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EFFECTIVENESS OF *TRICHOGRAMMA EVANESCENS* WESTWOOD ON CONTROLLING PINK BOLLWORM, *PECTINOPHORA GOSSYPIELLA* (SAUND.) IN COTTON

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Abstract

Field experiments were conducted in 1999-2001 cotton seasons to evaluate the role of the local strain of *Trichogramma evanescens* Westwood in reducing infestation with pink bollworm, *Pectinophora gossypiella* (Saund.). The real control effect of *T. evanescens* was determined through the analysis of the weekly infestation level of green cotton bolls in the release area in relation to the control. The obtained results show that release of *T. evanescens* to control pink bollworm is biologically effective and could be used as an important agent in integrated pest management programs. When *T. evanescens* was released in combination with insecticide treatment, resulted in 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 withought 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. These results show clearly that the control rates of pink bollworm are very related to the release time of *Trichogramma.* In conclusion, the local parasitoid, *T. evanescens* appeared to be highly effective against pink bollworm particularly when released earlier in the season before the formation of cotton bolls.

Introduction

There is a growing necessity and interest in the use of biological agents for management of insect pests. Practical uses of trichogrammatid egg parasites occur worldwide against many lepidopterous pests on several key crops (Smith 1986; Tuhan *et al*. 1987; Newton 1993; Smith 1994; Zandigiacome & Greatti 1997 and Lundgren & Heimpel 2003). In Egypt, control of pests in all cotton fields (except experimental and research station fields) is conducted through a recommended integrated pest management control program (IPM). In the last decade, biological control agents in cotton fields including *Trichogramma* are intensively directed and supported by Ministry of Agriculture and Land Reclamation. First attempts to release *Trichogramma* against pink and spiny bollworms started in Egyptian cotton fields since 1995 (Abd El-Hafez & Nada 2000; Abd El-Hafez *et al*. 2002 and Shalaby *et al.* 2002). Recently (2003 cotton season), the Egyptian Ministry of Agriculture and Land Reclamation applying a new strategy for controlling cotton bollworms depending on releasing *Trichogramma* in cotton fields (personal communication). The present study was conducted with the objectives of determine the role of the local strain, *T. evanescens* in reducing pink bollworm infestation when introduced in the IPM program, when used at the late season following the recommended cotton pests control program and when used alone for controlling this pest. This aimed to add three advantages to the control program. The first is minimizing the use of chemical insecticides which had a harm effect on natural enemies and cause environment pollution. The second is protecting the great quantity of green cotton bolls, which developed lately from infesting with pink bollworm. The third is suppressing the great numbers of pink bollworm larvae, which enter diapause and causing the new infestation in the subsequent season.

Materials and Methods

Rearing Technique

T. evanescens Westwood was reared on angoumois grain moth, *Sitotroga cerealella* (Oliv.) eggs according to the method described by Hassan (1993 and 1995). For efficient mass rearing of 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 nutrition and covered with cloth-wrapped cotton kept in position by rubber band. Egg sheets were renewed daily to avoid super-parasitism and the parasitized egg sheets were kept in clean glass jars. Rearing took place at constant temperature of 25 ± 1°C and 80 ± 5 %R.H.

The Releasing Cards

Trichogramma was released into the field using a release card that protects them from predators and unfavorable weather. The release card consists of thick paper (6 x 8cm) folded to make a closed container of 4 x 6 cm. Three strips of grain moth eggs that contain parasitoid (about 500parasitoids/ each) at three different stages of development (1, 3 & 5 days before emergence) were glued in this container. Thus, the total number of parasitoids/ card was about 1500 parasitoids. Six waves of *Trichogramma* adults emerge from each card with a rate of two waves per each stage. The emergence of parasitoid's waves begins within 12-24h after release and continue through six days. On this way, *Trichogramma* adults cover a control period ranged between 8-10 days according to the longevity of the emerged adults (Abd El-Hafez 2001). Seventy cotton plants/ fed-

dan were selected to serve as release points. The distance between the release points was 7m, and started 3.5 m from the edges of the field. Cards were hand-placed (before the sunset) on a 0.5m above soil surface.

Ten days after release, 5-cards/ feddan were selected at random and recovered to the laboratory where the percentage of broken eggs was calculated to determine the level of parasitoid emergence. The obtained data reveal optimal levels of emergence which are similar to those recorded under laboratory conditions (90-97%). Also, high percentage of females in progeny (62.5-70.0% females) was calculated when samples from released cards were kept to examine in the laboratory. The number of *Trichogramma*/ release/ feddan was selected according to these estimations in addition to our previous study in cotton (Abd El-Hafez & Nada 2000; Abd El-Hafez *et al.* 2002 and Shalaby *et al.* 2002). The target number of parasitoids/ release/ feddan was 60,000 ♀♀ (a rate of 20,000♀♀ from each released stage of *Trichogramma*). Accordingly, about 100,000 parasitoids (unsexed)/ feddan were released in each application. The releasing cards were transported to the field in a cooling box to avoid the adverse effect of hot weather during transportation.

Field Application

Three field experiments were conducted at Sharkia and Qalyubia Governorates during three successive cotton seasons (1999-2001) as follows:

1. Introducing T. evanescens into the Recommended IPM Control Program of Cotton Pests. This experiment was conducted in 1999 and 2000 cotton seasons at Sharkia Governorate, Egypt. The experimental area was 15 feddan for *Trichogramma* release and another identical area for control. The *Trichogramma* release area was selected downwind based on prevailing wind direction for that area. The release area was separated by 5 feddan from the control area to avoid dispersal of released *Trichogramma* into control plots. The cotton-seeds (Giza 85) were planted and cultivated under the same conditions in control and treated area. In the two seasons cottonseeds were planted lately; May 1st and April 25th, respectively. At each season, three releases of *Trichogramma* (on July 24th, August 8th and 22nd)+ one insecticide application (on August 14th) with Karate (Lambda-cyhalothrin) were done in the *Trichogramma* release area while two insecticide applications (on July 31st and August 14th) with Karate (Lambda- cyhalothrin) and Curacron (Profenofos) were done in the control area. The period between *Trichogramma* release and insecticide treatment was 7 days (Abd El-Hafez and Nada, 2000). *T. evanescens* release rate was estimated by 60,000♀♀/release/ feddan. Parasitoids were programmed to emerge from release cards with a rate of 20,000♀♀/ two days begin within 12-24h after release.

2. Releasing T. evanescens Follows the Recommended Control Program of Cotton Pests. This experiment was conducted in 1999 and 2000 cotton seasons at Sharkia Governorate. The experimental area was 12 feddan divided as follows; five feddan for *Trichogramma* release, 5 feddan for control and 2 feddan left between the two divisions to avoid dispersal of released *Trichogramma*. In the two seasons, the planting date of the cottonseeds in the selected area was relatively late (April 24th and May 3rd). Accordingly, the growing season of these plants was expanded until the end of September. Three weekly releases of *T. evanescens* (60,000♀♀/ release) were established at the two seasons after the termination of the recommended insecticide program (August 12th and 14th). These releases were conducted on August 20th, August 27th and September 3rd.

3. Using T. evanescens Alone as Biocontrol Agent Against Pink Bollworm. This experiment was carried out at Qalyubia Governorate in 2000 and 2001 cotton seasons. Because availability of land was restricted in that time, a small area of one feddan was selected for treatment and half feddan for control. The experimental area was free from any insecticide treatments while 5 weekly releases of *T. evanescens* were conducted in the two seasons. Releasing of *Trichogramma* (60,000♀♀/ release) was applied based on the recommended threshold of pink bollworm insecticide treatments in Egypt (3% of infested bolls or a catch of 8 moths/ 3 nights/ trap). Accordingly, the 1st release of *Trichogramma* started on July 12th at the 1st season and on July 16th at the 2nd one.

The sequential sampling method was used to evaluate the infestation of green cotton bolls with pink bollworm. Therefore, three samples (50-100 green bolls/ each) were collected randomly from treatment and control area at 7 days intervals, dissected and the number of infested bolls was recorded. The reduction in the infestation was determined 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

Introducing *T. evanescens* into the Recommended Control Program of Cotton Pests

1999 Cotton Season. The first release of *T. evanescens* took place on July 24th. At that time, the percentage of infested bolls by pink bollworm averaged 4.67 and 5.33% in the control and release area, respectively (Table 1). Seven days later (July 31st), the mean infestation with the pest averaged 5.00% in the release area opposed to 9.67% in control, indicating 54.70% reduction. At that time, an insecticide treatment with Karate (Lambda-cyhalothrin) was conducted in the control area according to the recommended program. On August 7th, the percentage of infestation with pink bollworm averaged 10.33% and 4.67% in

the control and release areas, respectively, indicating 60.39% reduction in the area that received *T. evanescens* than control. This means that, releasing of *T. evanescens* is more effective than spraying insecticides since it was able to prevent increasing of pink bollworm population for a period of two weeks. On August 14th, the recommended application with insecticides was done in the whole experimental area, although lower level of infestation (3.33%) was estimated in the treated area comparing with the control area (19.00%). An average of 80.03% reduction in infestation was achieved at that time due to *Trichogramma* release.

The third release of *Trichogramma* was done after 7 days from the insecticide treatment (August 21st), when the infestation with the pest averaged 5.33 and 20.67% in treatment and control areas, respectively, indicating 77.41% reduction. On August 28th the reduction slightly decreased to 76.18% as a result of increasing infestation in treatment to 10.33% opposed to 38.00% in control plots. The last inspection (September 5th) indicated that more than half of green cotton bolls in control area was infested with pink bollworm (52.33%), while 8.67% of green cotton bolls were infested in the release area, indicating 85.48% reduction (Table 1).

The present results reveal that *T. evanescens* was able to minimize the total infestation to be about one fourth that of control. The whole mean of infestation with pink bollworm throughout the whole period of experiment was determined by 6.24 & 22.10% in treated and control areas, respectively. While, the whole mean of reduction was estimated by 75.27%.

Season 2000. At the beginning of the experiment (July 24th) the average of infestation in green cotton bolls raveraged 5.00 and 6.00% in the treated and control area, respectively (Table 1). Seven days later (July 31st), the averages of infestation were 6.67 and 4.00% in the two areas, respectively. Therefore, releasing of *Trichogramma* caused 50.02% reduction in the infestation than control. At that time a recommended insecticide treatment with Karate was done in the control area.

On August 7th (the time of the 2nd release), the rate of cotton bolls infestation with pink bollworm was found to be reduced by 63.29% in the treated area (3.33%) than in the control area (8.33%). In the following inspection (August 14th) the percentage of pink bollworm infestation increased to 13.67% in control area opposed to 5.00% in release area. Accordingly, the percentage of reduction increased than the previous inspection to reach 69.52%. At that time an insecticide treatment was applied at the two areas according to the recommended program. In the subsequent sample (7 days after the insecticide treatment), infestation with pink bollworm averaged 6.33 and 15.33% in both treatment and control areas, respectively, indicating 65.59% reduction than control. The 3rd release of *Trichogramma* was applied at that time. On August 28th, high increase in pink bollworm infestation occurred in control area (28.00%) to be 7 folded that of release area (4.00%). The reduction in infestation due to *Trichogramma* release in that time was estimated by 88.10%. At the last inspection (September 4th), more than half of green cotton bolls (54.00%) was found infested with pink bollworm opposed to 7.33% only in *T. evanescens* release area. Therefore, there was 88.69% reduction in infestation due to *Trichogramma* treatment.

The seasonal mean percentages of infestation by pink bollworm reached 5.19 & 18.71% in release and control areas, respectively, indicating 76.89% reduction throughout the whole period of the experiment. Comparing the results of 1999 and 2000 experiments (Tables 1), it could be noted that, releasing of *T. evanescens* started at approximately the same level of infestation and caused statically the same effect in reducing pink bollworm infestation at the two seasons. F value = 0.1008 and the overall means of reduction were 75.27 & 76.89% at the two seasons, respectively

Releas*ing Trichogramma* after the Recommended Control Program of Cotton Pests

Season 1999. At this season the recommended insecticide program terminated in the experimental area on August 12th, while the 1st release of the parasitoid took place on August 20th. At that time, the pink bollworm infestation averaged 11.67 and 13.00% in control and release area, respectively. Seven days later (the time of the 2nd release, the percentage of infestation decreased to 10.00% at *T. evanescens* treatment while it increased to 18.00% in control area. Therefore, the infestation became lower than that of control by 50.13%. On September 3rd (the 3rd releasing date), the pink bollworm infestation increased in control to reach 24.00%, while it decreased slightly to 9.33% in case of *Trichogramma* treatment. The reduction in infestation which induced by the parasitoid averaged 65.10%. Seven days later (September 10th), the percentage of infestation increased in control to 26.00% while it decreased to 8.00% in *Trichogramma* treatment to give a high percentage of reduction estimated by 72.38% (Table 2).

On September 17th (two weeks after the last release), the infestation rates in *T. evanescens* treatment (12.00%) was below that of control (37.33%) by 71.14%. In the following inspection (September 24th), pink bollworm infestation increased greatly to 48.00% in control area opposed to 14.33% in treated areas, showing 73.20% reduction due to *Trichogramma* release. On October 1st, the infestation increased again to 54.00% in control, opposed to 18.00% in the parasitoid treatment. Thus, 70.08% reduction in infestation was estimated in the release area. The seasonal means of infestation with pink bollworm reached 31.29 and 12.09% in control and release area, respectively. This indicated that *T. evanescens* was able to decrease the whole infestation during the experimental period by 65.30% than control.

Season 2000. Higher rates of infestation by *P. gossypiella* to green cotton bolls were estimated at the time of the 1st release (August 20th) averaged 19.67 and 20.67% for control and release area, respectively. (Table 2). Seven days later (August 27th), the mean percent of pink bollworm infestation increased to 28.00% in control area while it decreased to 16.00% in *T. evanescens* treatment, indicating 45.62% reduction than control.

On September 3rd, (the time of the 3rd release) the infestation increased greatly to 44.00% in control, while another decrease occurred in *Trichogramma* treatment to reach 12.00%. Accordingly, 74.05% reduction in infestation occurred in the treated area. Seven days after the 3rd release, the reduction in infestation increased to 83.01% as a result of decreasing infestation in treatment to 10.00% opposed to 56.00% in control area. At the following inspection (September, 17th), higher increase occurred in the pink bollworm infestation to reach 64.00 and 16.00% in control and release area, respectively. Thus, 76.21% reduction in pink bollworm infestation was achieved in that time. On September 24th, infestation with pink bollworm increased again to reach 68.00 and 21.00% in control and treated area, respectively, indicating 70.61% reduction due two the release of *Trichogramma*. At the last inspection (October 1st), the percentage of infestation in control increased to a maximum of 71.00% while it decreased to 19.00% in *Trichogramma* treatment. So, the percentage of reduction in infestation due to release of the parasitoid averaged 74.53%.

The seasonal mean of infestation through the whole experimental period averaged 50.10 and 16.38 % in control and release area, respectively. Generally, *Trichogramma* was able to suppress the pink bollworm infestation to below that of control by 68.88%.

Comparing the results of 1999 and 2000 experiments (Table 2), it could be noted higher level of natural pink bollworm infestation in the second season (mean= 50.10%) than the first one (mean= 31.29%). While, releasing of *T. evanescens* shows statistically the same effect at the two seasons (F value= 0.5775); the whole percentages of reduction were 65.30 and 68.88% at 1999 and 2000 cotton seasons, respectively.

Using *T. evanescens* Alone as Biocontrol Agent Against Pink Bollworm

This experiment was carried out at Qalyubia Governorate, Egypt in 2000 and 2001 cotton seasons. The experimental area was free from any insecticidal treatments, while 5 weekly releases of *T. evanescens* were achieved in the two seasons. Release of the parasitoid (60,000♀♀/ release) was applied based on the recommended threshold of insecticide treatments against pink bollworm in Egypt (3% of infested bolls or a catch of 8 moths/ 3 nights/ trap).

2000 Cotton Season. On July 12th, the percentage of infested bolls by pink bollworm averaged 2.00 and 3.00% in the control and treated area (Table, 3). Accordingly, the first release of *T. evanescens* took place at that time since the level of infestation met the recommended threshold of pink bollworm treatment. Seven days later (July, 19th), the infestation increased to more than three folds (6.67%) in the control area while slight decrease occurred in the release area to reach 2.67% and indicating 73.31% reduction in the percentage of infested bolls due to *T. evanescens* release.

The 3rd release of *T. evanescens* occurred on July 26th. At that time, the percentage of infestation with pink bollworm in control (12.0%) was four folds that of treatment (3.0%), so the percentage of reduction than control reached 83.33%. In the 4th inspection (August, 2nd), the natural percentage of pink bollworm infestation averaged 17.00% opposed to 3.33% in treated area, respectively. Thus, the reduction of infestation was 86.94% due to *T. evanescens* release. The 4th release of *Trichogramma* was done at that time. At the following inspection (August 9th), the percent of infestation averaged 4.33% in treated area opposed to 22.00% in control, indicating approximately the same reduction of the previous inspection (86.88%). At the following inspection (August 16th), the percentage of open bolls reached about 10.0% while the majority of cotton bolls became matured. The percentage of pink bollworm infestation in release area (5.67%) was below that of control (26.00%) by 85.96%. The last inspection (August, 23rd), indicated that more than one third of green cotton bolls in control area was infested with pink bollworm (35.00%), while in the release area, this percentage was reduced to 9.00%. Therefore, 82.86% reduction was indicated due to releases of *T. evanescens* (Table 3).

Regarding the overall infestation with pink bollworm throughout the experimental period, it could be indicated that *T. evanescens* was able to minimize the infestation to be less than control by 82.80%; the whole mean of infestation averaged 4.43 & 17.24% in treatment and control, respectively.

Season 2001. During this season, five releases of *T. evanescens* were done on seven days intervals (July 16th until August 13th). At the beginning of the experiment the averages of infestation in green cotton bolls were 2.67 and 3.33% in the control and treated area, respectively (Table 3). On July 23rd (seven days after the first release and the time of the 2nd release), the average of total infestation in treatment declined to 1.67% in area that received *T. evanescens* release, while it increased to 5.67% in control. Therefore, releasing of the parasitoid caused 76.38% reduction in the percentage of pink bollworm infestation than control.

On July 30th (the time of the 3rd release), the infestation rate by pink bollworm was reduced by 78.13% in the treated area (3.00%) than that in control area (11.00%). Seven days later (On August 6th), the percentage of pink bollworm infestation in

the release area was as the same in the previous inspection (3.00%), while it increased to 15.00% in the control area. So percentage of reduction increased than that in the previous inspection to reach 83.96%. The last release of *Trichogramma* was applied at August 13th. At that time the percentage of pink bollworm infestation increased in control area to reach 20.33%. On the contrary, highest reduction in infestation (89.47%) was achieved in this inspection as a result to the effect of *T. evanescens* which caused a stable level of infestation with this pest (2.67%). On August 20th, (seven days after the 5th release), the pink bollworm infestation in the control area became 6.85 folds of that of treatment (32.00 and 4.67%, respectively). It means that *T. evanescens* caused 88.30% reduction than control. At the subsequent sample of August 27th (14 days after the last release), pink bollworm infestation increased greatly to reach 43.00% in control opposed to 8.33% in *Trichogramma* treatment, indicating 84.47% reduction than control. The seasonal mean of infestation with pink bollworm averaged 3.81& 18.52% in treatment and control area, respectively. Thus, the release of the parasitoid led to 83.51% reduction in infestation with this pest throughout the whole period of the growing season.

Comparing the results of 2000 and 2001 cotton seasons, it could be noted that, releasing of *T. evanescens* started at approximately the same level of infestation (the recommended level for starting the insecticide applications against cotton bollworms). Also, the seasonal mean infestation percentages at the two seasons were kept approximately at the same level (17.74 & 18.52% in control and 4.43 & 3.81% in treatment) and accordingly the same reduction percentages (82.80 and 83.51%) were achieved.

In the three experiments, the real control effect of the local strain of *T. evanescens* against pink bollworm was determined through the analysis of the weekly infestation level of green cotton bolls in relation to the control. According to the obtained results, release of *T. evanescens* to control pink bollworm is biologically effective and could be used as an important agent in integrated pest management programs. In the first experiment, using *T. evanescens* in combination with insecticide treatment resulted in 75.27 and 76.89% 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 withought any other control agents (the third experiment). 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 (the second experiment). These results show clearly that the control rates of pink bollworm are very related to the release time of *Trichogramma.* This finding is in agreement with that suggested by Scholz and Murry (1995). When they found high natural incidence of *T. bactrae* in Australian rain-grown cotton and mentioned that it may have some potential as biological control agent, particularly if it can be established in cotton earlier in the season.

In India, **Tuhan *et al.* (1987)** found that release of *Trichogramma brasilience* at a rate of 20 000 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* in 1993-95, in Nanpi County, to control cotton bollworms (Noctuidae) and found that the release of *T. flavum* was less costly than chemical sprays. The increase in seed cotton was 90-Kg ha-1. At the same time, natural enemies were protected, and environmental pollution was avoided. They added that, a small release of *T. flavum* was sufficient to control the pests' population during the year of moderate/light incidence of Noctuidae. However, during an outbreak year, both releases of both *T. flavum* and spraying chemicals were necessary. They recommended to using microbial pesticides to minimize harmful effects to *T. flavum*.

In Egypt, biological control agents in cotton fields including *Trichogramma* are intensively directed and supported by Ministry of Agriculture and Land Reclamation. Abd El-Hafez and Nada (2000) obtained good results when they introduced *T. bactrae* in the IPM program in cotton fields and when this parasitoid was released in combination with insecticides or released after the termination of the recommended insecticide program at Sharkia Governorate. In a further study, Shalaby *et al.* (2002) released *T. bactrae* for four times in cotton fields free from any insecticidal treatments at Qalyubia Governorate. They found that *T. bactrae* was able to minimize pink and spiny bollworm infestations as well as the percentage of crop losses. Also, Abd El-Hafez *et al.,* (2002) released four trichogrammatids (*Trichogramma embryophagum* Hartig, *Trichogramma brassicae* Bezdenko, *Trichogrammatoidea bactrae* Nagaraja, and *Trichogramma evanescens* Westwood) after the termination of the recommended insecticide program and found that all the 4 parasitoid species were able to suppress the pink bollworm population to below that of control by 64.0- 80.0%. Recently, a new strategy for controlling cotton bollworms depending on releasing the local strain; *T. evanescens* in cotton fields were applied (unpublished data). The new strategy recommended using *T. evanescens* and microbial pesticides during the high levels of infestation. This aimed to minimize the use of chemical insecticides which had a harm effect on natural enemies and cause environment pollution.

In conclusion, the local parasitoid *T. evanescens* appeared to be highly effective against pink bollworm particularly when released earlier in the season before the formation of cotton bolls.

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Table 1. Efficiency of introducing *T. evanescens* in IPM program on suppressing infestation with pink bollworm in Sharkia Governorate at 1999 and 2000 cotton seasons.

Date of inspections	1999 cotton season			2000 cotton season		
	% Infestation		% Reduction	% Infestation		% Reduction
	Control	*T. evanescens*		Control	*T. evanescens*	
24/7	4.67	5.33		5.00	6.00	
31/7	9.67	5.00	54.70	6.67	4.00	50.02
7/8	10.33	4.67	60.39	8.33	3.67	63.29
14/8	19.00	3.33	80.03	13.67	5.00	69.52
21/8	20.67	5.33	77.41	15.33	6.33	65.59
28/8	38.00	10.33	76.18	28.00	4.00	88.10
4/9	52.33	8.67	85.48	54.00	7.33	88.69
Mean	22.10	6.24	75.27	18.71	5.19	76.89

Table 2. Efficiency of treatment with *T. evanescens* on suppressing infestation with *P. gossypiella* in the late seasons of 1999 & 2000 at Sharkia Governorate

Date of inspections	1999 cotton season			2000 cotton season		
	% Infestation		%	% Infestation		%
	Control	Treated	Reduction	Control	Treated	Reduction
20/8	11.67	13.00		19.67	20.67	
27/8	18.00	10.00	50.13	28.00	16.00	45.62
3/9	24.00	9.33	65.10	44.00	12.00	74.05
10/9	26.00	8.00	72.38	56.00	10.00	83.01
17/9	37.33	12.00	71.14	64.00	16.00	76.21
24/9	48.00	14.33	73.20	68.00	21.00	70.61
1/10	54.00	18.00	70.08	71.00	19.00	74.53
Mean	31.29	12.09	65.30	50.10	16.38	68.88

Table 3. Efficiency of treatment with *T. evanescens* on suppressing infestation with pink bollworm in Qalyubia Governorate at 2000 and 2001 cotton seasons.

Inspection date	2000 cotton season			Inspection date	2001 cotton season		
	% Infestation		%		% Infestation		%
	Control	Treated	Reduction		Control	Treated	Reduction
12/7	2.00	3.00		16/7	2.67	3.33	
19/7	6.67	2.67	73.31	23/7	5.67	1.67	76.38
26/7	12.00	3.00	83.33	30/7	11.00	3.00	78.13
2/8	17.00	3.33	86.94	6/8	15.00	3.00	83.96
9/8	22.00	4.33	86.88	13/8	20.33	2.33	89.47
17/8	26.00	5.67	85.96	20/8	32.00	4.67	88.30
24/8	35.00	9.00	82.86	27/8	43.00	8.33	84.47
Mean	17.24	4.43	82.80	Mean	18.52	3.81	83.51