

ABUNDANCE OF NATURAL ENEMIES UNDER BIOCONTROL AND CONVENTIONAL INSECTICIDE CONTROL PROGRAMS FOR COTTON KEY PESTS IN MIDDLE EGYPT COTTON FIELDS

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ABSTRACT

Population densities of the natural enemies *Orius* spp., *Scymnus* spp, *Pedrus alfieri*, *Syrphus corolla*, *Coccinella undecimpunctata*, *Cydonia* spp., and true spiders were investigated through three successive cotton growing seasons (2004-2006) in large scale trails of cotton fields in Minia governorate (middle Egypt) under the bio-control and conventional insecticide programs for cotton key pests i.e, Cotton Leaf Worm (CLW), *Spodoptera littoralis*; Pink Boll Worm (PBW), *Pectinophora gossypiella* and Spiny boll Worm (SBW), *Earius insulana*.

Results indicated the abundance of high population levels of natural enemies in the cotton fields under bio-control program in comparison to a very low levels in cotton fields under the conventional insecticide applications. Relative abundance of the tested predators on the cotton plant levels showed high abundance of various predators in the lower level of the insecticide-treated cotton plants , meanwhile, normal distribution for natural enemies was recorded in cotton fields under the bio-control programs.

INTRODUCTION

In Egypt Cotton is subjected to yield and quality losses by arthropod insects i.e, cotton leaf worm, pink boll worm and spiny boll worm. The wide spread of pesticide applications for controlling the cotton key pests in cotton fields seriously affected the population

densities of natural enemies (Newson and Smith 1949 in Louisiana, Hassan *et al.* 1960 , Fayad and Ibrahim 1980, Moawad *et al.* 1992 and Gergis *et al.* ,2001). Undesirable side effects of using chemical insecticides in addition to the high costs of chemical control , continuing economic losses, secondary pest problems and environmental considerations , suggested the need for biologically oriented cotton pest management strategies.

Bio-control techniques are effective enough to suppress the pest populations below the economic injury levels .At the same time restoring the natural balance between the destructive insect pests and their natural enemies , is of great concern. Using egg parasitoid , *Trichogramma* and/ or other bio-products are among the most pest suppression agents, now being investigated as a new strategies for pest management without adverse effects on natural enemies (Justum *et al.*, 1983; Critchley *et al.*, 1985; El adl *et al.* 1988 and Gergis *et al.*, 2001).

In this paper different ways for use of biological control of cotton key pests as a reliable environmentally safe means of pest population reduction will be illustrated and evaluated on the basis of their side effects on the abundance of natural enemies.

MATERIALS AND METHODS

A large scale trails were carried out in a cotton fields at Minia Governorate, Northern Upper Egypt to evaluate the side effects of the bio-control and conventional insecticide control program on the population densities of natural enemies. About 400 feddans of cotton fields (Giza, 80) were treated with egg parasitoid, *Trichogramma* and/or bio product (Agerin) and compared to another equal and close area of same cotton variety but under conventional insecticide program

Weekly counts for main predators in both treatments were carried out through the period from 1st July to 1st September (10 weeks). The direct counting method (Hafez,1960) were applied in samples of 100 randomized plants per unit (30 feddans) and replicated four times for each treatment Separate counts for lower, middle and upper levels of each plant were also carried out to detect the relative

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distribution of predators among the different plant levels and under the two approaches of pest control.

Bio-control program:

- Using the egg parasitoid *Trichogramma evanescense*

T. evanescens was reared on angoumois grain moth *Sitotroga cerealella* eggs according to the method described by Hassan (1993 and 1995), Abdelhaféz, (2000) and Gergis, (2001). For efficient mass rearing of the parasitoid, *S. cerealella* eggs (<24 hours old) were glued to paper cards (10x15 cm.) and exposed to *T. evanescens* adults in glass jar and provided with 10% sucrose solution for nutrition and covered with cloth-wrapped cotton kept in position by rubber band. Egg sheets were renewed daily to avoid super parasitism and the parasitized egg sheets were kept in clean glass jars. Rearing took place at constant temperature of 25 ± 1 °C and 80 ± 5 % R.H.

Trichogramma were released into the cotton field using release cards that protect them from predators and unfavorable weather factors. The release card consists of thick paper (6x8 cm) folded to make a closed container of 4x6 cm. Three strips of grain moth eggs that contain parasitoid (about 500 parasitoid/each) at three different stages of development (1,3 and 5 days before emergence) were glued in this container. The total number of parasitoids/ card was about 1500 parasitoids.

Three waves of *Trichogramma* adults emerge from each card and the emergence begins within 12-24 h after release and continue through six days. 25 cards were used per feddan at ten days interval through the cotton season to keep cotton fields completely free of insecticides.

Field applications:

Four field experiments were conducted at Minia governorate during three successive cotton growing seasons (2004-2006) as follows:

1- Conventional insecticide program:

- Organophosphorous (Pestiban Lt / fed.)
- Pyrethroid (Somi alfa or Somi gold)
- Organophosphorous (Curacron, 600 ml./fed.)

2-*Trichogramma* (25 cards / fed.)

3-*Trichogramma* + Bio-product (Agerin, *Bacillus thuringensis*, 300gm./fed.)

(Successive treatments of *Trichogramma* and agerin)

4-Agerin only at the rate of 300 gm. /feddan (6 spray applications at ten days interval in between).

Agerin, "Bt" compound produced by Agricultural Genetic Engineering Research Institute, Agricultural Research Center (Egypt). It contains *Bacillus thuringiensis aegypti* distributed different profile with various combinatios of genes groups *cry2*, *cry8*, and *cry9*.

RESULTS AND DISCUSSION

Relative occurrence of predators in cotton fields under bio – control and conventional control programs:

Obtained results on the effects of each of the tested control programs in cotton fields trough three successive cotton growing seasons (2002-2004) are presented in Table 1. It is clear that the populations of all predators were much higher in the bio-control program in comparison to those under the conventional insecticide program.

Higher occurrence of the true spiders was recorded in cotton fields under bio control applications reaching an average of 16.5, 15.0 and 14.0 during the three years as compared to 0.75, 0.1.2 and 1.25 under the conventional control applications.

Mean total numbers of predators were: 0.35, 0.47 and 0.43 for the three successive years in the conventional insecticide cotton fields compared to 9.9 , 9.2 and 9.06 in the bio-controlled area. General average number of natural enemies were :0.39 and 9.39 for the cotton fields under insecticide and bio-control techniques (Table , 1).

Reduction percentages in predator population densities in cotton fields under conventional insecticide applications reached: 93.2, 92.6 and 90.9 during the three successive years.

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Table 1: Counts of certain predators on cotton plants under both of conventional and bio-control programs in cotton fields through three successive cotton growing seasons (2004-2006), Minia governorate.

Year (Seasons)	Predators	Mean number/plant		%Reduction
		Conv.	Bio.	
2004	<i>Orius spp.</i>	0.25	5.60	-91.4
	<i>Scymnus spp.</i>	0.30	7.50	-92.3
	<i>P. alfieri</i>	0.25	8.30	-94.15
	<i>Syrphus spp.</i>	0.00	9.5	-100.0
	<i>C.undecmpunctata</i>	0.25	11.50	-95.7
	<i>Cydonia spp.</i>	0.66	10.30	-87.9
	True spiders	0.75	16.50	-91.3
Average		0.35	9.90	-93.2
2005	<i>Orius spp.</i>	0.33	6.50	-90.3
	<i>Scymnus spp.</i>	0.00	7.50	-100.0
	<i>P. alfieri</i>	0.20	10.30	-96.2
	<i>Syrphus spp.</i>	0.66	11.00	-88.7
	<i>C.undecmpunctata</i>	0.00	6.60	-100.0
	<i>Cydonia spp.</i>	0.50	7.80	-87.9
	True spiders	1.20	15.00	-85.2
Average		0.47	9.20	-92.6
2006	<i>Orius spp.</i>	0.00	9.50	-100.0
	<i>Scymnus spp.</i>	0.20	11.00	-96.4
	<i>P. alfieri</i>	0.60	8.60	-87.0
	<i>Syrphus spp.</i>	0.33	10.30	-93.8
	<i>C.undecmpunctata</i>	1.00	10.00	-81.8
	<i>Cydonia spp.</i>	0.75	9.50	-85.3
	True spiders	1.25	14.00	-83.6
Average		0.43	9.06	-90.9
G. average		0.39	9.39	92.0

In conclusion, the results presented in this part of study clearly indicated highly significant increase in predator population densities in cotton fields under bio control programs as compared to the cotton fields under the conventional insecticide applications. That is also, indicates the adverse and negative effects of chemical insecticides on natural enemy population density and consequently natural balance. Meanwhile, the depending on bio control programs could be used to maximize the population densities of natural enemies to participate in restoring the balance between insect pests and their natural enemies as a part of management plan aimed to suppression of pest population densities and to minimize the role of cotton insect pests.

Distribution of predators on various cotton plant levels under pest control programs:

Results in Table 2 indicate high reduction effects of chemical insecticides against natural enemies and consequently disappearance of natural enemies in the upper and middle levels of cotton plants with the presence of a very low populations in the lower levels. Meanwhile, higher densities and natural distribution of these natural enemies were noticed in cotton fields under bio control program, (Table 3).

In conclusion, it seems clear that cotton key pests could be significantly reduced through area-wide management approaches. Successful development and implementation of this program will depend on a complete understanding of the pest biology and ecology and knowledge of how to integrate wide array of available cultural and suppression tactics into an effective management system.

These results are in full agreement with those obtained by Moawad *et al.* (1992) concerning the impact of sex pheromones as non chemical control and insecticides on the natural enemies in cotton fields in Middle Egypt.

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Table 2: Mean number / plant of predators in the lower, medium and upper levels of cotton plants under the conventional control program in cotton fields through three successive cotton growing seasons (Minia 2004-2006).

Year (Seasons)	Predators	Plant level			
		L	M	U	Total
2004	<i>Orius spp.</i>	0.15	0.10	0.00	0.25
	<i>Scymnus spp.</i>	0.20	0.10	0.00	0.30
	<i>P. alfieri</i>	0.20	0.05	0.00	0.25
	<i>Syrphus spp.</i>	0.00	0.00	0.00	0.00
	<i>C.undecmpunctata</i>	0.25	0.00	0.00	0.25
	<i>Cydonia spp.</i>	0.40	0.20	0.06	0.66
	True spiders	0.50	0.20	0.05	0.75
Average		0.24	0.09	0.016	0.31
2005	<i>Orius spp.</i>	0.20	0.10	0.03	0.33
	<i>Scymnus spp.</i>	0.00	0.00	0.00	0.00
	<i>P. alfieri</i>	0.20	0.00	0.00	0.20
	<i>Syrphus spp.</i>	0.50	0.16	0.00	0.66
	<i>C.undecmpunctata</i>	0.00	0.00	0.00	0.00
	<i>Cydonia spp.</i>	0.50	0.00	0.00	0.50
	True spiders	1.00	0.20	0.00	1.20
Average		0.34	0.066	0.00	0.41
2006	<i>Orius spp.</i>	0.00	0.00	0.00	0.00
	<i>Scymnus spp.</i>	0.20	0.00	0.00	0.20
	<i>P. alfieri</i>	0.50	0.10	0.00	0.60
	<i>Syrphus spp.</i>	0.33	0.00	0.00	0.33
	<i>C.undecmpunctata</i>	1.00	0.00	0.00	1.00
	<i>Cydonia spp.</i>	0.50	0.25	0.00	0.75
	True spiders	1.00	0.25	0.00	1.25
Average		0.504	0.086	0.00	0.59
G. average		0.387	0.084	0.005	0.45

Table 3: Mean number / plant of predators in the lower, medium and upper levels of cotton plants under the bio- control program in cotton fields through three successive cotton growing seasons (Minia 2004-2006).

Year (Seasons)	Predators	Mean number/plant			
		L	M	U	Total
2004	<i>Orius spp.</i>	0.6	2.0	3.0	5.6
	<i>Scymnus spp.</i>	1.0	2.5	4.0	7.5
	<i>P. alferii</i>	1.8	2.5	4.0	8.3
	<i>Syrphus spp.</i>	2.5	3.0	4.0	9.5
	<i>C.undecpunctata</i>	1.5	3.0	7.0	11.5
	<i>Cydonia spp.</i>	1.5	2.5	6.3	10.3
	True spiders	4.0	4.5	8.0	16.5
Average		1.84	2.9	5.19	9.9
2005	<i>Orius spp.</i>	2.0	1.5	3.0	6.5
	<i>Scymnus spp.</i>	2.0	2.9	5.2	10.1
	<i>P. alferii</i>	1.5	2.5	3.0	7.0
	<i>Syrphus spp.</i>	3.0	3.0	4.5	10.5
	<i>C.undecpunctata</i>	2.5	3.5	5.0	11.0
	<i>Cydonia spp.</i>	1.5	2.5	2.6	6.6
	True spiders	2.0	2.0	3.8	7.8
Average		2.1	2.6	3.5	8.2
2006	<i>Orius spp.</i>	3.0	2.5	4.0	9.5
	<i>Scymnus spp.</i>	2.5	4.4	4.5	11.4
	<i>P. alferii</i>	2.0	3.0	3.6	8.6
	<i>Syrphus spp.</i>	2.5	3.5	4.3	10.3
	<i>C.undecpunctata</i>	1.5	3.5	5.0	10.0
	<i>Cydonia spp.</i>	2.0	3.5	4.0	9.5
	True spiders	3.5	4.0	6.5	14.0
Average		2.5	3.5	4.6	10.6
G.average		2.5	3.0	4.2	9.7

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الوفرة العددية للأعداء الحيوية في حقول القطن بمنطقة مصر الوسطى تحت برامج مكافحة التقليدية باستخدام المبيدات الكيميائية والمكافحة الحيوية

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أجريت الدراسة لتقدير الكثافة العددية لبعض الأعداء الحيوية الفعالة بحقول القطن بمحافظة المنيا تحت نظم مكافحة الآفات الرئيسية للقطن (دودة ورق القطن وديدان اللوز الشوكية والقرنفلية) وتمت التجربة على مدى ثلاثة أعوام وفى مساحة بلغت حوالي أربعمائة فدان لكل من نظامي المكافحة باستخدام المكافحة التقليدية (المبيدات الكيميائية) والمكافحة الحيوية (بإطلاق طفيل البيض "التريكوجراما") بمفرده فى برنامج من ستة إلى ثماني إطلاقات إسبوعية متتالية أو استخدام برنامج من إطلاقا للطفيل ورشات من المركب الحيوي "أجرين" بالتبادل كل عشرة أيام أو استخدام رشات من مركب الأجرين فقط كل عشرة أيام بمعدل ثلاثمائة جرام للفدان. كما اشتملت الدراسة

على تقدير التوزيع النسبي للأعداء الحيوية تحت الدراسة على مستويات النباتات الثلاثة في المعاملتين.

وقد أظهرت النتائج المتحصل عليها لإخفاض الحاد في تعداد الأعداء الحيوية تحت الدراسة وكذا تواجدها على المستويات السفلى لنباتات القطن في الحقول المستخدم فيها برامج مكافحة التقليدية بالمبيدات الكيميائية في حين تواجدها الأعداد الكبيرة من تلك الأعداء الحيوية في توزيع طبيعي على مستويات النباتات الثلاثة في الحقول تحت برامج مكافحة الحيوية بدون استخدام المبيدات الكيميائية. كما برهنت الدراسة على فعالية برامج مكافحة الحيوية في مكافحة آفات القطن الرئيسية والمساعدة على إستعادة التوازن الطبيعي بين الآفات وأعدائها الحيوية وخفض الاعتماد على استخدام مبيدات الآفات.