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COMPARISON BETWEEN CERTAIN BIO CONTROL COMPOUNDS AND *TRICHOGRAMMA* PARASITOIDS ON *Pectinophora gossypiella* AND *Earias insulana* ON COTTON PLANTS

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ABSTRACT

Results indicated variation effects of certain bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) in comparison with *Trichogramma evanescens* parasitoids on some biological parameters of *Pectinophora gossypiella* and *Earias insulana* such as %hatching, %larval mortality, larval and pupal weight, %pupation and adult emergence, larval and pupal duration, pupal and adult deformations, as well as effects on yield and yield loss after infestation under laboratory and field conditions on cotton plants in Minia Governorates.

INTRODUCTION

Cotton plants are attacked by two lepiodopeterous species. The pink bollworm, *Pectinophora gossypiella* (Saund.) and the spiny bollworm, *Earias insulana* (Boisd.), which considered as mid-late season pests and the most destructive insects (El-Shaarawy *et al.,* 1975). *P. gossypiella* emerges from the diapousing larvae in spring and continues into late July and early August. Some early moth's emergence occurs before cotton bolls are available (Slosser and Watson, 1975). On the other hand, *E. insulana* is a dangerous pest of cotton bolls in the majority of cotton areas. The importance of this pest is due to the fact that infestation happens in the early season. The young larvae attack the terminal growing points of the cotton plants (Badawy, 1971). The heavy infestation of the spiny bollworm occurs during mid-August till early November.

The present work aims to evaluate some bio-control compounds, plants extracts, IGR (Consult), the insecticide Cypermethrin and its mixtures in comparison with release of *Trichogramma evanescens* parasitoids on some biological aspects of *P. gossypiella* and *E. insulana* as well as effect on cotton yield.

MATERIALS AND METHODS

Adults of the pink bollworm, *Pectinophora gossypiella* and the spiny bollworm, *Earias insulana* were originated from eggs which obtained from a laboratory established strains reared in Plant Protection Research Institute, Dokki, Giza, Egypt, for two successive seasons (2007 and 2008).

1. Laboratory rearing:

The pink and spiny bollworms rearing by using semi-artificial diet with a slight modification (Rashad and Ammar 1985 and Mohamed 1996). The diet consists of 1000 g of dried beans boiled in water, 150 g dried yeast, 15 g me-

thyl- P-hydroxy benzoate, 6.5 g sorbic acid, 10 g ascorbic acid, 16.6 ml formalin and 66.6 g agar. The prepared diet was transferred into glass vials (2X7.5 cm). The eggs were incubated at 25±1°C and 65±5% relative humidity until hatching. The newly hatched larvae were transferred, via fine hair brush, into diet-vials, one or two larvae per each vial. The latter was copped with cotton piece, and all vials were incubated at the same rearing conditions until pupation.

The newly formed pupae were transferred to another glass vials, until moth emergence. The newly emerged moths were sex and adequate groups of females and males were confined, each in glass chimneys placed on a Petri-dish enclosed by muslin lay at its bottom. The upper chimney opening was covered with muslin that held in position by a rubber band. A thin strip of muslin fall down the upper one and a rubber stripe with cotton-piece soaked in 10% sugar solution for moth feeding. Muslin pieces were daily replaced by other clean ones and the old ones were put in small gars until egg hatching and incubated at the rearing conditions temperature 25ºC.

2. Compound used:

2.1. Spinosad [Spentor 24% SC (Dow Agrow Sciences)] is derived from the metabolites of the naturally occurring bacteria, *Saccharopolyspora spinosa.* Spinosad is associated with excitation of the insect nervous system (Salgado, 1998).

2.2. Consult 10% EC (hexaflumuron): A commercial product used in these trails in which the active ingredients based on formulated by Dow AgroSciences, 9330 Zionsville Rd.Indianapolis, IN 46268-1054, USA containing: 1-[3,5-dichloro-4-(1,1,2,2-tetrafluoroethoxy)phenyl]-3-(2,6-difluorobenzoyl) urea.

2.3. Agrin 32000 IU/mg (*Bacillus thurengiensis* var *kurstaki*):

A commercial microbial products used in these trails in which the active ingredients based on bacterium *Bacillus thurengiensis* var *kurstaki* (Bt) formulated by BioAgro International, Egypt containing (32000 IU/mg).

2.4.Cypermethrin: A commercial product used in these trails in which the active ingredients based on formulated by Agro-Chemie, containing: (*RS*)-α-cyano-3-phenoxybenzyl(1*RS,*3*RS*;1*RS,*3*SR*)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclo propanecarboxylate.

3. Plant extracts:

Tagetes oil: plant origin oil was extracted from leaves and flowers of *Tagetes minuta* plants by steam distillation according to (Wells *et al.,* 1992 and Weaver *et al.,* 1994). The samples were placed in flasks of 500 ml and water was added to cover the sample. Distillation took 180 minutes to obtain all the oil the sample.

4. *Trichogramma evanescens*:

The species of *Trichogramma evanescens* were obtained from "Centeral Laboratory of Mass Rearing of Trichogramma Parasitoid at El-Fayoum Governorate"

5. Relative toxicity of different compounds on *P. gossypiella* and *E. insulana* under laboratory conditions:

The tested compounds were sprayed (0.07 ml/litre) on the upper surface of diet. Five concentrations of each compound were used; twelve newly larval instars used and three replicates for each concentration were carried

out. Also, eggs were dipped for 4 seconds, and then left for drying and incubating at 25ºC and 75% RH in incubator until hatching. The percentage of survivals and dead larvae was recorded.

6. Determination the effect of different compounds on *P. gossypiella* and *E. insulana* under field conditions:

This study also conducted on cotton plants (Giza 80) grown in Minia Governorates. The experiments were conducted during beginning, mid and late July 2007 and 2008 seasons. The plots were arranged in complete randomized block with four replicates for each treatment, and another four replicates as control. The plots were sprayed with different tested agents using a knapsack sprayer with recommended concentration. Control plots were sprayed with water only.

The number of natural enemies was counted, and average percent infestation, yield weigh and yield loss were recorded at the end of the season.

7. Release of *Trichogramma evanescens*:

This study also conducted on cotton plants (Giza 80) grown in Minia Governorates (one feddan). The experiments were conducted during beginning, mid and late July 2007 and 2008 seasons. The plots were arranged in complete randomized block with four replicates, and another four replicates as control.

Trichogramma evanescens released on cotton field, the cards hold on the cotton plants (25 cards/feddan). Each card contains 1000 parasitoids eggs (2×3 cm), the cards hold above half meter from the ground and released three times.

8. Statistical analysis:

In laboratory tests, mortality percentages were calculated and corrected for natural mortalities by Abbott's formula (1925):

Field studies:

Reduction percentage of bollworms was calculated according to the equation of Henderson and Tilton (1955).

RESULTS AND DISCUSSION

1. Effect of different bio-control compounds, plant extract, IGR's and Cypermethrin on *P. gossypiella*:

1.1. %Hatching:

Results in Table (1) indicate the susceptibility of the newly instar larvae of *P. gossypiella* at laboratory conditions (25±1ºC and 65±5% R.H.) towards different bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1).

Results show that % hatching was highly affected with Consult and Cypermethrin (40.7 & 40.5), followed by mixture of Cypermethrin+ Agrin (3:1) and Spinosad+Tagetes (1:3) (35.4 and 31.4), whereas Spinosad+Tagetes (3:1) and Tagetes gave 26.0 and 25.5%, respectively finally, Agrin and Spinosad gave 16.3 and 16.0% hatching percentage, respectively during 2007 season.

During 2008 season, data indicated that hatching percentages was highly affected with Consult and Cypermethrin (48.0 & 35.0%), followed by mixture of Spinosad+Tagetes (3:1), Cypermethrin+ Agrin (3:1) and Tagetes (30.0, 28.0 and 28.0%) whereas Spinosad+Tagetes (1:3) gave 23.0%. Finally, both of Agrin and Spinosad gave 15.0% hatching percentage.

Similar results were obtained by Laecke *et al.* (1989) found hatching percentage of the eggs of the beet army worm, *S. exigua* was decreased when treated with sublethal doses of chlorfluazuron, diflubenzuron and hexaflumuron.

1.2. %Larval mortality:

Data show that %larval mortality was recorded for Spinosad+Tagetes (3:1) and Spinosad+Tagetes (1:3) with highly effects (70.7 & 60.4%), while mixture of Cypermethrin+ Agrin (3:1), Spinosad, and Agrin compounds exhibited low mortality (50.8, 50.8 and 53.5%), followed by Tagetes, Cypermethrin and Consult which gave 40.7, 40.5 and 30.7% percent larval mortality after 10 days from treatment, respectively during 2007 season.

During 2008 season, data indicated that %larval mortality was recorded for Spinosad+Tagetes (3:1) with highly effects (85.0%), while the different compounds came the next percent recording larval mortality ranged between 68-45.8% after 10 days from treatment, respectively.

This results coincided with that obtained by Mostafa (1998) who found that 50 ppm of lufenuron, 62 ppm of chlorfluazuron and 25 ppm of triflumuron had the same effect on the black cutworm, *Agrotis ipsilon* larvae causing 97.5% mortality of treated larvae.

1.3. Larval and pupal weight:

Results obtained in Table (1) show that the weight of larval instars of *P. gossypiella* with different bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were ranged between 180.3 to 220.5 compared with control (350.5) during 2007 season. Whereas ranged between 178.7 to 258.1 compared with untreated (350.5) during 2008 season.

On the other hand, weight of pupal instars ranged between 155.8 to 240.7 compared with untreated (140.7) during 2007 season. Whereas ranged between 158.7 to 280.5 compared with untreated (135.9) during 2008 season.

Abd El-Salam *et al*. (1979) reported that feeding of *Agrotis ipsilon* larvae on castor-been leaves dipped in dimilin resulted in increased larval mortality and decrease of pupation percentages and pupal weight in a concentration depending manner.

1.4. %Pupation and adult emergence:

Results obtained in Table (1) show that the percentage of pupation and adult emergence resulted from the larvae treated as newly instar of *P. gossypiella* with different bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were reduced in comparison to the untreated larvae. Consult and Tagetes exhibited the highest reduction in percentage of pupation (74.3 and

61.4), respectively. While, other compounds and its mixtures gave reduction in percentage of pupation round 55% during 2007 season comparison to the untreated larvae (82.0%). During 2008 season, Tagetes and Consult exhibited the highest reduction in percentage of pupation (68.0 and 70.7), respectively, followed by, other compounds and its mixtures. Agrin gave reduction in percentage of pupation round 55% in comparison to the untreated larvae (control) (85.0%).

Results obtained in Table (1) show that the percentage of adult emergence resulted from the larvae treated as newly instar of *P. gossypiella* with different bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were reduced in comparison to the untreated larvae. Compounds and its mixtures gave percentage of %adult emergence ranged between 43.4-60.7% during 2007 season comparison to the untreated larvae (81.9%). While during 2008 season, compounds and its mixtures gave percentage of %adult emergence ranged between 40-65.7% compared with the untreated larvae (control) (84.0%).

These results are in agreement with that obtained by El-Sayed (1981) and Aldebis *et al.* (1988). They found that the survival of treated *S. littoralis* larvae with diflubenzuron and flufenoxuron suffered a reduction in subsequent pupation and adult emergence.

1.5. Larval and pupal duration:

As shown in Table (1) data revealed that the duration of larvae and pupal instars of *P. gossypiella* with different bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were decreased or increased compared with untreated larvae.

Mixture of Spinosad+Tagetes (3:1) and Cypermethrin caused prolonged larval duration (33 and 25%), while other compounds and its mixtures decreased larval duration during 2007 season compared with the untreated larvae (control) (23%). While, during 2008 season all compounds caused increase in larval duration (18-28%) compared with untreated larvae (control) (15%).

Consult caused increase in pupal duration (29 and 31%), while other compounds and its mixtures decreased pupal duration compared with untreated larvae (control) (21 and 19%), during two seasons 2007 and 2008, respectively.

These results are in agreement with that obtained by Dimetry and Radwan (1979) recorded that the insect growth regulator, FMC-23509 prolonged slightly the duration of the larvae when topically applied to newly moulted 6^{th} instar larvae of *S. littoralis.* Also the percentage of pupated larvae was progressively decreased as the dose increased. The pupal duration correlated negatively with the dose of the insect growth regulator which showed ovicidal potentials at higher doses.

Table (1)

1.6. Pupal and adult deformations:

Results obtained in Table (1) show that Consult and Tagetes caused higher pupal and adult deformation during the two seasons, which gave (28.7&23.6%), and (30.1&25.7%) for pupae (20.0& 18.7%) and (15.7&13.6%) for adult, respectively. Whereas, Agrin and mixture of Spinosad+Tagetes (1:3) gave (9.0&8.7%), and (10.0&9.7%) for pupae, (11.8& 10.3%) and (13.0&11.3%) for adult, respectively.

Similar results were obtained by El-Badawy (1979), who found that diflubenzuron and Altosid (JHA), induced several morphogenetic effects in (larvae, pupae and adults) of *S. littoralis* treated as pre-pupae.

2. Effect of different bio control agents, plant extract, IGR's and Cypermethrin on *Earias insulana*:

2.1.%Hatching:

Results in Table (2) indicate the susceptibility of the newly instar larvae of *E. insulana* at laboratory conditions (25±1ºC and 65±5% R.H.) towards different bio control agents (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1).

Results show that %hatching recorded highly effects for Consult and Cypermethrin (44.7&38.0%), while mixture of Spinosad+Tagetes (1:3), Spinosad+Tagetes (3:1), Cypermethrin+ Agrin (3:1) and Tagetes come next (28.0, 28.0, 23.8 and 27.3%, whereas Spinosad and Agrin gave 18.0 and 14.7%, respectively during 2007 season.

During 2008 season, data indicated that hatching percentages were recorded for Consult and Cypermethrin exhibited highly effects (43.5&40.5%), followed by mixture of Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3) and Cypermethrin+ Agrin (3:1) gave (31.7, 30.7 and 30.5%, whereas Tagetes, Spinosad and Agrin gave 20.5, 16.7 and 16.7%, respectively during 2008 season.

2.2. %Larval mortality:

Data in Table (2) show that %larval mortality recorded highly effects for Spinosad+Tagetes (3:1) (80.1%), while mixture of Spinosad+Tagetes (1:3), Agrin, Cypermethrin+ Agrin (3:1), Tagetes, and Spinosad come to the next (60.4, 53.5, 50.8, 50.7 and 48.4%), whereas, Cypermethrin and Consult gave 40.5 and 30.7% percent larval mortality after 10 days from treatment, respectively during 2007 season. Also, similar trend was occurred during 2008 season.

Similar results were obtained by Moawad *et al.* (1996) found Buprofezin recorded 27.3% larval mortality of *S. littoralis*.

2.3. Larval and pupal weight:

Results obtained in Table (2) show that the weight of larval instars of *E. insulana* with different bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were ranged between 180.7 to 240.4 compared with control (370.3) during 2007 season. Whereas, it ranged between 155.6 to 207.5 compared with control (350.4) during 2008 season.

On the other hand, weight of pupal instars ranged between 155.7 to 260.5 compared with control (130.6) during 2007 season. Whereas, it ranged between 155.6 to 280.4 compared with control (155.6) during 2008 season.

Abd El-Kader *et al.* (1995) found that larval and pupal durations of *S. littorals* became longer and pupal weight decreased when treated with triflumuron and chlorfluazuron and their combinations.

2.4. %Pupation and adult emergence:

Results obtained in Table (2) show that the percentage of pupation and adult emergence resulted from the larvae treated as newly instar of *E. insulana* with different bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were reduced in comparison to the untreated larvae (control). Tagetes, Cypermethrin+ Agrin (3:1), Consult and Cypermethrin exhibited the highest reduction in percentage of pupation, recorded 64.7, 61.7, 60.8 and 60.7%, respectively. While, Spinosad+Tagetes (1:3) and Agrin gave reduction in percentage of pupation round between 55.7 and 45.5% during 2007 season compared with the untreated larvae (control) (80.5%). The similar trend was occurred during 2007/2008 season.

These results are in agreement with that obtained by Abd El-Naby *et al.* (1990) who found that chlorfluazuron and triflumuron caused reduction in pupation and adult emergence percentages when 4th instar larvae of *S. littoralis* treated with different concentrations of the two tested compounds.

2.5. Larval and pupal duration:

Data in Table (2) show that larval and pupal duration of *E. insulana* treated with different bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) decrease or increase compared with untreated larvae (control).

Mixture of Spinosad+Tagetes (3:1) caused increase in larval duration (29%), while other compounds and its mixtures decrease larval duration during 2007 season compared with the untreated larvae (control) (28%). While, during 2008 season all compounds caused increase in larval duration (18-25%) compared with untreated larvae (control) (14%).

Consult caused increase in pupal duration (27 and 28%), while other compounds and its mixtures decreased pupal duration compared with untreated larvae (control) (22 and 20%), during the two seasons 2007 and 2008, respectively.

These results coincided with that obtained by Abd El-Kader *et al.* (1995) who studied the effect of triflumuron and chlorfluazuron and their combinations on some biological aspects of *S. littoralis.* Data indicated that larval and pupal durations became longer and decrease in pupal weight, while the adult life span shortened compared to the control insects. They also, reported that the fecundity of the produced adults was highly reduced in all treatments.

Table (2)

2.6. Pupal and adult deformations:

Results obtained in Table (2) showed the pupal and adult deformation of *E. insulana* with different bio-control compounds (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1).

Consult and Tagetes caused higher pupal and adult deformation during the two seasons, gave (25.6&35.3%), and (31.5&30.4%) for pupae, and (15.0& 15.7%), and (28.7&25.1%) for adult, respectively. Whereas, Agrin and mixture of Spinosad+Tagetes (1:3) gave (7.0&5.8%), and (14.0&15.6%) for pupae, and (6.5& 4.7%), and (7.8&8.7%) for adult, respectively.

Similar results were obtained by Prasad *et al.* (1992) who found that topical treatment of last-instar larvae of *S. litura* with diflubenzuron caused inhibition of moulting and various deformities in the pupae and adults.

3. Effect of bio-control compounds, plant extract, IGR's and Cypermethrin on yield and yield loss after infestation with:

3.1. *Earias insulana*:

As shown in Table (3) data indicated that the %infestation with *E. insulana* in Minia Governorate reached 17.8% when release *Trichogramma* parasitoids three times, while, %infestation after spraying with bio control agents (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were 17.8, 14.8, 7.8, 10.5, 7.4, 11.0, 16.7, 10.5 and 8.7%, respectively compared with control (20.3%) during 2007 season.

Obtained results in Table (3) indicated that the yield loss after infestation with *E. insulana* reached 66.4% after releases *Trichogramma* parasitoids three times, while the yield loss reached 45.6, 18.7, 47.5, 20.8, 21.6, 50.7, 47.6 and 19.7 when spraying with Consult, Spinosad, Tagetes, Spinosad+Tagetes (3:1), Cypermethrin, Agrin, Cypermethrin+ Agrin (3:1), and Spinosad+Tagetes (1:3), respectively, compared with control (68.7%).

Results obtained in Table (3) indicated that the actual yield after infestation with *E. insulana* reached 4.0 after releases *Trichogramma* parasitoids three times, while the actual yield reached 4.3, 8.0, 3.2, 7.5, 7.3, 3.4, 4.9 and 5.0 when spraying with Consult, Spinosad, Tagetes, Spinosad+Tagetes (3:1), Cypermethrin, Agrin, Cypermethrin+ Agrin (3:1), and Spinosad+Tagetes (1:3), respectively compared with control (3.0%) during 2007 season (Table 3). While, during 2008 season, data in Table (4) indicated that the %infestation with *E. insulana* in Minia Governorate reached 18.7% when release *Trichogramma* also, %infestation after spraying with bio control agents (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were 15.4, 9.7, 11.3, 8.7, 11.8, 18.7, 11.8, and 9.7, respectively compared with control (18.8%).

As shown in Table (4) data indicated that the yield loss after infestation with *E. insulana* reached 68.7% after releases *Trichogramma* parasitoids three times, while the yield loss reached 48.3, 15.9, 48.3, 19.7, 21.8, 55.4, 45.7 and 18.7 when spraying with Consult, Spinosad, Tagetes, Spi-

nosad+Tagetes (3:1), Cypermethrin, Agrin, Cypermethrin+ Agrin (3:1), and Spinosad+Tagetes (1:3), respectively compared with control (68.8%). Also, the actual yield after infestation with *E. insulana* reached 4.3 after releases *Trichogramma* parasitoids three times, while the actual yield reached 4.8, 8.3, 3.7, 8.2, 7.5, 3.5, 4.8 and 5.3/Feddan when spraying with Consult, Spinosad, Tagetes, Spinosad+Tagetes (3:1), Cypermethrin, Agrin, Cypermethrin+ Agrin (3:1), and Spinosad+Tagetes (1:3), respectively compared with control (3.75%) during 2008 season.

3.2. *Pectinophora gossypiella*:

Also, data obtained in Table (3) indicated that the %infestation with *P. gossypiella* in Minia Governorate reached 18.9% when release *Trichogramma*, also, when spraying with bio control agents (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were 16.0, 9.8, 11.3, 8.4, 11.7, 18.7, 9.7 and 11.5, respectively compared with control (18.7%) %) during 2007 season.

Results obtained in Table (3) indicated that the yield loss after infestation with *P. gossypiella* reached 60.5 after releases *Trichogramma* parasitoids three times, while the yield loss reached 55.7, 16.3, 45.4, 20.0, 17.6, 47.3, 46.7 and 18.7 when spraying with Consult, Spinosad, Tagetes, Spinosad+Tagetes (3:1), Cypermethrin, Agrin, Cypermethrin+ Agrin (3:1), and Spinosad+Tagetes (1:3), respectively compared with control (65.7%) %) during 2007 season.

Table (3): Effect of different bio-control compounds, IGR's, Cypermethrin and release *Trichogramma* parasitoids on yield and yield loss after infestation with *Pectinophora gossypiella* and *Earias insulana* during 2007 season.

Trade name	*Earias insulana*			*Pectinophora gossypiella*		
	Average % infestation	Yield loss%	Actual yield	Average % infestation	Yield loss%	Actual yield
Trichogramma	17.8	66.4	4.0	18.9	60.5	3.9
Consult	14.8	45.6	4.3	16.0	55.7	3.9
Spinosad	7.8	18.7	8.0	9.8	16.3	7.8
Tagetes	10.5	47.5	3.2	11.3	45.4	4.3
Spinosad+Tagetes (3:1)	7.4	20.8	7.5	8.4	20.0	6.8
Cypermethrin	11.0	21.6	7.3	11.7	17.6	6.0
Agrin	16.7	50.7	3.4	18.7	47.3	3.5
Cypermethrin+Agrin (3:1)	10.5	47.6	4.9	9.7	46.7	5.0
Spinosad+ Tagetes (1:3)	8.7	19.7	5.0	11.5	18.7	7.0
Control	20.3	68.7	3.0	18.7	65.7	3.2

As shown in Table (3) data indicated that the actual yield after infestation with *P. gossypiella* reached 3.9 after releases *Trichogramma* parasitoids three times, while the actual yield reached 3.9, 7.8, 4.3, 6.8, 6.0, 3.5, 5.0 and 7.0 when spraying with Consult, Spinosad, Tagetes, Spinosad+Tagetes (3:1), Cypermethrin, Agrin, Cypermethrin+ Agrin (3:1), and Spinosad+Tagetes (1:3), respectively compared with control (3.2%) %) during 2007 season.

Whereas, data obtained in Table (4) indicated that the %infestation with *P. gossypiella* in Minia Governorate reached 20.3% when release *Trichogramma*, also, when spraying with bio control agents (Spinosad and Agrin), plant extract (Tagetes), IGR (Consult) and Cypermethrin & its mixtures [(Spinosad+Tagetes (3:1), Spinosad+Tagetes (1:3)] and Cypermethrin+ Agrin (3:1) were 16.3, 10.5, 10.5, 9.8, 13.7, 20.7, 10.8 and 10.5, respectively compared with control (20.3%) during 2008 season.

Table (4): Effect of different bio-control compounds, IGR's, Cypermethrin and release *Trichogramma* parasitoids on yield and yield loss after infestation with *Pectinophora gossypiella* and *Earias insulana* during 2008 season.

Trade name	*Pectinophora gossypiella*			*Earias insulana*		
	Average % infestation	Yield loss	Actual yield	Average % infestation	Actual yield	Actual yield
Trichogramma	18.7	68.7	4.3	20.3	63.4	3.7
Consult	15.4	48.3	4.8	16.3	50.5	4.0
Spinosad	9.7	15.9	8.3	10.5	15.7	7.5
Tagetes	11.3	48.3	3.7	10.5	44.7	4.0
Spinosad+Tagetes (3:1)	8.7	19.7	8.2	9.8	20.7	7.3
Cypermethrin	11.8	21.8	7.5	13.7	20.8	6.4
Agrin	18.7	55.4	3.5	20.7	50.4	3.7
Cypermethrin+Agrin (3:1)	11.8	45.7	4.8	10.8	48.6	5.2
Spinosad+Tagetes (1:3)	9.7	18.7	5.3	10.5	19.8	6.0
Control	18.8	68.8	3.75	20.3	75.3	3.4

Results obtained in Table (4) indicated that the yield loss after infestation with *P. gossypiella* reached 63.4 after releases *Trichogramma* parasitoids three times, while the yield loss reached 50.5, 15.7, 44.7, 20.7, 20.8, 50.4, 48.6 and 19.8 when spraying with Consult, Spinosad, Tagetes, Spinosad+Tagetes (3:1), Cypermethrin, Agrin, Cypermethrin+ Agrin (3:1), and Spinosad+Tagetes (1:3), respectively compared with control (75.3%) during 2008 season. Also, the actual yield after infestation with *P. gossypiella* reached 3.7 after releases *Trichogramma* parasitoids three times, while the actual yield reached 4.0, 7.5, 4.0, 7.3, 6.4, 3.7, 5.2 and 6.0 when spraying with Consult, Spinosad, Tagetes, Spinosad+Tagetes (3:1), Cypermethrin, Agrin, Cypermethrin+ Agrin (3:1), and Spinosad+Tagetes (1:3), respectively compared with control (3.4%) during 2008 season.

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المقارنة بين فعالية بعض المركبات الحيوية وطفيل التريكوجراما علي دودة اللوز القرنفلية ودودة اللوز الشوكية علي محصول القطن

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أوضحت النتائج حدوث تأثيرات متباينة لبعض المركبات الحيوية مثل (الإسبينوساد، الأجرين)، المستخلص النباتي (القطيفة العطرية)، منظم النمو الحشري (كونسلت)، ومبيد السيبرمثرين، ومخاليط الإسبينوساد + القطيفة العطرية (1:3)، الإسبينوساد + القطيفة العطرية (3:1)، السيبرمثرين + الأجرين (1:3) وكذلك إطلاق طفيل التريكوجراما علي بعض الأنشطة الحيوية لدودة اللوز القرنفلية ودودة اللوز الشوكية مثل النسبة المئوية للفقس، النسبة المئوية لموت اليرقات، النسبة المئوية للتعذير، مدة حياة اليرقات والعذاري، ووزن اليرقات والعذاري، والنسبة المئوية لحدوث التشوهات في العذاري والحشرات الكاملة وكذلك معدل الفقد في محصول القطن في محافظة المنيا.

قام بتحكيم البحث

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Table (1): Effect of different bio-control compounds, IGR's and Cypermethrin on *Pectinophora gossypiella* during 2007 and 2008 seasons.

Treatment	% Hatching	%Larval mortality				Larval weight	Pupal weight	% Pupation	% Emergence	Larval duration	Pupal duration	% Pupal malformation	% Adult malformation
		One day	3 days	5 days	10 days								
2007													
Consult	40.7	23.0	40.6	45.0	30.7	200.5	190.7	74.3	57.7	19.0	29.0	28.7	20.0
Spinosad	16.0	48.0	60.0	45.7	50.8	193.7	-	-	-	-	-	-	-
Tagestes	25.5	51.3	44.7	51.4	40.7	181.5	160.7	61.4	60.7	20.0	15.0	23.6	15.7
Spinosad+Tagestes (3:1)	26.0	22.9	50.7	53.8	70.7	190.5	-	-	-	33.0	-	-	-
Cypermethrin	40.5	30.5	45.7	45.8	40.5	180.7	200.3	55.9	60.0	25.0	18.0	-	-
Agrin	16.3	51.6	57.4	51.6	53.5	180.3	203.5	58.6	43.4	20.0	16.0	9	11.8
Cypermethrin+Agrin (3:1)	35.4	45.7	50.5	53.4	50.8	220.5	240.7	55.8	60.8	16.0	19.0	-	-
Spinosad+ Tagestes (1:3)	31.4	60.5	61.4	58.5	60.4	203.7	155.8	55.6	50.7	20.0	17.0	10	13.0
Control	93.0	12.0	15.0	14.0	18.5	350.5	140.7	82.0	81.9	23.0	21.0	-	-
2008													
Consult	48.0	30.0	40.0	40.0	55.6	200.7	180.7	68.0	65.7	18.0	31.0	30.1	18.7
Spinosad	15.0	68.0	65.0	65.0	68.0	178.7	-	-	-	-	-	-	-
Tagestes	28.0	45.0	55.0	55.7	45.8	202.8	158.7	70.7	65.0	21.0	14.0	25.7	13.6
Spinosad+ Tagestes (3:1)	30.0	25.0	45.0	65.0	85.0	203.5	-	-	-	-	-	-	-
Cypermethrin	35.0	35.0	45.0	47.0	58.0	207.8	225.7	58.5	65.4	28.0	16.0	-	-
Agrin	15.0	65.0	60.0	55.0	50.0	198.7	203.5	50.0	40.0	23.0	14.0	8.7	10.3
Cypermethrin+ Agrin (3:1)	28.0	55.0	50.0	50.0	58.0	258.1	280.5	55.8	58.9	20.0	15.0	-	-
Spinosad+ Tagestes (1:3)	23.0	65.0	60.0	60.0	48.0	255.6	225.1	55.5	50.0	27.0	16.0	9.7	11.3
Control	98.0	5.0	8.0	15.0	15.0	350.6	135.9	85.0	84.0	15.0	19.0	-	-

Table (2): Effect of different bio-control compounds, IGR's and Cypermethrin on *Earias insulana* during 2007 and 2008 seasons.

Treatment	% Hatching	%Larval mortality				Larval weight	Pupal weight	% Pupa-tion	%Emergence	Larval duration	Pupal duration	%Pupal malfor-mation	%Adult malfor-mation
		One day	3 days	5 days	10 days								
2007													
Consult	44.7	25.0	38.5	45.4	30.7	208.7	185.5	76.4	60.8	20.0	27.0	25.6	15.0
Spinosad	18.0	58.0	63.7	60.4	48.4	188.5	-	-	-	-	-	-	-
Tagestes	23.8	41.7	40.8	50.8	50.7	180.7	155.7	65.8	64.7	21.0	16.0	31.5	28.7
Spinosad+ Tagestes (3:1)	28.0	23.7	48.7	60.7	80.1	198.7	-	-	-	29.0	-	-	-
Cypermethrin	38.0	32.6	43.4	45.3	40.5	200.3	220.5	60.7	60.5	26.0	17.0	-	-
Agrin	14.7	55.4	58.3	50.4	53.5	190.7	209.4	55.7	45.5	21.0	18.0	7.0	6.5
Cypermethrin+Agrin (3:1)	27.3	50.7	48.4	50.5	50.8	240.3	260.5	50.7	61.7	19.0	18.0	-	-
Spinosad+ Tagestes (3:1)	28.0	60.4	58.4	60.3	60.4	240.4	208.9	50.5	55.7	22.0	18.0	14.0	7.8
Control	95.0	7.4	10.5	15.4	18.5	370.3	130.6	80.7	80.5	28.0	22.0	-	-
2008													
Consult	43.5	28.0	33.6	40.0	35.5	207.5	155.6	45.0	45.7	18.0	28.0	35.3	15.7
Spinosad	16.7	50.3	57.8	58.7	50.5	195.9	-	-	-	-	-	-	-
Tagestes	20.5	45.6	41.8	51.7	53.8	190.6	158.7	55.6	60.7	19.0	15.0	30.4	25.1
Spinosad+ Tagestes (3:1)	31.7	25.7	50.6	55.8	78.6	155.6	-	-	-	-	-	-	-
Cypermethrin	40.5	35.7	45.8	40.7	53.6	197.6	280.4	65.7	63.5	23.0	17.0	-	-
Agrin	16.7	50.5	55.8	45.8	50.7	195.7	200.4	45.7	40.7	21.0	16.0	5.8	4.7
Cypermethrin+Agrin (3:1)	30.5	51.6	49.7	55.8	43.7	205.7	255.8	51.6	63.6	18.0	14.0	-	-
Spinosad+ Tagestes (3:1)	30.7	61.8	50.7	63.6	60.5	203.5	200.7	55.6	56.5	25.0	16.0	15.6	8.7
Control	96.5	7.3	5.7	10.7	12.4	350.4	155.6	85.7	83.6	14.0	20.0	-	-