ALEXANDRIA

SCIENCE EXCHANGE JOURNAL

VOL. 33 JANUARY- MARCH 2012

The Release of the Parasitoid *Trichogramma evancens* to Control the Pink Bollworm *Pectinophora gossypiella* (Saunders) and the Side-Effect of Certain Insecticides on It

Saad, A. S. A.[1], E. H. M. Tayeb[1], H. A. Awad[2] and H.M. El-Bassiuony[2]

ABSTRACT

The present study was conducted to evaluate the effectiveness of the parasitoid *Trichogramma evenecens* (Hymenoptera, Trichogrammatidae) as a potential biological control agent upon the laid eggs of the pink bollworm *Pectinophora gossypiella* (Saunders) (PBW) in cotton fields. The effect of releasing *Trichogramma evenecens*, the application of the insecticide spinetoram (Radiant®) and their combination on the yield of cotton was considered. Meanwhile, the side-effect of certain insecticides on the parasitoid *Trichogramma evanescens* was involved. The toxic side-effects of these insecticides that have been recommended for controlling insect-pests attacking cotton plants namely gama-cyhalothrin, chlorpyrifos, spinetoram, methoxyfenozide and thiamethoxam were tested on the parasitized eggs of the Angoumois grain moth *Sitotroga cerealella* (Olvier).

The results showed that the parasitoid *T. evancens* efficiently parasitized PBW *Pectinophora gossypiella* eggs. Parasitism percentage and the cotton yield were greatly affected by releasing *T. evenecens* at the rate of 33000 parasites/fed./release; thus decreasing the infestation of PBW and consequently increasing cotton yield. The efficiency of spinetoram was compared with the release of *T. evanescens* when they were separately used or when they were combined. The combination of releasing *T. evanescens* and application of spinetoram was superior to control PBW. Herein, the highest rate of infestation was recorded in the untreated check (9.3 and 15.5%); gradually decreased by the release of *T. evanescens* alone up to 3.4 and 5.0%, spinetoram alone (2.8 and 3.2%) and spinetoram with *T. evanescens* release (1.2 and 2.1%) in 2009 and 2010, respectively. The increase of cotton yield was the highest in case of releasing *T. evanescens* with the application of spinetoram during both seasons (8.5 and 8.2 Ken. / Fed., respectively). Chlorpyrifos and gama-cyhalothrin were extremely toxic and adversely affected the exposed parasitized eggs of the grain moth *S. cerealella* (Olvier) since they caused complete inhibition (100%) of adults emergence in the treated parasitized egg of 48, 96 and 192 hrs old post-parasitisation, while more than 80% inhibition of adult emergence from the eggs of 24 hrs old was occurred. Methoxyfenozide was the least toxic and safer compound compared with the other tested ones.

INTRODUCTION

The pink bollworm (*Pectinophora gossypiella*) is one of the most destructive pests of cotton in many areas of the world. In Egypt, cotton (*Gossypium barbadens* L.) is attacked by various pests during the different stages of its development; amongst, the most dangerous one is the pink bollworm *P. gossypiella* (PBW) (Salama, 1983). In Egypt, cotton field represents about 1/6 of the total cultivated area; heavy losses are yearly recorded due to the attack of PBW (Monsarrat *et al*., 1995).

Pesticides can provide economical protection by killing pests population that otherwise would cause significant loss. Careless or excessive use of pesticides, however, can result in poor control, crop damage, higher expenses and hazards to health and the environment. Crop injury (phytotoxicity) due to pesticides application can result from an improper method, poor timing and/or excessive rates of application, besides drift and residues in soil or water. Moreover, the extensive use of pesticides in cotton fields has seriously affected the population densities of the natural enemies. The widespread application of pesticides might accelerate some cotton pests, mostly insects and mites which develop resistance to certain pesticides (King and Janine, 1992).

Therefore, the biological control of phytophagous insects by mass release of egg parasitoids has become more practical in recent years. Practical uses of Trichogrammatid (egg parasitoids) are worldwide utilized against many lepidopterous pests on several key crop i.e.; corn, sugar-cane, cotton, fruit trees and vegetables (Smith *et al*., 1986; Tuhan *et al*., 1987; Hassan, 1993; Smith, 1994; Wang, 1997; Shalaby *et al*., 2002; Abd El-Hafez *et al.,* 2002; Khidr *et al*., 2003; Abd El-Hafez *et al*., 2004; El- El-Wakeil and Vidal,

[1]Plant Protection Dept., Fac. Agric. (Saba Basha), Alex. Univ., Egypt
[2]Plant Protection Res. Institute, Agric. Res. Center, Egypt
Received February 13, 2012, Accepted March 18, 2012

2005; El-Bassouiny, 2006 and Agamy, 2010). The wide use of Trichogrammatids is mostly due to the easy mass production techniques of these parasitoids on numerous hosts which are mainly the lepidopterous insect-pests of stored products, such as *Sitotroga cerealella*, *Ephestia kuehniella* and *Plodia interpunctella*. These insects are easy to be reared all the year round and produce a large number of eggs. Undoubtedly, the egg parasitoids are the most efficient tool in controlling many insects, as these prevent the hatching of the host eggs by feeding on the developing embryos within the eggs, and consequently killing that target pest before the larvae cause crop damage (Knutson, 2003). In this respect, the release of true egg parasitoids in sufficient numbers, efficiently act in controlling the pest in a similar way of that enhanced by ovicides as both cause mortality of the pest when still in egg stage, but the egg parasitoids have the advantage of never to cause any kind of environmental pollution.

Parasitoids can have a major impact in natural and agricultural ecosystems where they influence or regulate the population density of many of their pest hosts (Godfray, 1994). Trichogrammatides and other egg parasitoids are generally part of the local ecosystem and often contribute to control certain lepidopterous pests in the absence of disruptive pesticides. The genus *Trichogramma* has different species responsible for natural control of several insect pests, mainly lepidopterous. Faria (2000) reported that the species *Trichogramma pretiosum* Riley has been used in Brazil for controlling several insect pests in corn, cassava and cotton crops.

The utilization of selective insecticides is a reasonable strategy in pest management, because it favors the conservation of natural enemies in the agro-ecosystem (Carvalho, 1999).

The control of insects via the release of *Trichogramma* might fail if this release synchronized with pesticide use. That parasitoid as others is generally sensitive to pesticides (Franz *et al*., 1980). Chemicals can be immediately toxic and cause death (contact toxicity) and this effect can persist due to toxicity of dried residue (Hassan *et al.,* 1998; Thomson *et al*., 2000). Contact with pesticides at the less susceptible life stages (parasitoids within eggs of their hosts) can cause prolonged development at time of the immature stages and reduced rates of emergence, fecundity, parasitism capacity, adult longevity and mating likelihood (Franz *et al*., 1980; Consoli *et al*., 1998, Hassan *et al*., 1994; Brunner *et al*., 2001; Takada *et al*., 2001).

Therefore, the present study was conducted to determine the efficiency of *Trichogramma evanescens* as a biological control agent against the pink bollworm *Pectinophora gossypiella* in cotton fields in Egypt and the impact of some insecticides, at dosage rates currently recommended in Egypt for cotton fields, on the development of the immatures of T. *evancens*, within the parasitized eggs of its host.

MATERIALS AND METHODS

1. Field experimental design

Field experiments were carried out in a private farm at Abo-Homos, El-Behaira Governorate, Egypt, during two successive growing cotton seasons of 2009 and 2010. In both seasons an area of one feddan and half was cultivated with cotton (Geiza 88 variety) on April the 15^{th} and the 20^{th}, consequentially. The normal agricultural practices were followed during both seasons. The experimental area was divided to plots, each of 0.25feddan (1050m^2). The completely randomized block design was utilized in the initiated experimental traits with three replicates for each treatment as well as the untreated check. Each plot was separated from the adjacent one by half-meter belt to minimize the interference of spray drift from one treatment to another.

The parasitoid was released as pupae within the parasitized *Sitotroga cerealella* eggs at a rate of 33000 parasites/feddan. Releases were applied into the field using a device that protects them from predators and unfavorable weather conditions. To decrease the labor cost, the device which consists of thick paper card (8 x 12 cm.) was modified, as it was folded to make a closed container (8 x 6 cm.). Three cards of *S. cerealella* eggs (1x1cm.) containing about 500 parasitoids/ each in three different stages of development (1, 2 & 3 days pre-emergence) were glued in this container. Thus, the total number of parasitoids/ card was about 1500 parasitoids. Cards were hanged manually before the sunset on the plant at about 50 cm above the ground. Each feddan required about 22 cards; though the rate of releasing comprised 22 paper cards / feddan / release. Also, the distance between the release points was 14m, and started 7m apart from the edges of the field.

The release of parasitoid *T. evanescens* was performed after the formation of the first fruiting branch on cotton plant to control the pink bollworm during the growing cotton seasons of 2009 &2010. The insecticide (spinetoram) (Radiant®) was applied when the number of detected insect-pest increased to reach the economic threshold level (ETL) of infestation (>3%). The evaluated treatments were spinetoram (an insecticide) (T1), *Trichgramma evanescens* release (T2) and a combination of spinetoram + *Trichgramma evanescens* release (T3) compared with the untreated check treatment (T4). Prior to treatments application (release of the parasitoid and/or insecticide spray), an immediate initial estimation was carried out to determine the primary infestation level of inspected pink bollworm. Thereafter, weekly samples of 100 green bolls / treatment were taken randomly. The level of bollworm infestation was weekly estimated along ten weeks during the growing seasons of 2009 and 2010. The sampled bolls were examined externally before dissection and internal inspection. Infestation records were based on the existence of injury symptoms regardless the presence of the larvae. Statistical analysis using "F" and "L.S.D." testes was performed for the comparison between the means. Prior to analysis, the recorded values were transferred using the formula of Bartlett (1937) as follows:

T.V= $\sqrt{x + 0.5}$ where X is the recorded value and T.V=Transformed Value; this equation will give a definite value to a zero count equal to 0.7.

2. Laboratory experimental design

Parasitized *Sitotroga cerealella* eggs with *T. evancens* of different ages (24, 48, 96, 192 hrs post-parasitistion) were individualized according to their age in glass Jars (10.5cm x 22.5cm) each contained a white paper card (1.0cm x 1.0cm) implying about 500 parasitoides.

The tested insecticides in the treatment were: gama-cyhalothrin (Ventex®), chlorpyrifos (Dursban®), methoxyfenozide (Runner®), Spinetoram (Radiant®) and thiamethoxam (Actara®). The completely randomized design was used with six treatments (five insecticides and the untreated check in which water was only applied). The tests were run in jars each containing the dilution of recommended dose. These paper cards with the parasitized eggs of *S. cerealella* were dipped in the dilution of each of these selected insecticides for 15 sec. Three replicates of each concentration of the tested insecticides were used. After elimination of water excess from the egg surface, the treated paper cards were individualized in glass Jar (10.5cm x 22.5cm); maintained under controlled photo-higrothemic conditions of 25±2ºC, 70±10% RH and 14h photophase for normal development of *Trichogramma evancens* immature stages to enhance the according to the method of (Carvalho *et al*., 2003).

To determine the side effects of evaluated pesticides, the rate of emerged adults of the parasitoid from the parasitized eggs of different ages (24, 48, 96, 192 hours post-parasitisation) was considered and the numbers of eggs reached the final developmental stage and emerged adults of *Trichogramma evancens* were counted and recorded.

3. Pesticides used:

The pesticides and their common names, chemical names, trade names, formulations, source and applied rates/ feddan are shown in Table1.

RESULTS AND DISCUSSION

The release of *T. evenecens*, the application of insecticide and their combination for controlling the pink bollworm

If the cotton pink bollworm; the probably most destructive insect-pests of cotton, was left uncontrolled, it could cause a cotton production of zero %. Control of the pink bollworm by chemical means alone is rather costly; besides their hazards to man and the environment. The use of the parasitoids *T. evanescens* is an alternative biological control agent that has been found to be effective against the PBW in Egypt. The adults of *T. evanescens* are small parasitoids that attack a variety of lepidopterous pests and they have the advantage of attacking the bollworm by ovipositing on and parasitizing their eggs.

Table 1. The applied pesticides and *Trichogramma evancens*

Common name	Trade name	Source	Formulation	Application rate/Fed.
Gama- cyhalothrin	Vantex®	Dow AgroSciences	6%CS	100 ml
Chlorpyrifos	Dursban®	Dow AgroSciences	48%EC	1000 ml
Methoxyfenozide	Runner®	Bayer CropScience	24% SC	150 ml
Spinetoram a mixture of (Spinosyn J and Spinosyn L)	Radant®	Dow AgroSciences	24% SC	50 ml
Thiamethoxam	Actara®	Syngenta	25 %WG	30g
Trichogramma evancens	Tricho®	International Company for Biological Agricultural	-	22 card

The data in Tables 2 and 3 represent the deduced infestation percentages of the PBW larvae due to the application of the tested insecticide Radiant® SC (spinetoram) (T1), the release of the parasitoid *Trichogramma evanescens* (T2) and their combination (T3) during the growing seasons of 2009 and 2010 compared with the untreated check (T4).

The tested insecticide (spinetoram) was applied when the EIL was >3%. It could be noticed that T3 (spinetoram with the release of *T. evanescens*) achieved the lower overall mean of infestation (1.2%), followed by T1 and T2 (2.8 and 3.4%, respectively). Statistical analysis showed significant differences either between the performed treatments themselves or between them and the untreated check (T4) which showed the highest overall mean of infestation (9.3%). Herein, the adopted control treatments against the PBW, to a more or a less extent, were reflected on the cotton yield. The more effective treatment in controlling PBW (T3) was utmostly efficient one that resulted in a higher cotton seed yield amounted to 8.5 Ken. /fed. The application of the tested insecticide (spinetoram) alone (T1) was comparatively more efficient than the release of *T. evanescens* (T2) since that insecticide reduced the PBW infestation to an overall mean of 2.8%; and gave a yield of 6.5 Ken./fed. The highest percentage of infestation (9.3%) with the lowest production (2.4 Ken./fed.) was detected for the untreated check plants (T4) during the growing season of 2009.

Table 3 also show the calculated infestation percentages of the PBW larvae post the application of the tested insecticide (spinetoram) (T1), the release of the evaluated parasitoid *Trichgramma evanescens* (T2) and their combination (T3) during the second growing season of 2010. In this season, the lower mean of PBW infestation was recorded for T3 which amounted to 2.1%, followed by spinetoram alone (T1) (3.2%) and the release of parasitoid (T2) (5%) compared with the highest detected infestation level of the untreated check (15.5%). Remarkably, the trend of the results that have been obtained during the growing season of 2010 was as that of 2009.

Table 2. Effect of different applied treatments for controlling the pink bollworm during the growing season of 2009

Date	Mean number of larvae/100 bolls (=Infestation %)			
	Treatment			
	T1	T2	T3	T4
15-Jun*	0.0***	0.0	0.0	0.0
22-Jun	0.0	0.0	0.0	0.0
29-Jun	0.0	0.0	0.0	0.0
06-Jul	0.0	0.0	0.0	2.3
13-Jul	1.7	1.7	1.7	5.3
20-Jul	3.3	0.6	0.6	7.0
27-Jul**	5.0	1.0	1.0	9.3
03-Aug	3.0	2.0	1.7	9.7
10-Aug	6.0	3.0	1.7	11.0
17-Aug	2.3	2.3	2.3	11.3
24-Aug	4.0	3.0	2.3	11.3
13- Aug	3.0	4.3	3.7	11.3
07-Sep	4.7	4.7	0.0	10.0
14-Sep	2.7	6.3	0.0	10.7
21-Sept	4.7	7.3	1.0	18.7
28-Sep	3.0	8.3	2.0	17.0
05-Oct	3.3	8.7	2.0	16.3
12-Oct	3.0	8.0	2.0	16.0
Overall mean	2.8_c****	3.4_b	1.2_d	9.3_a
Seed cotton yield (Ken./Fed.)	6.5_b	4.8_c	8.5_a	2.4_d

T1: Spinetoram treatment, T2: *T. evancens* treatment, T3: *T. evancens* + spinetoram, T4: control (untreated check).
* Date of *T. evancens* release.
** Date of spinetoram application.
*** Non transformed values.
****Means followed by the same letter(s) within the same row are not significantly different.

Table 3. effect of different applied treatments for controlling the pink bollworm during the growing season of 2010

Date	Mean number of larvae/100 bolls (=Infestation %)			
	Treatment			
	T1	T2	T3	T4
15-Jun*	0.0***	0.0	0.0	0.0
22-Jun	0.0	0.0	0.0	0.0
29-Jun	2.7	1.0	1.3	3.7
06-Jul	3.0	2.3	2.3	6.7
13-Jul	3.3	2.7	2.0	7.0
20-Jul**	4.0	2.7	2.7	9.3
27-Jul	3.7	3.3	2.7	10.7
03-Aug	4.3	4.3	2.7	16.7
10-Aug	3.3	6.0	3.0	18.0
17-Aug	4.0	6.0	3.7	17.3
24-Aug	3.3	8.3	4.0	18.3
13- Aug	4.7	8.0	2.3	19.7
07-Sep	2.7	5.3	2.0	22.7
14-Sep	4.7	4.7	1.0	20.3
21-Sept	3.0	4.3	2.0	17.0
28-Sep	2.3	5.3	1.0	16.3
05-Oct	2.0	5.7	0	16
12-Oct	2.0	5.7	0	16
Overall mean	3.2_c****	5.0_b	2.1_d	15.5_a
Seed cotton yield (Ken.)/Fed.	6.0_b	4.5_c	8.2_a	1.7_d

T1: Spinetoram treatment, T2: *T. evancens* treatment, T3: *T. evancens* + Spinetoram, T4: control (untreated check).

* Date of *T. evancens* release.

** Date of spinetoram application.

*** Non transferred values.

****Means followed by the same letter(s) within the same row are not significantly different

Also, it is observed that the estimated infestation level of the PBW was higher during the growing season 0f 2010 than that of 2009.The mean number of inspected PBW larvae was the least in the case of releasing the parasitoid *Trichogramma evanescens* with the application of spinetoram (Tables 2 and 3).

During both seasons of study, the number of inspected PBW was reduced to reach 0.00 larvae / 100 bolls within the 3rd treatment (T3) during certain periods in Sept. & October. Also, that treatment (T3) was rather effective in reducing PBW infestation and increasing the cotton yield which comprised 8.2 Ken./fed. The statistical analysis also showed the significant differences between the three run treatments themselves and/or between these treatments and the untreated check.

The above-mentioned results are in agreement with those arrived at by Abd El-Hafez *et al***.** (2004) who reported that when *Trichogramma evanescens* was released in combination with insecticide treatment, the reduction percentage of the pink bollworm infestation reached 75.27 and 76.27% compared with the untreated check in both the growing seasons of study, respectively. Moreover, El-Bassiuony (2006) reported that the use of Spintor® (spinosad**)** with the release of *Trichogramma evanescens* was effective to suppress PBW in cotton fields in Egypt.

Impact of certain insecticides on the emergence of *T. evancens*

Table 4 shows the effect of the recommended dose of certain evaluated insecticides on the parasitized eggs of *S. cerealella* of different ages by *T. evancens*. It was found that chlorpyrifos (Dursban®) and gama-cyhalothrin (Ventex®) gave the highest efficient drastic negative effect on the parasitized eggs of different ages in most cases inhibiting the adult emergence of the parasitoid. Generally, spinetoram (Radaint®) showed moderate effects, while thiamethoxam (Actra®) and methoxyfenozide (Runner®) gave less drastic toxic effects on these parasitized eggs by *T. evancens* (Table 4).

Table 4. Effect of tested insecticides on the number of the developed immatures of *Trichogramma evanescens* to pupae in the parasitized eggs of *Sitotroga cerealella* and the rate of emerged adult parasitoids

Insecticides	Age of parasitized egg (hrs) treated with insecticides							
	24		48		96		196	
	No. of parasitoid reached the pupal stage *	Emergence rate (%)	No. of parasitoid reached the pupal stage	Emergence rate (%)	No. of parasitoid reached the pupal stage	Emergence rate (%)	No. of parasitoid reached the pupal stage	Emergence rate (%)
Gama-cyhalothrin	24.67±0.88^{e**}	13.5±0.00^{e}	7.00±1.00^{f}	0.00±0.00^{e}	17.33±1.33^{d}	0.00±0.00^{d}	16.33±1.33^{d}	000±0.00^{e}
Chlorpyrifos	23.00±0.58^{e}	12.04±0.00^{e}	6.00±2.00^{g}	0.00±0.00^{e}	12.00±1.45^{e}	0.00±0.00^{d}	13.00±1.45^{e}	0.00±0.00^{e}
Methoxyfenozide	74.00±2.00^{b}	70.67±0.67^{b}	64.00±2.00^{c}	55.33±0.33^{c}	71.67±0.67^{b}	60.67±0.67^{b}	62.67±0.67^{b}	79.78±0.67^{b}
Spinetoram	62.00±4.00^{d}	58.00±0.00^{d}	43.00±0.00^{e}	38.00±0.00^{d}	64.00±0.00^{c}	58.33±0.00^{c}	60.00±0.00^{bc}	68.06±0.00^{d}
Thiamethoxam	67.00±1.00^{c}	62.00±0.58^{c}	65.00±1.00^{b}	58.00±4.50^{b}	71.00±0.58^{b}	61.00±0.58^{b}	62.00±0.58^{b}	72.58±1.42^{c}
control	99.00±0.00^{a}	88.33±0.33^{a}	99.00±0.00^{a}	88.00±0.00^{a}	89.33±0.33^{a}	88.33±0.33^{a}	89.33±0.33^{a}	88.33±0.33^{a}

* Number of parasitoid reached the pupal = the Number of black eggs

It was observed that after chlorpyrifos and gama-cyhalothrin application, the emerged *T. evancens* adults from the fewer survived numbers of eggs (that reached the pupal stage) died soon within few hours post emergence (0–1 day) compared to the control. The parasitized eggs treated with spinetoram gave moderate rates of survived eggs which reached the pupal stage and gave an emergence of adults. Thiamethoxam and methoxyfenozide gave higher rates of survived eggs implying vital pupal of parasitoid which gave high numbers of the emerged adults from them. It could be said that application of insecticides must be performed firstly before the release of *T. evancens*.

The results reported here resemble those of Charles *et al.* (2000) who showed that lambda-cyhalothrin, chlorpyrifos and spinosad were the toxic compounds to *Trichogramma* sp.

Shoeb (2010) reported that the $O.P_s$, lambda-cyhalothrin and spinosad were toxic compounds to *Trichogramma*. She showed also that $O.P_s$ and lambda-cyhalothrin caused death of the emerged adults within few hours post-emergence (0–1day) compared to the control.

The different developing immature stages of the parasitoid *Trichogramma evanescens* within the eggs of the Angoumois grain moth *S. cerealella* of different ages 24, 48, 92 and 192 hrs post-parasitisation were highly sensitive to the treatment of gama-cyhalothrin and chlorpyrifos. The treatment of both insecticides at the recommended field rate had proved to be extremely toxic; killed the different immature stages inside the host eggs, while spinetoram was moderately toxic and less effective on the needed durational intervals for the completion of immatures development within the eggs of host. Thiamethoxam and methoxyfenozide did not affect the durational period needed till the emergence of adult parasitoids.

In addition, Figure 1 illustrates the effect of the applied recommended doses of the evaluated insecticides on the rate of emerged adults of the parasitoid expressed as inhibition of emergence percentage. It is confirmed that chlorpyrifos and gama-cyhalothrin were found to have the most drastic effect on the parasitized eggs of different ages (24, 48, 96 and 192 hrs post-parasitisation). Their effect was highly pronounced and reflected on the emergence percentage of the parasitoid adults that failed to survive and/or complete their life cycle within the treated eggs. Also, that rate of parasitoid adult's emergence was varied according to the applied insecticide and the age of the parasitoid females. Kawamura *et al*. (2001) reported that each of the tested insecticides showed different degrees of toxicity to the parasitoid. It was observed that there was no emergence of the parasitoid adults when the parasitized eggs were treated with chlorpyrifos and gamma-cyhalothrin since these two insecticides caused complete inhibition (100%) of the emerged adults in case of the parasitized egg of 48, 96 and 192 hrs old treatment.

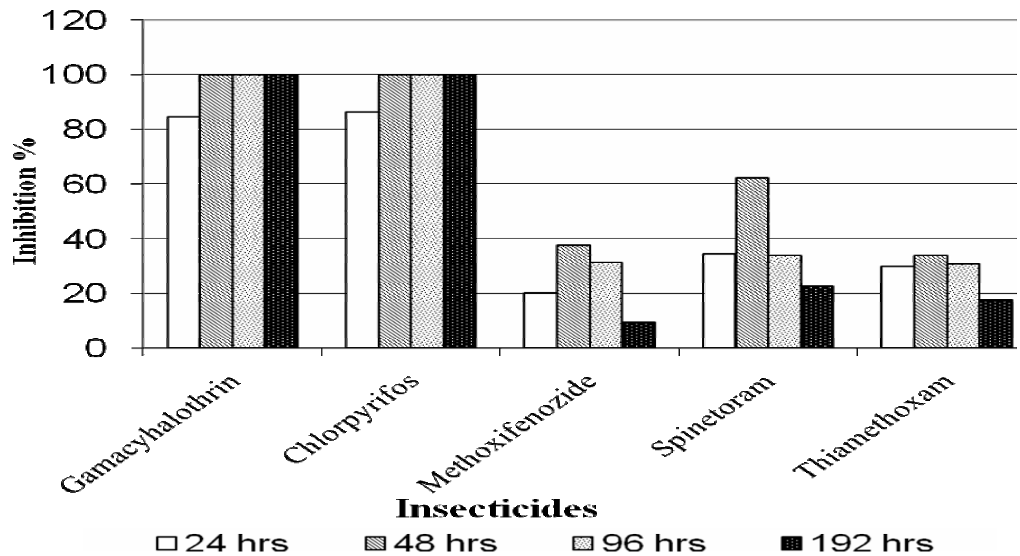

Fig. 1. Inhibition percentages of emerged adults parasitoids from the parasitized eggs of different ages after treatment with the recommended doses of tested insecticides

The adults emergence of the treated parasitized eggs of 24hrs old was inhibited by more than 80%. It could be seen also that methoxyfenozide was the least toxic compound compared with the other tested ones. It would be considered as the more suitable compound to be used within an integrated program for controlling the pink bollworm with the release of the parasitoid, i.e, regular distribution of hanged cards which replacing the cards which contain different stages of the parasitoid pupae in cotton field.

Therefore, the above explained results in our present study elucidate the importance of the concluded practical application that will help the farmer who used to apply the insecticides with the release of *T. evancens*, and enhance him of choosing the best and safer insecticides to be applied, since the insecticide products with the lowest impact on the biological control agents such as *T. evancens* are the most appropriate for controlling the pink bollworm within an IPM program.

Moreover, it could be recommended that the parasitoid *T. evancens* should be released after 8 days from the application of chlorpyrifos or gamma-cyhalothrin if their applications would be necessary and therefore they must be applied cautiously, otherwise another safer insecticide (i.e methoxyfenozide) might be used and this agreed with the results of Kapuge *et al.* (2003) who found that methoxyfenozide was not toxic to *Trichogramma* when it was assayed at field rate.

REFERENCES

Abd El-Hafez, Alia M., F. F. Shalaby, E. F. El-khayat and A.A. El-Shrkawy (2002). Efficiency of late season releasing of four Trichogrammatid species in suppressing infestation with *Pectinophora gosspiella* (Saund.) in cotton filed at Sharkia Gavarnorate. 2nd Int. Conf., Plant Protection Res. Institute, Cairo, Egypt, 21-24 December: 605 – 609.

Abd El-Hafez, Alia M., F. G. Malak, and A. E. Mortada (2004). Effectiveness of *Trichogramma evanescens* on controlling pink bollworm in cotton fields. Beltwide Cotton Conferences, Sanantonio, TX, USA, January 5-9, 1463-1470.

Agamy, E. (2010). Field evaluation of the egg parasitoid, *Trichogramma evanescens* West. against the olive moth *Prays oleae* (Bern.) in Egypt. J. Pestic. Sci., 83:53–58.

Bartleti, M. S. (1937). The square root transformation in the analysis of variance. Suppl. J. Roy. Stat., 3: 68-78.

Brunner, J. F., J. E. Dunle, M. D. Doerr and E. H. Beers (2001). Effect of pesticides on *Colpoclypeus florus* (Hymenoptera; Eulophidae) and *Trichogramma platneri* (Hymenoptera: Trichogrammatidae), parasitoids of leafrollers in Washington. J. Econ. Entomol., 94: 1075–1084.

Carvalho, G.A. (1999). Ação residual de alguns inseticidas pulverizados em plantas de tomateiro sobre duas linhagens de Trichogramma pretiosum Riley, 1879(Hymenoptera: Trichogrammatidae) em casa-devegetação. Ciên. Agrotec., Lavras, 23(4): 770-775.

Carvalho, G. A., P. R. Reis, L. C. D. Rocha, J. C. Moraes, L. C. Fuini and C. C. Ecole (2003). Side-effects of insecticides used in tomato fields on *Trichogramma pretiosum* (Hymenoptera, Trichogrammatidae). Maringá, 25(2): 275-279.

Charles, P. C., S. D. B. Orr and J. W. Van-Duyn (2000). Effect of Insecticides on *Trichogramma exiguum* (Trichogrammatidae: Hymenoptera) Preimaginal Development and Adult Survival. J. Econ. Entomol., 93(3): 577-583.

Consoli, F. L., J. R. P Parra and S. A. Hassan (1998). Side-effects of insecticides used in tomato fields on the egg parasitoid *Trichogramma pretiosum* Riley (Hym., Trichogrammatidae), a natural enemy of *Tuta absoluta* (Meyrick) (Lep., Gelechiidae). J. Appl. Entomol., 122: 43–47.

El-Bassiuony, H. M. (2006). The role of the natural enemies in reducing cotton infestation with some lepidopterous pests through the application of insect growth inhibitors and bio-insecticides. M. Sc. Thesis, Faculty of Agric. (Saba Bacha), Alex. Univ., Egypt.

El-Wakeil, N. and S. Vidal (2005). Using of *Chrysoperla carnea* in combination with *Trichogramma* species for controlling *Helicoverpa armigera*. Eygpt. J. Res., 83(3): 891-901.

Faria, C.A. (2000). Resposta funcional de *Trichogramma pretiosum* Riley (Hymenoptera: Trichogrammatidae) parasitando ovos de *Tuta absoluta* (Meyrick) (Lepidoptera Gelechiidae): efeito da idade do hospedeiro. An. Soc. Entomol. Bras. Itabuna, 29(1): 85-93.

Franz, J. M., H. Bogenschutz, S. A. Hassan, P. Huang, S. Naton, E. H. Suter and G. Viggiani (1980). Results of a joint pesticide test program by the working group: Pesticides and beneficial arthropods. Entomophaga, 25:231-236.

Godfray, H. C. J. (1994). Parasitoids: *Behavioral and Evolutionary Ecology*. Princeton University Press, Princeton, New Jersey, U.S.A.

Hassan, S. A. (1993). The mass rearing and utilization of *Trichogramma* to control lepedopterous pests: Achievements and outlook. Pestic. Sci. Essex App. Sci., 37(4):387-391.

Hassan, S. A., B. Hafes, P. E. Degrande and K. Herai (1998). The side effects of pesticides on the egg parasitoid *Trichogramma caecoeciae* Marchal (Hym., Trichogrammatidae), acute dose-response and persistence tests. J. Appl. Entomol. Zeitschrift fur Angewandte Entomologie, 122: 569-573.

Hassan, S. A., B. H. H. Bogenschutz, E. Boller, J. Brun, J. N. M. Callis, J. P Coremans, C . Duso, A. Grove, U. Heimbach, H. Hokkanen, G. B. Lewis, F. Mansour, L. Moreth, L. Polgar, L. S. Petersen, B. Suphanor, A. Staubli, G. Stern, A. Vainio, M. Van De Veire, G. Viggiani and H. Vogt (1994). Results of the sixth joint pesticide testing programme of the IOBC/WPRS-working group "Pesticides and Beneficial Organisms." Entomophaga, 39: 107-119.

Kapuge, S., S. Mcdougall, and A. A. Hoffmann (2003). Effects of methoxyfenozide, indoxacarb, and other insecticides on the beneficial egg parasitoid *Trichogramma nr. brassicae* (Hymenoptera: Trichogrammatidae) under laboratory and field conditions. . Econ. Entomol., 96: 1083–1090

Khidr, A. A., A. H. El-Heneidy, A. Abdel-Halim, M. A. Eissa and A. M. Matter (2003). Comparative studies between the efficiency of the egg parastiod *Trichogramma evanesecens* West. and the insecticidal application against the cotton bollworms in Egyptian cotton fields. The First Int. Egyptian Romanian Conf., Zagazig, Egypt, 6-8th Dec., 455-464.

King, E. G and E. P. Janine (1992). Propagation and release of natural enemies for control of cotton insect and mite pests in the United States. Crop Prrotiction 11: 497-506.

Knutson A. E. (2003). Release of *Trichogramma pretiosum* in cotton with a novel ground sprayer. Southwestern Entomologist, 28: 11

Monsarrat, A., S. Abol-Ela, I. Abdel-Hamid, G. Fediere, G. Kuhl, M. El-Husseini and J. Giannotti (1995). A new RNA Picorna-link virus in the cotton pink bollworm in Egypt. Entomophaga, 40: 47-54.

Salama, H. S. (1983). Cotton pest management in Egypt. Crop Prot., 2:183-191.

Shalaby, F. F., Alia M. Abd El-Hafez, E. F. El-khayat and A. A. El-Sharkawy (2002) Applied control of *Pectinophora gossypiella* (Saund) and *Earias insuulana* (Boisd.) in cotton field by *Trichogramma bactrae* Naagriai. 2nd Int. Conf., Plant Protection Res. Institute, Cairo, Egypt, 21-24 December, 403-411.

Shoeb, Mona A. (2010). Effect of some insecticides on the immature stages of the egg parasitoid *Trichogramma evanescens* West. (Hym., Trichogrammatidae). Egypt. Acad. J. Biol. Sci., 3 (1): 31- 38.

Smith, M., M. Hubbes and J. R. Garrow (1986). Factor affecting inudative releases of *Trichogramma minutu* Ril. against the spruce budworm. J. App. Entomol., 101: 29-39.

Smith, S. (1994). Methods and timing of releases *Trichogramma* to control lepidopteron Pests. *In*: Biological control with egg parasitoids. Wajnberg, E. and S. A. Hassan (eds.) CAB International, 113-144.

Takada, Y., S. Kawamura and T. Tanaka (2001). Effects of various insecticides on the development of the egg parasitoid *Trichogramma dendrolimi* (Hymenoptera: Trichogrammatidae). J. Econ. Entomol., 94: 1340–1343.

Thomson, L. J., D. C. Glenn and A. A. Hoffmann (2000). Effects of sulfur on *Trichogramma* egg parasitoids in vineyards: Measuring toxic effects and establishing release windows. Australian J. Exper. Agri., 40: 1165–1171.

Tuhan, N. C., A. D. Pawer and R. S. Arora (1987). Use of *Trichogramma brasiliansis* Ashmed against cotton bollworm in Srigangagar Rajasthan India. J. Advan. Zool., 8(2): 131-134.

Wang, C. L. (1997). Biological control of *Ostrinia furnacalis* with *Trichogramma* Spp. in China. *In*: *Trichogramma* and other egg parasites, 2nd Int. Sym., Voegel, J., J. Waage and J. Van Lenteren (eds.), les colloquse de l' INRA, 43: 609-611.

ا لمخص العر

استخدام الطفيل تريكوجراما إيفانسنس كافحة دودة اللوز القرنفلية وتأث بعض ا بيدات على الطفيل

عبدالفتاح سيد عبدالكر سعد، السيد حسن مد تايب، دي أم عوض، هشام مد البسيو

أجريت الدراسة ا الية لتقيم فعالية الطفيل تريكوجراما إيفانسنس كعامل مكافحة حيوية فعال ضد بيض دودة اللوز القرنفلية حقول القطن. تقدير تأث إطلاق الطفيل وتطبيق ا بيد ا شرى رادينت(سبينتورام) كلٍ فرده أو معاً وذلك على معدلات الإصابة بديدان اللوز وكذلك الإنتاجية. كما دراسة التأث ا ان للمبيدات ا شرية ا وصى با كافحة أفات القطن على الطفيل وهى چاما سيهالوثرين وكلورب فوس، سبينتورام، ميثوكسى فينوزيد والثياميثوكسام وذلك على بيض فراشة ا بوب (الذى التطفل عليه بواسطة الطفيل تريكوجراما إيفانسنس) أعمار تلفة ناهزت ٢٤، ٤٨، ٩٦، ١٩٢ساعة بعد التطفل حيث غمر البيض التركيزات ا وصى با حقلياً من ا بيدات ا خت ة دة ١٥ ثانية. وعلي هذا فإن استخدام هذا البيض ا تطفل عليه ذو أعمار ا ختلفة ثل الأعمار ا ختلفة من الأطوار الغ كاملة للطفيل داخل بيض العائل.

وقد تقدير نسبة خروج الأفراد الكاملة البالغة بعد معاملة البيض با بيدات ا ذكورة. أظهرت النتائج أن الطفيل تريكوجراما إيفانسنس كان فعالاً التطفل على بيض دودة اللوز القرنفلية حيث إطلاقه عدل ٣٣٠٠٠طفيل/فدان/إطلاقة وانعكس هذا على خفض الإصابة وزيادة الإنتاج. وقد ت مقارنة إطلاق الطفيل بتطبيق ا بيد رادينت فرده أو توليفة مع الطفيل. وحققت التوليفة باستخدام ا بيد ا شرى وإطلاق الطفيل أقل نسبة إصابة وصلت إ ١,٢ و٢,١%، وقد إنعكس ذلك علي إنتاجية ا صول ال بلغت ٨,٥، ٨,٢ قنطار/فدان مو ى ٢٠٠٩ و٢٠١٠ على التوا . وقد أظهر كل من الكلورب فوس والچاما-سيهالوثرين تأث ا السام إحداث نسبة تثبيط كاملة (١٠٠%) روج ا شرات الكاملة من الطفيل عند معاملة البيض ا توي على مراحل و تلفة بينما كان مركب ميثوكسى فينوزيد ا ركب الأقل ية والآمن تأث ه ضد الطفيل با قارنة مع ا ركبات الأخرى ا ستخدمة.