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COMPARATIVE EFFICACY OF *Trichogramma evanescens* WEST. AND THE BIOCIDE (AGERIN) WITH RECOMMENDED INSECTICIDES PROGRAM FOR CONTROLLING COTTON BOLLWORMS AND ITS EFFECT ON COTTON PRODUCTIVITY IN MIDDLE EGYPT REGION.

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ABSTRACT

This study was carried out at Mallawi region , Minia, Governorate during three successive seasons of cotton (2004, 2005 and 2006) to evaluate the efficiency of releasing distances , numbers of releasing times of the egg- parasitoid , *Trichogramma evanescens* West. and further to determine the effect of such parasitoid; alone or with Agerin, (a local commercial product of *Bacillus thuringiensis*) as a biological control compared with recommended insecticides (Nastiban ,Tetition and Kendo) against the bollworms *Pectinophora gossypiella* and *Earias insulana* infesting cotton fields.Besides, effects of different treatments on seed cotton yield and some yield components were also studied.Results could be concluded as follows :

The efficiency of the egg- parasitoid , *T. evanescens* releasing process was gradually enhanced with decreasing the distance between the wasp release point, but with increasing number of applications. The lowest cotton boll damage caused by the bollworm larvae and highest cotton productivity were obtained from cotton fields 10 m away between releasing points with no significant differences between 10 and 15 m releasing distances .The higher number of *Trichogramma* application (five times) gave the lowest mean number of bollworm larvae (2.5 and 2.8) associated with the highest number of open bolls/plant (11.1 and 9.8),boll weight(2.92 and 2.89) and seed cotton yield (8.0 and 6.8 kent./fed.) in both season, respectively.

Results showed that the biological control by egg- parasitoid, *T. evanescens* alone or with Agerin (*B.t.*) was more efficient than chemical control in reducing boll worms damage and in improving cotton yield under both early and late planting dates. Early planting of cotton fields gave lower bollworm infestation and higher yield and yield components in all control treatments as compared with late planting in both seasons. The maximum reduction in bollworm and the highest seed cotton yield and yield components were produced by the combination application of *Trichogramma* parasite and Agerin (*B.t*) followed by *Trichogramma* alone.

In addition, biological control against bollworm increased number of five predaceous insects in released cotton as compared with chemical control in both seasons. The highest number of predators was recorded in fields treated with *Trichogramma* parasite and Agerin (*B.t.*). together (52.6 , 72.6) ,

followed by those released with *Trichogramma* parasite alone (46.4 , 63.6), treated areas with recommended insecticides
were the least (31.7 , 33.8) in both seasons, respectively

Furthermore, biological control reduced the costs of cotton protection. The costs of protection per feddan were dropped by 60.15 % and 27.10 % for the utilization of *Trichogramma* parasite and with Agerin (*B.t.*) compared with the chemical treatments.

It could be concluded that the biological control program including five applications of the *Trichogramma* parasite and two sprays of Agerin (*B.t.*) achieved the highest rate of reduction in infestation cotton bollworms, increasing predaceous insects associated with bollworms, improving cotton productivity, decreasing the costs of cotton protection process and avoiding environmental pollution at the same time.

INTRODUCTION

Cotton is considered the main economic crop in Egypt. It is the first crop used for fiber and oil production , and the second crop used for livestock provender production. It is also considered the main crop for export. This crop is exposed to be infested during different growing stages with several insect pests such as pink bollworm (PBW), *Pectinophora gossypiella* (Saunders) and spiny bollworm (SBW), *Earias insulana* (Boisd.).These insects are the principal pest of cotton in Egypt which cause considerable loss in quality and quantity of cotton yield in spite of the wide spread use of insecticides to control of them.(El – Shaarawy *et al* 1975 ; Abul – Nasr *et al.* 1979, and Mesbah *et al.* 2003) .Pink and Spiny bollworms cause damage by attacking terminal shoots, flower buds, and green bolls. The most serious damage to cotton is caused when larvae bore into the bolls, destroying the fiber, consuming seeds, and producing putrefaction due to the accumulation of feces and fungus. In some regions, if the attack is not controlled, *P. gossypeilla E. insulana* larvae can destroy all the cotton bolls in the field. The main period of infestation on cotton occurs between Huly toSeptember. The economic threshold level is 3 -5 % percent infestation of green bolls . Yielld losses varied from 4-7 % in years of light infestation up to 30 %in untreated cotton(Mesbah *etal.* 2003).

The extensive use of conventional insecticides has given rise to problems such residual toxicity and environmental pollution, development of pesticides resistance pest strains , rapid resurgence of target pests, outbreak of secondary pests , high costs , perceived risk to human health and disturbance of natural balance between pests and their natural enemies. In order to avoid these hazards, there is great need to develop alternative safe control agents, one of these is using biological. The egg parasitoid , *Trichogramma evanescens* (West) alone or combined with *Bacillus thuringiensis* subspecies Egypt (Agerin)show considerable promise in controlling several important lepidopterous pests in various crops having no adverse effect on beneficial insect species (parasites and predators) and having non toxic effect to people , plants , animals and fish.(Gergis *et al.* 2001; Abbas 2004 ; Mansour, 2004 and Tohamy and Hafez , 2005).

Trichogramma wasps attack the eggs of over 200 species of moths and butterflies. These almost microscopic wasps (0.5 mm;1/50 inch) are very important in preventing crop damage because they kill their hosts before the insects can cause plant damage. The female *Trichogramma* lays an egg within a recently laid host egg, and as the wasp larva develops, the host egg turns black. Each female parasitizes about 100 eggs and may also destroy additional eggs by host feeding. The short life cycle of 8-10 days allows the wasp population to increase rapidly. These wasps are harmless to people, animals, and plants (Wasilla 2003).

Several authors reported the important role of using *Trichogramma evanescens* for controlling cotton bollworms in Egypt (Tohamy ,1997; Alia *et al.* , 2002 ; Shalaby *et.al.* 2002 ; El –Heneidy *et. al.* , 2004).The egg parasitoid, *T. evanescens* parasitizes successfully on the eggs of the cotton bollworms and drastically reduces their damage (Mesbah *et al.* 2003).

The production and use of biological compounds such as *Bacillus thuringiensis* (*B.t.*) for controlling spiny and pink boll worm has been used by Abul-Nasr *et al.*, 1983; Bekheit *et al.*,1995; Zidan *etal.* 1998; Bekheit, 1999 Alia *et al.* , 2002 and María *et al.*, 2006).In frame of Integrated Pest Management (IPM), the utilization of bioagents has been seen to reduce the cost of protection by at least 65 % and increase the efficiency of pest suppression (Kogan , 1998)

The results obtained from this study will be used as the basis for the development of an integrated pest management program for this cotton bollworms in Egypt.

MATERIALS AND METHODS

Field experiments:

Three field experiments were conducted at Mallawi region , Minia Governorate, during the cotton growing seasons ; 2004, 2005 and 2006 .The chosen fields were prepared and planted with the recommended cotton cultivar ,Giza 80 on March 25 th . Complete randomized block design was used in four replicates. All normal agriculture practices excluded any pesticides use, were done in the releasing plots during the seasons of study in the three experiments.

1- Efficiency of *Trichogramma* releasing distances:

To determine the proper releasing distances (10, 15 or 20 meters) of the egg- parasitoid, *T. evanescens* , an area of about five feddans, at Mallawi Agriculture Secondary school Farm was divided into three equal parts. Each part far apart 100 m from other to reduce movement parasitoid adult across treatment .Each parts contained 4 plots each of 1750 m2. The three parts were randomly chosen and specialized for each treatment. of :

a- The parasitoid bags were hanged on upper leaves of cotton plants with far 20 meters between releasing points. b-Releasing of parasitoid bags were put on the plants , 15 meters away from the point of wasp release . c- Releasing of parasitoid bags in distance of 10 meters apart. Release bag each was measured 5x3 cm and contained two small cards , each produced 500 individuals , represented two ages of parasitized eggs gave two waves of wasps at 2- days intervals. The releasing of egg parasitoid bags carried out

biweekly in all the treatments beginning of the first week of July till the first week of September in each season. The parasitoid was obtained from *Trichogramma* Mass Production Laboratory in Mallawi Agricultural Research Station , Plant Protection Research Institute, Agricultural Research Center, Giza.. Techniques for mass production of *Trichogramma* parasitoid were as described before by Tohamy (2002).

2- Efficiency of times number of *Trichogramma* application :

Another area of about five feddans was used to determine the proper number of the egg- parasitoid , *T. evanescens* application . Such area was divided into four equal parts, each replicate four plots.The plot area was 1312.5 m^2 The egg parasitoid bags were released at rate of 22000 individuals /fed. each one , two .three and four weeks in the replicates of the first, second , third and fourth part , respectively, at sites of 15 meters apart Factors studied in this case were one , two , three , four and five releases of the egg parasitoid. in sites of 15 meters apart between release points ,at 10 day intervals , before three mouths after planting.The releasing process was done during the cotton flowering and fruiting stage , *i.e. Trichogramma* (egg parasitoid bags) were released five , four , three and two times in the considered parts , respectively.

3- Efficiency of *T. evanescens*, Agerin and chemical insecticides for controlling bollworms in two planting dates :

An area of about 100 feddans was selected in each Naga marcab and Tanda villages, from Mallawi region and planted with cotton seeds in two dates during 2005 and 2006 seasons : early date in March, 25 at (Naga marcab site) and lately in 25 April at (Tanda site). Each area was divided into three equal parts ; each included 4 plots for early planting and 4 plots for late plantig date. An area of each plots about four feddans. The first part was specialized to distributed egg-parasitoid cards at rate of 22 000 wasps/ fed, in distant 15 m from releasing points, five dates at biweekly intervals starting from the first week of July to the first week of September in early and late sowing dates in each region . The second part was specialized for releasing egg-parasitoid cards in the same rate and dates combined with Agerin (*B.t.*) which applied two times only in the second week of July and August at a dose of 500 gm /1000 LW/ fed. in both sowing dates.. The latter part was located, about 500 m apart from the release plots to prevent connection between the parasitoid and chemical treatments .The recommended conventional insecticidal program in cotton field was applied three times, Nastban 48% (phosphorus insecticide) was sprayed at a dose of one liter per 600 LW in the second week of July , the Tetiton 72% (phosphorus insecticide) was applied at a dose of 750 cm^3 / 600 LW in the first week of August and pyrethroids insecticide (Kendo 24.35%) was sprayed at a dose of 375 cm^3/ 600 LW in the third week of August in both sowing dates. Each insecticides was applied in four replicates randomly were chosen this part.

Sampling techniques and evaluation measurements:

Weekly samples of 50 green cotton bolls/ plot were collected at random from each treatment. These samples were shosen from the three sites starting from the first week of July up to the first week of

September .The samples were transferred to the laboratory in paper bags for inspection and estimating the percentage of infestation .Sampling procedure used for estimating the percentages of infestation was done according to Abd El- Salam *et al.* (1991) .

$$\text{Percentage of infestation} = \frac{\text{No. of infested bolls}}{\text{Total no. of collect bolls}} \times 100$$

Field releases of *Trichogramma* were evaluated by measuring bollworms infestation percent, crop damage and economic return relative to similar fields treated with insecticides

At harvest of the three experiments , sampling of 10 plants was randomly chosen from each plot to estimate number of open bolls per plant. Samples of 25 harvestable were randomly collected to determine the average boll weight (gm) .Seed cotton yield was estimated in kentars per feddan .

Assessment of predators:

Five species of predators were surveyed. Larval stages of *Coccinella undecimpunctata* Reiche ;*Orius albidipennis* (Reut.); *Chrysoperla carnea* Steph ; *Paederus alferii* Koch and true spiders were counted weekly . Ten cotton plants were chosen randomly from each plot/ treatment during 2005 and 2006
seasons susing lens (5x).

Assessment of control cost:

The control cost of bollworms in cotton fields has been calculated in one feddan /treatment. The price of egg parasitoids; 1000 gm Agerin, 1000 cm3 Nastibam, 750 cm^3 Titetion ; wages of labours/ treatment and charter of spray motor at five times were estimated. The percent reduction of bollworm control cost in cotton field treated with egg- parasitoids, *T. evanescens* and those treated with egg-parasitoid plus Agerin were calculated compared with fields treated with recommended insecticides.

Statistical analysis was done to show the significance of differences among means of treatments according to Duncan's (1955) method through SAS- computer program .

RESULTS AND DISCUSSION

Data in Table (1) showed that the mean percentages of infestation ranged between 5.1 – 6.3 with an average of 5.70 % ; 3.0 -3.5 with an average of 3.25% and 2.0 – 2.30 with an average of 2.15% in plots treated with *Trichogramma* cards at distant 20 , 15 and 10 m apart from releasing points, respectively in the two seasons. Generally , lowest mean percent of boll worm infestation was achieved in released plots at 10 m apart between releasing points followed with ones treated with 15 m apart. Mean highest percentages of infested bolls and least yield were recorded in the released plots at 20 m apart in the two seasons. treated with in the two seasons. On the other hand, the obtained data showed that there are significant difference between the distance of *Trichogramma* cards (20 m and 10 m) but no significant differences were found between the effectiveness of the two releasing distances (10 and 15 m) for the percent of infestation. Generally, our results are in agreement with those reported by Hirai *et al.* (1996).

Results in Table (2) showed the minimum average of infestation rate by bollworms larvae was achieved in cotton field treated five times by *Trichogramma* parasite where it was 2.5 and 2.8 % with an average of 2.65 % in two seasons , respectively. The maximum mean infestation level (5.5 and 6.6% with an average of 6.05%) was recorded on released plots two times by the parasitoid. The present study obviously indicated that, there were significant difference in the larval infestation by bollworms among the cotton field treated with five releases of *Trichogramma* parasitoid as well as treated with both three and two times. Similar results were obtained by Tuhan *et al.* (1987) who showed that release of *Trichogramma brasiliense* at a rate of 20000 newly emerged adults/acre per week significantly reduced the damage caused to cotton by *Earias insulana, E. vittella and Pectinophora gossypiella*. Releases at the same rate but at intervals of 15 and 30 days were less effective.

Results presented in Table (3) indicated that. the mean percentages of infestation in cotton green bolls in both seasons ranged between 3.6 – 5.3 with an average of 4.45 %; 2.8 -5.1 with an average of 3.95 % and 5.5 – 6.8 with an average of 6.15 % in early sown plots ranged between 6.3 – 7.3 with an average of 6.8% ; 6.0 -6.9 with an average of 6.45 % and 8.1 – 8.7 with an average of 8.4 % in lately sown ones treated with *Trichogramma* parasitoid alone and parasitoid plus Agerin and recommended insecticides , respectively. The mean percentages of infestation was lower in the early sown plots than the late sown ones in all treatments .Generally, the lowest mean number of bollworms larvae, i.e boll infestation percent was recorded when cotton plants treated with egg-*Trichogramma* parasitoid in combination with two sprays of Agerin (*B.t.*) ; followed by plots treated with *Trichogramma* alone .The highest mean percentages of boll infestation was achieved in plots treated with recommended insecticides in both seasons regardless of cotton sowing dates. Statistical analysis showed significant differences between the plots treated with egg-parasitoid and plots treated with insecticides, for infestation boll percent in both sowing dates. It could concluded that the obtained results of the present study agree with those recorded by Bilal-Rasool *et al.*(2002) ,who reported that the infestation of *H. armigera* in Karishma in early sown plots was maximum (18.27 and 16.23%, respectively) in the 4th week of September.They also showed that the infestation was suppressed up to 41.16 and 44.87% in NIAB-86 and NIAB-Karishma, respectively, by *Trichogramma chilonis* releases , whereas, in late sown plots under the same genotypes, the infestation was higher (19.32 and 19.30%, respectively) and *T. chilonis* parasitoids suppressed the *H. armigera* population by 14.87 and 36.63%, respectively, in the 4th week of September. It was concluded that *T. chilonis* can successfully be used for suppression of *H. armigera* in cotton.Mansour (2004) showed that the differences in the percentages of green boll infestation were significantly higher in plots treated with chemical insecticides than plots treated with egg parasitoid alone and with Agerin.

Data in Tables (4), (5) showed the survey of the predators associated with bollworms which conducted in Mallawi (Minia) region from July to September in cotton fields treated with *T. evanescens* alone and with Agerin compared with the recommended insecticides during the two seasons .

Table(1):Weekly number of bollworm larvae/ 100 cotton green bolls for three releasing distances(m)treatments of T. *evanescens* at Mallawi, Minia region , 2004 and 2005 seasons .

	Mean number of larvae/ 100 cotton green bolls						Averge two seasons			
R . d / Date	20m	15 m	10m	R . d / Date	20m	15 m	10m	20m	15 m	10m
July 2/2004	1	0	0	July 4/2005	1	1	1	1.0	0.5	0.5
July 9	2	1	1	July 11	2	1	1	2.0	1.0	1.0
July 16	2	2	1	July 18	3	2	2	2.5	2.0	1.5
July 23	4	2	2	July 25	5	3	2	4.5	2.5	2.0
July 30	5	3	2	Aug. 1	6	4	2	5.5	3.5	2.0
Aug. 6	6	4	2	Aug. 8	7	3	3	6.5	3.5	2.5
Aug. 13	6	3	2	Aug 15	8	4	2	7.0	3.5	2.0
Aug . 20	7	4	3	Aug 22	9	5	3	8.0	4.5	3.0
Aug . 27	8	5	3	Aug 29	10	5	3	9.0	5.0	3.0
Sept. 3	10	6	4	Sept. 5	12	7	4	11.0	6.5	4.0
Total	51	30	20	Total	63	35	23	57	32.5	21.5
Mean	5.1[a]	3.0[b]	2.0[b]	Mean	6.3[a]	3.5[b]	2.3[c]	5.70[a]	3.25[b]	2.15[b]

Means have the same letters not differ in significancy at (P < 0.05) as determined by Ducan's(1955) multiple rang test

Table (2): Weekly number of bollworm larvae/ 100 bolls for four releasing times of *T. evanescens* cotton fields at Mallawi, Minia region , 2004 and 2005 seasons

Season	Mean number of larvae/ 100 bolls									Averge of seasons			
	2004				2005								
R.T / Date	2	3	4	5	R.T / Date	2	3	4	5	2	3	4	5
July 5	1	1	0	0	July 4	1	1	1	1	1.0	1.0	0.5	0.5
July 12	2	2	1	1	July11	2	2	1	1	2.0	2.0	1.0	1.0
July 19	2	3	2	2	July18	3	2	2	1	2.5	2.5	2.0	1.5
July 26	4	4	3	2	July25	5	3	2	2	4.5	3.5	2.5	2.0
Aug. 2	4	3	3	3	Aug. 1	6	4	3	2	5.0	3.5	3.0	2.5
Aug. 9	7	4	3	2	Aug 8	8	5	4	3	7.5	4.5	3.5	2.5
Aug 16	6	5	3	3	Aug15	8	6	5	3	7.0	5.5	4.0	3.0
Aug 23	8	6	4	3	Aug22	10	8	6	4	9.0	7.0	5.0	3.5
Aug 30	9	8	5	4	Aug.9	12	8	7	5	10.5	8.0	6.0	4.5
Sept. 6	12	9	6	5	Sept. 5	11	10	7	6	11.5	9.5	6.5	5.5
Total	55	45	30	25	Total	66	49	38	28	60.5	47.0	34	26.5
Mean	5.5[a]	4.5[b]	3.0[c]	2.5[c]	Mean	6.6[a]	4.9[b]	3.8[c]	2.8[d]	6.05[a]	4.7[b]	3.4[c]	2.65[c]

Means have the same letters of each treatment not differ in significancy at (P < 0.05) as determined by Ducan's(1955) multiple rang test.

R .T : Re lease Times . R . d : Release distance .

Table (3): Weekly number of bollworm larvae/ 100 cotton green bolls in different planting dates in cotton fields treated with *T. evanescens* and combind with Agerin compared with recommended insecticides , Mallawi, Minia region , 2005 - 2006 seasons.

Season	Mean number of larvae/ 100 cotton green bolls																	
	2005						2006						Average of two seasons					
P.d / Date	Early planting			Late planting			Early planting			Late planting			Early planting			Late planting		
	T	T+A	RI	T	T+A	RI	T	T+A	RI	T	T+A	RI	T	T+A	RI	T	T+A	RI
July 7	0	0	1	1	1	2	1	0	2	1	1	2	0.5	0.0	1.5	1.0	1.0	2.0
July 14	2	1	2	2	3	3	2	2	3	3	2	3	2.0	1.5	2.5	2.5	2.5	3.0
July 21	2	2	3	3	3	4	2	2	3	3	3	3	2.0	2.0	3.0	3.0	3.0	3.5
July 28	2	2	3	4	2	5	3	3	4	4	2	5	2.5	2.5	3.5	4.0	2.0	5.0
Aug. 4	3	2	4	6	5	6	3	4	5	7	6	7	3.0	3.0	5.0	6.5	5.5	6.5
Aug. 11	4	3	6	6	7	8	5	7	6	9	8	11	4.5	5.0	6.0	7.5	7.5	9.5
Aug. 18	4	3	6	8	7	11	8	6	8	13	10	12	6.0	4.5	7.0	10.5	9.0	11.5
Aug. 25	5	4	7	10	9	12	7	9	10	11	13	16	6.0	6.5	8.5	10.5	10.5	14.0
Sept. 1	6	5	10	12	11	14	10	8	13	10	13	16	8.0	6.5	11.5	11.0	12.0	15.0
Sept. 8	8	6	12	11	12	16	12	10	14	12	11	12	10.0	8.0	13.0	11.5	11.5	14.0
Total	36	28	55	63	60	81	53	51	68	73	69	87	44.5	39.5	61.5	68.0	64.5	84.0
Mean	3.6	2.8	5.5	6.3	6.0	8.1	5.3	5.1	6.8	7.3	6.9	8.7	4.45^{b}	3.95^{a}	6.15^{c}	6.80^{ab}	6.45^{a}	8.40^{b}
Yield/ Ken./fed.	7.5	7.7	7.0	6.1	6.4	5.9	6.2	6.3	6.0	5.5	5.8	5.1	6.85^{ab}	7.00^{a}	6.50^{cd}	5.80^{de}	6.10^{bc}	5.50^{e}

Means have the same letters of each treatment not differ in significancy at (P < 0.05) as determined by Ducan's(1955) multiple rang test.
T = Trichograma only T+A = Trichograma plus Agerin RI = recommended insecticides P . d : Planting date .

Table(4) :Weekly mean number of certain predators associated with bollworms in cotton field treated with *T. evanescens* alone and combined with Agerin compared with the recommended insecticides in Mina region, 2005 season.

Date	Mean number of predators / 100 plants																	
	C.undecimpuctata			*C. carnea*			*O.albidipennis*			*P. alfieril*			True spiders			Predators total		
	T	T+A	RI	T	T+A	RI	T	T+A	RI	T	T+A	RI	T	T+A	RI	T	T+A	RI
July 8	3	4	3	2	2	1	7	5	4	5	4	4	2	3	4	19	18	16
July15	8	7	4	4	3	4	8	10	6	5	3	4	5	7	4	30	30	26
July22	11	15	7	7	10	6	10	12	8	7	6	5	7	10	7	42	53	28
July29	20	22	12	3	5	3	19	29	12	10	9	7	14	11	8	66	76	42
Aug. 5	14	13	9	5	7	3	25	21	16	12	13	8	25	20	15	81	73	51
Aug.12	12	14	8	5	7	6	14	15	10	7	10	7	18	32	13	56	81	44
Aug.19	19	15	7	10	13	8	11	22	8	8	5	4	14	19	10	62	74	37
Aug.26	11	21	15	6	7	5	19	14	11	10	11	6	17	22	14	63	75	51
Sept.2	7	9	5	3	5	2	6	7	3	4	3	2	9	7	3	29	31	15
Sept.9	5	4	2	1	2	1	3	4	2	2	3	0	5	4	2	16	17	7
Total	110	124	72	46	61	43	122	139	80	70	67	47	106	135	80	464	528	317
Mean	11.0 a	12.4 a	7.2 b	4.6 a	6.1 b	4.3 a	12.2 a	13.9 a	8.0 b	7.0 a	6.7 a	4.7 b	10.6 a	13.5 b	8.0 c	46.4 a	52.8 b	31.7 c

Means have the same letters of each predator not differ in significancy at (P < 0.05) as determined by Ducan'sns(1955).

Five predaceous insects on cotton plants were counted weekly. The predators, *Coccinella undecimpunctata* Reiche ;*Orius albidipennis* (Reut.); *Chrysoperla carnea* Steph ; *Paederus alferii* Koch and true spiders were the most abundant as natural enemies for bollworms in cotton field treated with three treatments in both seasons. Data cleared that two peaks of predators associated with bollworms was noticed in July 29 th and August 19 th in the first season and in July 28 th and August 25 th in the second season in three treatments.

Generally , the highest mean numbers of predators / 10 plants were found in cotton fields treated with the egg- parasitoid *T. evanescens* plus Agerin (52.8 and 72.1 individuals), followed by fields treated with the egg-parasitoid *T. evanescens* alone.(46.4 and 63.6 individuals), while the lowest mean numbers(31.7 and 33.8) were recorded in fields treated with recommended Insecticides in both seasons , respectively. The obtained results showed significant differences among the effectiveness of the three control methods on the mean numbers of predators associated with cotton bollworms during two seasons. Importantly , the obtained results revealed that the organic phosphorus insecticides had the highly significant side effect on the predators compared with the two methods of control where these predators were destroyed by these insecticides.According to Pham *et al.* (1994), the efficiency of IPM and the role of natural enemies were increased in the released fields by *T. japonicum* , however the number of natural enemies were significant different. They showed that the utilization of chemical insecticides at wrong time may effect natural enemies and create a favorable condition for the increase of the pests.Mansour (2004) showed that the chemical insecticides exhibited drastic effects on predators (55.4 and 58.7 % reduction), while the release of *T. evanescens* had the least effect (2.0 and 0.7) in 2001 and 2002, respectively.Wu and Gue (2005) in China showed that the pest management tactics associated with the bacterium cotton (*B.t*) have resulted in advastic reduction in insecticides use, which usually results in a significant increase in populations of beneficial insects and thus contributes to the improvement of the natural control of some pests.

Data presented in Table (6) clearly reveal that increasing number of egg-parasitoid ,*T. evanescens* application or decreasing releasing distances to 10 meter away from wasp release points was associated with gradual increase in number of open bolls per plant, boll weight and seed cotton yield in both seasons. The highest number of open bolls / plant ranged between 10.9 – 12.0 and 9.8 -11.1; highest boll weight ranged between 2.95 -3.10 gm and 2.89 – 2.92 gm and the highest yield ranged between 7.80 – 8.50 and 6.80 – 8.0 kent. / fed. in plots treated with closely wasp release point(10 m) and five times of *Trichogramma* parasitoid releases in both seasons , respectively. In general, no significant differences were found in cotton seed yield and yield components among the plants treated with four and five releases of *Trichogramma* parasite or between the two closer releasing distances (10 and 15 meters) in both seasons. It seems logic that increasing number of *Trichogramma* parasite applications at closely releasing points in cotton fields lead to increasing the released individuals of such parasite which enhance its chance for successful parasitism on eggs of bollworms leading to lower damaged bolls and higher number of harvestable bolls per plant, boll weight and seed cotton yield per feddan.

Table(5) : Weekly mean number of certain predators of certain predators associated with bollworms in cotton field Treated with *T. evanescens* alone and combined with Agerin compared with the recommended insecticides in Mina region, 2006 season.

Date	Mean number of predators / 100 plants																	
	C.undecimpunctata			*C. carnea*			*O.albidipennis*			*P. alfieril*			True spiders			Predators total		
	T	T+A	RI	T	T+A	RI	T	T+A	RI	T	T+A	RI	T	T+A	RI	T	T+A	RI
July 7	6	4	3	3	2	3	5	4	3	7	5	3	7	10	7	28	25	19
July14	11	9	4	6	5	3	11	7	6	5	6	5	9	13	7	42	40	25
July21	16	18	6	4	7	4	15	19	11	6	8	5	14	13	10	55	65	36
July28	29	25	11	10	13	7	31	35	22	14	17	9	22	25	11	106	105	60
Aug. 4	19	33	14	8	10	8	20	26	16	2	15	8	39	47	25	98	131	71
Aug.11	14	19	8	6	5	3	18	21	8	8	11	4	20	27	29	66	83	52
Aug.18	20	14	7	12	10	5	14	16	7	10	8	11	16	14	10	72	62	40
Aug.25	23	20	12	8	15	6	25	28	13	11	14	6	24	31	15	91	108	52
Sept.1	10	12	3	5	7	2	16	18	6	5	7	5	12	16	6	48	60	22
Sept.8	4	7	2	4	6	0	10	8	4	4	5	2	8	6	3	30	32	11
Total	152	161	70	66	80	41	165	182	96	82	96	58	171	202	123	636	721	338
Mean	15.2a	16.1a	7.0b	6.6a	8.0a	4.1b	16.5a	18.2a	9.6b	8.2a	9.6a	5.8b	17.1b	20.2a	12.3c	63.6b	72.1a	33.8c

Means have the same letters of each predator not differ in significancy at (P < 0.05) as determined by Ducan's(1955).

Table (6):Efect of releasing distances , releasing times of egg parasitoid, *T. evanescens* and some bollwarm control treatments on certain agronomic characters of cotton, Mallawi , Minia region , 2004 – 2006 seasons.

Season	2004							2005					
Treatments	Releasing distance (m)			Releasing times				Biological versus chemical control treatments					
Characters	20	15	10	2	3	4	5	Early plantin			Late planting		
								T	T+A	RI	T	T+A	RI
No of open bolls/ plant	9.80 b	11.4 a	12.0 a	9.2b	9.8ab	10.9a	11.1a	1o.8a	11.3a	9.8b	8.6c	9.3bc	7.4d
Boll weight (gm)	2.80 b	3.03 a	3.10 a	2.76b	2.81ab	2.92a	2.92a	3.03a	3.06 a	2.98ab	2.80bc	2.88c	2.70 d
Seed cotton yield (kent/ fed.	7.20b	8.10 a	8.50 a	6.60c	7.10bc	7.80ab	8.0 a	7.50a	7.70a	7.0b	6.10c	6.40c	5.90d
Season	2005							2006					
No of open bolls/ plant	8.3 b	10.4ab	10.9a	7.0b	7.8b	9.4a	9.8a	8.9b	9.3a	8.0c	7.2d	7.8c	6.5e
Boll weight (gm)	2.74b	2.92a	2.95a	2.68c	2.72bc	2.85ab	2.89a	2.92a	2.95a	2.80b	2.71c	2.75c	2.65d
Seed cotton yield (kent/ fed.	6.30b	7.50a	7.80a	5.20b	5.50b	6.50a	6.80a	6.20a	6.30a	6.0b	5.50c	5.80c	5.10d

Means of each treatment within each experiment followed by the same letter (s) are not significantly different at (P < 0.05) as determined by Ducan's(1955). T: Trichogramma alone T+A: Trichogramma + Agerin and RI: Recommended insecticides program

With regard to the comparison between biological and chemical control, results shown in Table (6) reveal that the combined application of *Trichogramma* parasite and Agerin (*B.t*) gave the maximum yield and yield components followed by the application of *Trichogramma* parasite only under early and late planting in both seasons. However, early planting of cotton fields gave the higher number of harvestable bolls per plant, boll weight and seed cotton yield per feddan in all control treatments as compared with late planting dates in both seasons. The cotton yield was higher in early planting than late sowing date in all treatments. The mean maximum number of open bolls varied from 9.3 – 11.3 ; boll weight varied from 2.95 – 3.06 gm and cotton seed yieid varied from 6.30 – 7.70 kent./ fed.) in early sown plots treated with *Trichogramma* parasitoid combined with Agerin. While the minimum mean number of open bolls varied from 6.5 – 7.4 ; boll weight varied from 2.65 – 2.70 gm and cotton seed yield varied from 5.10 – 5.90 kent./fed. in late sown plots treated with chemical insecticides. This seems to be a result of reducing infested bolls along with increasing number of predaceous insects in cotton fields treated with biological control treatments. Similar results were obtained by El-Heneidy *et al.*(2004) reported the cotton boll weight averaged 3.14 and 2.82 gm in the *T. evanescens* release and insecticide areas of cotton , respectively.

Costs for producers (irrigation , fertilizer , hoeing , etc.) were the same in the three treatments, the only difference was the cost for cotton field protection. Data in Table (7) showed that the costs of protection per feddan were 35 ; 99 and 133 L.E. in cotton fields treated with egg-parasitoid only, egg- parasitoid plus Agerin (*B.t*) and chemical insecticides , respectively. Consequently, the costs were dropped by 60.15 % and 27.10 % in the parasitoid released fields and those combined with Agerin compared with the chemical treatments. Such results are in agreement with those reported by Pham *et al.* (1994) that showed the costs of plant protection was the lowest and the profit was only 58 %of the productivity obtained for egg- parasitoid treated plots. According to El-Heneidy *et al.* (2004) who mentioned that , in the parasitoid release areas , number of insecticidal application was reduced to almost the half and consequently, the costs were dropped by 29.3 to 36%.

Table(7): Estimated costs of using *Trichogramma* parasite alone and *Trichogramma* with Agerin for controlling the bollworm in Cotton fields compared with the recommended insecticides, Mallawi Minia.2005 and 2006 seasons.

Item	*Trichogramma* alone			*Trichogrmama* + Agerin			Recommended Insecticides		
	Using Times	Dose/ Fed.	Price (LE)	Using Times	Dose/ Fed.	Price (LE)	Using times	Dose/ Fed.	Price (LE)
Trichogramma	5	22000W	25	5	22000W	25	-	-	-
Agerin	-	-	-	2	500gm	40	-	-	-
Insecticides:									
a-Nestiban 48%	-	-	-	-	-	-	1	1 Litre	36
b- Kindo 5%	-	-	-	-	-	-	1	375 cm	25
c-Tetiton 72%	-	-	-	-	-	-	1	750cm	36
Labours wags	5	1/2man	10	7	1/2man	20	3	1 man	15
Charater of spraying motor	-	-	-	2	600 L.W	14	3	600 L.W.	21
Total	-	-	35	-	-	99	-	-	133

From the previous result it was evident that pesticidal treatment not recommended for boll worm control because it's adverse effect on the insect parasitoids and predators. As well as the dangerous effect of the residue on human and its environment. Here in the complete coverage of the bollworms with five releases of *T. evanescens* with two sprays of Agerin(*B. t.*) seemed to be the most suitable method for the cotton protection from the spiny and pink bollworms infestation.

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فاعلية طفيل التريكوجراما ايفانسنس والمركب الحيوي أجرين مقارنة ببرنامج المبيدات الموصى به فى مقاومة ديدان اللوز وتأثير ذلك على إنتاجية محصول القطن بمنطقة مصر الوسطي .

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أجريت هذه الدراسة بملوي محافظة المنيا فى مواسم زراعة القطن ٢٠٠٤، ٢٠٠٥، ٢٠٠٦ بهدف تحديد انسب عد مرات إطلاق طفيل التريكوجراما (مرتين، ثلاثة، أربعة، خمس إطلاقات) وكذلك أنسب مسافة بين نقط الإطلاق (١٠، ١٥، ٢٠ متر) وأيضا دراسة فاعلية طفيل التريكوجراما بمفرده أو مع الأجرين مقارنة ببرنامج المبيدات الموصى به فى مقاومة دودتي اللوز (القرنفلية والشوكية) وتأثير ذلك على بعض الصفات المحصولية للقطن.

يمكن تلخيص نتائج هذه الدراسة فيما يلي:

- أدى كل من زيادة عدد الإطلاقات ونقص مسافات الإطلاق إلى زيادة فاعلية طفيل التريكوجراما فى تقليل الضرر بديدان اللوز وبالتالي زيادة إنتاجية محصول القطن حيث نتج أقل معدل للإصابة بديدان اللوز(2.8, 2.5) وأعلى تعداد للوز المميز للنبات(11.1، 9.8) ووزن اللوزة (2.92, 2.89) وأعلى محصول للقطن الزهر (8.0.، 6.80 قنطار للفدان) بإطلاق طفيل التريكوجراما بمعدل خمس مرات و يقل أيضا الضرر بديدان اللوز ويزيد المحصول عندما تكون المسافة بين نقاط الإطلاق ١٠ متر مع عدم وجود فروق معنوية بين معاملتي خمس وأربعة إطلاقات أو بين مسافتي ١٠ ، ١٥ متر فى كلا الموسمين .

- أظهرت المقاومة الحيوية باستخدام التريكوجراما والأجرين معا فاعلية أعلى فى مقاومة ديدان اللوز مقارنة بالمبيدات حيث أعطى استخدام التريكوجراما والأجرين معا أقل معدل إصابة بديدان اللوز وأعلى قيم للمحصول ومكوناته متبوعا بمعاملة إطلاق طفيل التريكوجراما منفردا وسجلت المعاملة بالمبيدات أعلى إصابة واقل محصولا فى كل من مواعيد الزراعة المبكرة والمتأخرة فى كلا الموسمين وعموما سجلت مواعيد الزراعة المبكرة إصابة أقل بديدان اللوز و أعلى قيم للمحصول ومكوناته عن مواعيد الزراعة المتأخرة فى المعاملات الثلاثة فى كلا الموسمين
- أظهرت النتائج أن المقاومة الحيوية باستخدام طفيل التريكوجراما والأجرين معا أدت إلى زيادة تعداد المفترسات بحقول القطن (52.6, 72.6) يليها المعاملة باستخدام الطفيل فقط (46.4, 63.6), بالمقارنة باستخدام المبيدات التي سجلت أقل تعداد للمفترسات (31.7, 33.8) فى كل من الموسمين.
- انخفضت تكاليف مقاومة ديدان اللوز بحوالى ٢٥,٦ % عند استخدام طفيل التريكوجراما والأجرين معا بنسبة ٧٣% عند استخدام طفيل التريكوجراما بمفرده بالمقارنة باستخدام المبيدات .
- يمكن أن نستخلص من هذه الدراسة أن المقاومة الحيوية لديدان اللوز باستخدام خمس إطلاقات لطفيل التريكوجراما مع رشتين من المركب الحيوي أجرين قد أدى إلى نقص معدل إصابة بديدان اللوز، زيادة تعداد الحشرات المفترسة بحقول القطن مما أدى إلى زيادة إنتاجية محصول القطن بالإضافة إلى نقص تكاليف عملية المكافحة وتقليل التلوث البيئي فى نفس الوقت.