the 2nd generation, the individuals surviving from the 2nd generation reached to the 3rd generation and so on until reached to the 12th generation which was the stronger and all the adults surviving in the natural conditions.

Field Application:

A field experiment was conducted at Plant Protection Research Institute Experimental Station, Qaha district, Qalubeia Governorate, Egypt during two successive cotton (Giza 86 variety, 2017 strain) growing seasons 2018 and 2019. The parasitoid of *T. evanescens* was released when insect pests of pink bollworm, *P. gossypiella* (Saunders) and/ or *E. insulana* (Boisd.) (it started 15 Jun) depending on infestation 1% in each one or both of them in green cotton bolls. The cards containing parasitized eggs of *T. evanescens* glued on cards were hanged on the cotton plants, using pieces of wire. The experimental was done as follows:

A. *T. evanescens* was releasing as one card/ plot area (1Kirate, 175 m)/ distributed as release points that were 7m and started 3.5m from the edges of the field.

B. *T. evanescens* was releasing as 3 cards/ plot area/ distributed as previously mentioned.

C. *T. evanescens* was releasing as 5 cards/ plot area/ distributed as previously mentioned.

- All cards were hand-placed (before the sunset) on 0.5m above the soil surface.

D. Insecticidal applications (Plot insecticidal): Plot area for profenofos application (Actacron) 72% EC, 750 cm3/ Fadden); it started late June (29 June) depending on recommended infestation threshold level (3%). The applied insecticides; profenofos were sprayed three times by using a Kubota knapsack motor sprayer with 20 liters of water capacity.

E. The plot area for untreated as a control.

Green bolls' Infestation And Reduction:

Population fluctuation of Pink and spiny bollworms, based on the number of larvae and rate of infestation in cotton green bolls, was estimated during the 2 successive cotton seasons, 2018 and 2019. Samples (100 green bolls/ treatment) were picked randomly up weekly from each plot area treatment. The bolls were inspected in the laboratory to check up the PBW and SPW larvae and/or their damages. The weekly number of larvae at each treatment and percentages of infestation were counted in the two seasons. In addition, the reduction in the infestation was estimated by using Henderson and Tilton equation (1955).

While analyses of variance (ANOVA) were conducted on data of the two seasons in each experiment and when statistical differences existed within a data set, Duncan's multiple range test was used to separate the means.

RESULTS AND DISCUSSION

A field trial release for the efficacy of the eggs parasitoid, *Trichogramma evanescens* used alone compared with the insecticide applications against the pink bollworm, *Pectinophora gossypiella* (Saund.) and spiny bollworm, *Earias insulana* (Boisd.) was evaluated during the two cotton-growing seasons, 2018 and 2019. Data summarized in **table 2**, recorded that the efficacy of *T. evanescens* used as 1, 3 and 5 cards, each card had *T. evanescens* (as a parasitoid in *Sitotroga cerealella* egg). In addition, the insecticidal treatment was recorded in late June (29 June) and 1st week in July depending on the recommended infestation of *P. gossypiella* and *E. insulana* threshold level (4%).

Table 2: Reduction percentages for larval of the pink and spiny bollworms during releases the *Trichogramma evanescens* and application insect compound at 2018 cotton season.

Dates	Control		1 card		3 cards		5 cards		Profenofos	
	P.	E.	P.	E.	P.	E.	P.	E.	P.	E.
Larval population reductions%										
15/6	1	1	100	100	100	100	100	100	-	-
22/6	1	1	100	100	100	100	100	100	-	-
29/6	4	2	100	100	100	100	100	100	-	-
6/7	6	4	83.3	75	100	100	100	100	70	70
13/7	10	10	70	70	100	100	100	100	74	72
20/7	15	15	66.7	66.7	100	100	100	100	72	70
27/7	27	23	59.3	52.2	100	100	100	100	79.5	78
3/8	28	27	50	48.2	96.4	96.3	96.4	96.3	82.5	80
10/8	32	29	53.1	44.8	96.9	96.6	96.9	96.6	80.8	80
17/8	35	30	48.6	33.3	94.3	93.3	94.3	93.3	84.1	82
24/8	37	33	45.9	39.4	94.6	93.9	94.6	93.9	88.8	85
1/9	40	35	45	37.2	95	94.3	95	94.3	86.5	87
Seasonal Average	19.7	17.5	68.5	63.9	98.1	97.9	98.1	97.9	79.8	78.2

P= *Pectinophora gossypiella* (Saund.) E= *Earias insulana* (Boisd.)

Cotton Season 2018:

Larval Population Reduction:

The pink and spiny bollworms larval population/100 (no. of larvae/ in green bolls/ 100) green cotton bolls ranged beginning from one larvae/ 100 bolls to 40 larvae of *P gossypiella* and 35 of *E. insulana* larvae/ 100 bolls, with seasonal average was 19.7 and 17.5 for pink and spiny bollworms were recorded at the end of cotton season, 2018, Table 2. When *T. evanescens* was released as 1 card used, the larval population reduction percentages ranged influence from 83.3 and 75% at the first cotton season (6 July) to 45 and 37.2% at the end of season (the first week in Sebtember). The seasonal average was 68.5 and 63.9% for pink and spiny bollworms, respectively. In addition, when applied, conventional insecticide Profenofos, caused the increase in both larval population reduction percentages influenced between 70 to 89.5 larvae of *P gossypiella* / 100 bolls and between 70 to 87% reduction in populations of the spiny bollworms. The seasonal average was 79.8 and 78.2 in *E. insulana* (at first week in July until 1st week in September).

On the other hand, *T. evanescens* was released like 3 or 5 cards used, the pink and spiny bollworms population reductions were increased. It recorded 100% at the first cotton season (15/6 until 27/7) to 95 and 94.3% at the end of the cotton season, with, a seasonal average of 98.1and 97.9% for the pink and spiny bollworms as described in **Table 2**. The data mentioned that the population reduction percentages of both pink and spiny bollworms in the treatments of *T. evanescens* that had 3 cards as well as reductions in 5 cards treatments, Also, data show that the influence in Larval population reductions% from the end week in July until the first week in September

Infestation Reductions:

Table 3 demonstrated that pink and spiny bollworms infestation were ranged from one infested boll/ 100 green boll with 100% reductions at 1st cotton season (from 15/6) to 63.3 and 65.5% infestation reduction/ 100 green bolls at the end of the cotton season (1/9), with seasonal average of 67.3 and 67.9% for the pink and spiny bollworms, respectively. Two pests infestation were reducing ranged from 100% at 1st season to 93.3 and 93.1% at the end of cotton season with seasonal average of 97.5 and 97.1% when 3 or 5 cards of *T. evanescens* released for pink and spiny bollworms. While it ranged from 100% at 1st season to 93.3 and 93.1% infestation reductions for pink and spiny bollworms at the end of cotton seasons as shown in Table 2. The treatments of profenofos reduced the two pests' pink and spiny bollworms infestation to 80.1 and 77.1%, respectively.

Table 3: weekly mean infestation reductions of the pink and spiny bollworms during releases the *Trichogramma evanescens* and application insect compound at 2018 cotton season.

Dates	Control		1 card		3 cards		5 cards		Profenofos	
	P.	E.	P.	E.	P.	E.	P.	E.	P.	E.
Infestation reductions%										
15/6	1	1	100	100	100	100	100	100	-	-
22/6	1	1	100	100	100	100	100	100	-	-
29/6	2	2	100	100	100	100	100	100	-	-
6/7	3	3	66.7	66.7	100	100	100	100	75	72
13/7	6	6	50	50	100	100	100	100	78.8	75
20/7	9	10	55.6	60	100	100	100	100	76.9	73
27/7	16	14	43.8	42.9	100	100	100	100	80	80
3/8	21	17	52.4	52.9	95.2	94.1	95.2	94.1	82	80
10/8	23	20	56.5	60	95.7	95	95.7	95	81	78
17/8	26	23	57.7	56.5	92.3	91.3	92.3	91.3	85	80
24/8	29	25	62.1	60	93.1	92	93.1	92	80	75
1/9	30	29	63.3	65.5	93.3	93.1	93.3	93.1	82.5	81
Seasonal Average	13.9	12.6	67.3	67.9	97.5	97.1	97.5	97.1	80.1	77.1

P= *Pectinophora gossypiella* (Saund.) E= *Earias insulana* (Boisd.)

Cotton Season 2019:

Larval Population Reduction:

The larval population of the pink and spiny bollworms were ranged between 1 larvae/ 100 green cotton bolls at 1st season (15/6) to 40 and 30 larvae for pink and spiny bollworms at the first week of September. The parasitoid of *T. evanescens* contributed to reducing the pest population to range from 100% population reduction at the first cotton season and reached to 55.8 and 47.7% seasonal average for the pink and spiny bollworms population, respectively, reduction percentages at the end of season when 1 card of *T. evanescens* was used in application as in Table 4. In addition, the population reductions were reached to 98.6 & 98.4% when 3 cards, as well as 5 cards of T. evanescens, were used in applications Table

4. On the other hand, profenofos compound caused a 73.3 & 72.9% reduction in the population of the pink and spiny bollworms, respectively.

Table 4: Weekly Larval population (No. of larvae/ in green bolls) and reductions of the pink and spiny bollworms during application *Trichogramma evanescens* with insect compound at 2019 cotton season.

Dates	control		1 card		3 cards		5 cards		Profenofos	
	P.	E.	P.	E.	P.	E.	P.	E.	P.	E.
Larval population reductions%										
15/6	1	1	100	100	100	100	100	100	-	-
22/6	1	1	100	100	100	100	100	100	-	-
29/6	4	3	100	100	100	100	100	100	-	-
6/7	5	5	60	60	100	100	100	100	64	65
13/7	9	7	55.6	42.9	100	100	100	100	68.8	67.5
20/7	15	10	46.7	20	100	100	100	100	66	66.4
27/7	23	20	34.8	25	100	100	100	100	72.5	73
3/8	27	25	44.5	36	100	100	100	100	75.1	75.1
10/8	30	30	33.3	33.3	96.7	96.7	96.7	96.7	73.8	74
17/8	35	30	28.6	16.7	97.1	96.7	97.1	96.7	80.8	80
24/8	35	32	28.6	21.9	94.3	93.8	94.3	93.8	78.8	75
1/9	40	30	37.5	16.7	95	93.3	95	93.3	79.8	80
Seasonal Average	18.8	16.2	55.8	47.7	98.6	98.4	98.6	98.4	73.3	72.9

P= *Pectinophora gossypiella* (Saund.) E= *Earias insulana* (Boisd.)

Infestation Reductions:

As described in Table 5, pink and spiny bollworms infestation reached 33 and 30 infested bolls/ 100 bolls. *T. evanescens* has controlled the two boll pests by releasing as 1 card uses in application to reduce the pest infestations and reached 62.7 and 56.6%. While, *T. evanescens* when released as 3 and 5 cards in the application, the infestation reductions reached 97.6 and 97.3% seasonal average for the pink and spiny bollworms, respectively Table 5. On the other hand, profenofos had infestation reductions of 81.2 & 79.6% for the pink and spiny bollworms.

Results recorded during the 2018 and 2019 seasons in Table 6 showed that the larval population in a green boll and locale damage by spiny bollworm were less significant (17.5 and 16.2 larvae) than pink bollworm (19.7 &18.8 larvae), with high significant difference between in insecticide treatments comparable with *T. evanescens*, when *T. evanescens* was released as 1 card. On contrast no a significant difference between used 3 or 5 cards release in controlled the pink or spiny bollworm during the two seasons.

On the other hand, the parasitoid release was significantly effective as chemical pesticide application; there was a significant difference between the larval populations and damage levels between the two years of study (2018 and 2019) when *T. evanescens* was released as 3 &5 cards. This may be attributed to differences in adult emergence or rate of parasitization, pest density or host egg availability and age of the egg of cards used.

Table 5. Infestation reduction in populations of the pink and spiny bollworms during application the *Trichogramma evanescens* with insect compound at 2019 cotton season.

Dates	Control		1 card		3 cards		5 cards		Profenofos	
	P.	E.	P.	E.	P.	P.	P.	E.	P.	E.
Infestation reductions%										
15/6	1	1	100	100	100	100	100	100	-	-
22/6	1	1	100	100	100	100	100	100	-	-
29/6	3	2	100	100	100	100	100	100	-	-
6/7	4	3	75	66.7	100	100	100	100	80	75
13/7	8	6	62.5	50	100	100	100	100	80	78
20/7	11	10	54.6	50	100	100	100	100	80	80
27/7	18	16	44.5	37.5	100	100	100	100	85	82
3/8	22	20	54.6	50	95.5	95	95.5	95	82	80
10/8	28	20	50	30	96.4	95	96.4	95	83.5	84
17/8	27	25	37.1	32	92.6	92	92.6	92	80	81
24/8	29	27	34.5	29.6	93.1	92.6	93.1	92.6	80	82
1/9	33	30	39.4	33.3	93.9	93.3	93.9	93.3	80	74
Total										
Seasonal Average	15.4	13.4	62.7	56.6	97.6	97.3	97.6	97.3	81.2	79.6

P= *Pectinophora gossypiella* (Saund.) E= *Earias insulana* (Boisd.)

Table 6: Comparative evaluation of *Trichogramma evanescens* (Westwood) with conventional insecticide used in control the *Pectinophora gossypiella* and *Earias insulan*.

Dates of Seasonal Average	Larval population (average)		reductions%		Larval population (average		reductions%	
	2018				2019			
	P.	E.	P.	E.	P.	E.	P.	E.
1 card	19.7b	17.5a	68.5b	63.9a	18.8b	16.2a	55.8a	47.7a
3 cards			98.1c	97.9b			98.6c	98.4c
5 cards			98.1c	97.9b			98.6c	98.4c
Profenofos			79.8a	78.2c			73.3b	72.9b
P			***	***			***	***
LSD	1.013		4.817		0.571		6.33	4.214

P= *Pectinophora gossypiella* (Saund.) E= *Earias insulana* (Boisd.)

Generally at 2018-2019 cotton seasons, reductions in population and infestation of the pink and spiny bollworms by using *T. evanescens* releasing was higher at the first cotton season than the late season, it may be due to the less number in the population and infestation for the two pests. Also, the parasitoid of *T. evanescens* had proved successful control for pink and spiny bollworms when released as 1 card parasitoid application (seasonal average ranged from 47.7 to 68.5%), but the reductions happened was lower than profenofos application (seasonal average ranged from 72.9 to 81.2%). Meanwhile, parasitoid caused the highly reduction in population and infestations of two pests when released as 3 cards as well as 5 cards to range from 97.1 to 98.6% for two pests of the pink and spiny bollworms

controlling since it was able to prevent increasing of pink bollworm population for a period of seven weeks.

Finally, these results clearly that the control rates of pink bollworm or spiny bollworm are much related to the release egg age and numbers of cards used of Trichogramma in control. In conclusion, the local parasitoid, *T. evanescens* appeared to be highly effective against the pink and spiny bollworm particularly when released earlier in the season before the formation of cotton bolls until the end season.

These results show clearly that the control rates of pink bollworm are much related to the release time of Trichogramma. This finding is in agreement with that suggested by Tuhan *et al.*,(1987) In India, found the release of *T. brasilience* at a rate of 20000 newly emerged adults/acre per week in combination with sprays of carbaryl, dimethoate and monocrotophos, significantly, reduced the damage caused to cotton by *Earias insulana, E. vittella* and *P. gossypiella*. In China, Chao *et al.*, (1996) released *T. flavum* to control cotton bollworms (Noctuidae) and found that the release of *T. flavum* was sufficient to control the pests' population during the year of moderate/light incidence of Noctuidae. In Egypt, using the biological control agents *E. insulana* and *P. gossypiella* in cotton fields including Trichogramma considerably intensively directed and supported by the Ministry of Agriculture and Land Reclamation. Abd El-Hafez and Nada (2000) obtained good results when they introduced *T. bactrae* parasitoid and released it in combination with insecticides or released after the termination of the recommended insecticide program at Qalubeia Governorate. In a further study, Shalaby *et al.*, (2002) released *T. bactrae* four times in cotton fields without any insecticidal treatments at Qalyubia Governorate. They found that *T. bactrae* was able to minimize pink and spiny bollworm infestations with the percentage of crop losses. Also, Abd El-Hafez *et al.*, (2002) released four trichogrammatids (*T. embryophagum Hartig, T. brassicae Bezdenko, T. bactrae Nagaraja, and T. evanescens*) after the termination of the insecticide program and found that all 4 parasitoid species were able to suppress the pink bollworm population to below that of control by 64.0- 80.0%. In addition, Abd-El Hafez, *et al.*, (2004) evaluate the role of the local strain of *T. evanescens* in reducing infestation with pink bollworm, *P. gossypiella* (Saund.). When *T. evanescens* was released in combination with insecticide treatment, resulted in a 75.27 and 76.27% reduction in pink bollworm infestation than control in the two seasons, respectively. These levels of control were relatively lower than those determined (82.8 and 83.51%) when this parasitoid was released in cotton earlier in the season without any other control agents. On the other hand, the lowest reduction rates (65.3 and 68.88%) were achieved when Trichogramma was released lately after the termination of the recommended control program.

El-Agamy *et al.*, (2011) used efficient insecticide against *Pectinophora gossypiella* (Saund.) and *Earias insulana* (Boisd.) The result showed that the most efficient insecticide against *P. gossypiella* larvae was sumi-alpha withe a reduction of 80.9, 78.7 and 79.9% in the first spray while in the second spray the reduction was 82.1, 85.2 and 83.7% in the three seasons of study, 2008, 2009, 2010 respectively Biovar and protecto were the least effective compounds in controlling this pest. As for Earias insulana larval population took almost the same trend with sumi-alpha while biovar and protecto were the least effective. Releasing trichograma evanescence Westwood in two waves gave reduction for *P. gossypiella* and *E. insulana* larvae with ranges of 31.7- 44.8 and 23.3 -36.7 % respectively. While, Saad, *et al.*, (2015) releasing the parasitoid, *T. evanescens* alone and with certain pesticides against, *E. insulana* infestation in early and late cotton cultivation and the reflection on the cotton yield. The results revealed that the treatment of *T. evanescens*+ fipronil gave the lowest infestation (1.56 and 2.30 larvae/100 bolls) for early and late-sown plants, respectively. On the other hand, the release of *T. evanescens* alone gave the highest infestation with an

average of 4.14 and 5.39 larvae/100 bolls for early and late sown plants compared with untreated check-in 2013 season. However, *T. evanescens* alone was less effective on the spiny bollworm with an average infestation of 4.86 &5.39 larvae /100 boll in both early and late-sown plants. While the treatment of indoxacarb with the release of *T. evanescens* gave the lowest infestation (2.25 & 2.72 larvae/100bools) in both early and late-sown cotton plants compared with the untreated check-in 2014 season.

While, Mohamed, *et al.,* (2016) revealed that different rates of releases *T. evanescens* at the two different application dates showed a significant reduction in % of infestation in green bolls; with PBW (12.54 to 66.36 and 43.74 to 90.03%) and (18.95 to 62.17 and 59.1 to 93.03%) with SBW as compared to control (untreated) in 2013 and 2014, respectively. Moreover, 4-releases early at) < 50%(flowering stage succeeded to suppress the infestation with PBW by (66.36 and 90.03%) in the two seasons, respectively. For SBW, the 4-releases caused a higher reduction in the infestation in the 2nd season (93.09%), opposed to (50%) in the 1st one. Thus, 4-releases of the parasitoid caused (58.18 and 91.56%) the overall mean of reduction in populations of the two cotton pests throughout the two cotton seasons, respectively. pest infestation and high yield. In addition, Darwish *et al.*, (2017) found that the releasing of egg parasitoid, *T. evanescens* (Hymenoptera: and/or mass trapping of the male moths of PBW compared with insecticide caused reduction percentages in green boll infestation by (30.65 and 43.1% in season, 2013 and 37.66 and 49.77% in season, 2014), respectively, opposed to (37.78 and 47.30%) at the insecticide application plot. Also, Ahmad *et al.,* (2005) supported also the results obtained in this study. They carried out trials in Pakistan to evaluate a release of egg parasitoid, *Trichogramma chilonis* in conjugation with pheromone to suppress the infestation with cotton bollworm, *Earias sp*. in cotton fields. They stated that the treatment of parasitoids in combination with pheromones suppressed bollworm infestation effectively. Naik, *et al.,* (2019) evaluated the efficacy of egg parasitoid *Trichogramma bactrae* (Negaraja) and *T. barasiliensis* (Ashmead) along and with insecticides as check for management of cotton pink bollworm. The infestation of both bollworms *P. gossypiella* and *E. insulana* larvae in the boll or locale damage was significantly lower in insecticides treated plots comparable with *T. bactrae* and *T. brasiliensis* released plots.

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ARABIC SUMMARY

مكافحة دودتى اللوز القرنفلية والشوكية فى الحقل بإستخدام الجيل الثانى عشر من طفيل *Trichogramma evanescens* المربى تحت الظروف الطبيعية فى المعمل

محمد سالم محمد سالم

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى ، الجيزة.

اجريت تجربة حلقية خلال موسمى 2018و 2019 على نبات القطن لتقييم طفيل *Trichogramma evanescens* والذى تم تربية فى الظروف الطبيعية فى المعمل بعيدا عن الحضانة إلى أن حصلنا على أقوى جيل يستطيع التأقلم مع الظروف الطبيعية وكان هو الجيل الثانى عشر من التربية على حشرتى اللوز القرنفلية والشوكية مقارنا بمبيد profenofos وال control.

أظهر الجيل الثانى عشر من *Trichogramma evanescens* المربى تحت الظروف الطبيعية فى المعمل أعلى كفاءة عند 3 و 5 كروت على خفض نسبة الاصابة بدودتى اللوز القرنفلية والشوكية إلى أقل معدل مقارنا بمبيد profenofos.

ولذلك يجب استخدام *Trichogramma evanescens* كعامل مهم في برامج المكافحة المتكاملة للآفات.