

**DIRECT AND INDIRECT EFFECTS OF CHEMICAL
INSECTICIDE AND BIO-CONTROL PROGRAMS ON
THE COTTON MAJOR PESTS AND SUKING PESTS IN
COTTON FIELDS.**

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ABSTRACT

Direct and indirect effects of conventional and bio-control programs for cotton key pests were studied on population densities of sucking pests of commercial cotton fields i.e, whitefly , *Bemisia tabaci*; aphid, *Aphis gossypii*; jassids, *Empoasca lipica* and mite, *Tetranychus urticae*. Biological control by Conservation and augmentation of natural enemies as an important component of pest measurement practices was involved particularly for *Trichogramma* species and/or the bio product "Agerin" in comparison to the conventional insecticide approach.

Results of this study revealed that cotton key pests could be significantly reduced through area- wide management approaches, to avoid the responsibility of chemical control on the outbreak of secondary pest populations.

In such case estimating economic impact of a biological control program has to be used on a lot of different indicators including, among others: 1] reduction of the target pest population size; 2] reduction of the secondary pest populations; 3] maximizing natural enemy population densities and activities so as to minimize the possibility of resurgence of pest populations and 4] increase crop yield and quality.

Conventional chemical control for cotton major pests resulted in sucking pests outbreaks. Suppuration of cotton key pest populations of cotton fields under bio-control approach could be explained on the basis of direct effects of program components plus the role of high populations of natural enemies.

INTRODUCTION

Cotton growers in Egypt experienced severe economic losses from cotton key pests due to reduced yields, low lint quality and increased costs of insecticides (Burrows *et al.*, 1982). Chemical control did not provide a long term solution for cotton pest problems because of the high costs, environmental impact and related problems (insecticide resistant insect strains, the reduction of pest insect natural enemies, the resurgence of pest populations in the absence of natural enemies and the occurrence of secondary pests). Insecticide control, also focuses on attacking localized populations on a farm by farm basis. In contrast, to this approach, the area-wide suppression and management has evolved with increasing awareness of the limitations of attacking local infestations which represent only a small part of the total pest populations (Knipling, 1979).

The negative effects of insecticides suggested the need for ecologically and biologically oriented cotton pest management strategies.

Moawad *et al.* (1992) and Gergis *et al.* (2001) reported the negative effects of the conventional insecticide program on the natural enemies which led to the outbreaks of secondary pest populations in cotton fields in Middle Egypt.

MATERIALS AND METHODS

A large scale trials were conducted in commercial cotton fields in Minia governorate (about 400 feddans of cotton Giza, 80 variety) to study the negative and/or positive impacts of using the conventional insecticide control program of cotton key pests in comparison to the bio-control one.

Treatments

Experimental field:

400 feddans were divided into small units of 30 feddan/each and kept completely free of insecticides but under bio-control program, meanwhile an equal area of the same cotton variety and on a short distance (1000 meter) from that area were under the conventional insecticide program. Dates of sowing, soil and agricultural practices were nearly the same in both treatments.

Effects of chemical and Bio-control programs on cotton major and suking pests

Control programs:

A-Conventional insecticide program:

Early season pests such as aphid, whitefly and mite in the infested spots were under control by using detergent in the bio controlled area, meanwhile, in the other area of chemical- controlled cotton area, some farmers applied one or more sprays using organo phosphorus insecticides (Malathion, Selecron or Curacron) or the carbamate insecticide (Marshal) according to the size of infestation.

Cotton major pests, i.e, cotton leafworm and cotton bollworms (pink and spiny) were under the conventional spray system by applying three or four successive sprays according to the infestation levels as follows:

- a) Organophosphorus compounds (pestiban , 1 L/fed.) or curacron (600 ml./fed.)
- b) Pyrthroid (Somigold or Somialpha)
- c) organophosphorus or carbamate

B)-Bio-control program:

Three methods were used in this program;

- a) The egg parasitoid *Trichogramma evanescens* only *Trichogramma* reared in laboratory as described by Abdelhafez and Neda (2000) and used in cotton fields at ten days intervals, starting from the early fruiting stage and continued until the end of cotton season. Six to eight waves of *Trichogramma* were released into the field using folded cards for protection from the unfavorable factors. The total number of parasitoid/card were about 1500. Some cards similar to those contain the egg parasitoid , but with only newly deposited *Sitotroga* eggs were distributed over certain points of the fields to check the rate of parasitism under field conditions.
- b) Alternative applications of *Trichogramma* and the bioproduct "Agerin" .Three to four waves of *Trichogramma* and equal number of sprays using the bio-product Agerin (300 gm./fed.) were applied in successive pattern at ten day intervals.
- c) Agerin only : 6-8 sprays (300gm)/ fed. were applied automatically every ten days.

All treatments were started at nearly the same dates.

Counts:

Weekly counts for major secondary and sucking pests in different treatments were carried out through the period from 1st July to the 1st September (10 weeks). The direct count method (Hafez, 1960) was applied on samples of 100 randomized plants and replicated four times for each treatment. Separate counts for cotton plant levels (lower, middle and upper) were also carried out to detect the relative distribution of sucking pests among different plant levels.

RESULTS AND DISCUSSION

Direct effects of chemical and bio control programs on cotton key Pests:

Data in Table 1 illustrate the efficacy of three bio-control programs i.e, 1) release of egg-parasitoid *Trichogramma* in 6-8 waves. 2) alternative treatments of *Trichogramma* and the bio product "Agerin" 3-4 treatments /each 3) "Agerin" in 6-8 sprays. 4) , compared to the conventional chemical control program.

The bio-product "Agerin" was the most effective against cotton leafworm followed by "*Trichogramma*/Agerin and *Trichogramma*."

Percentages of reduction were: 92.0, 90.6 and 85.7% for Agerin; 82.0, 88.5 and 80.4% for *Trichogramma*/Agerin and 74.5, 79.0 and 66.5 for *Trichogramma* through the three successive seasons, respectively.

As for the pink bollworm and spiny bollworm, *Trichogramma* and *Trichogramma* / Agerin treatments were nearly of the same order followed by Agerin. Meanwhile, conventional chemical insecticide program was the least effective one for the three cotton pests through the three successive seasons.

Sucking pest population densities under chemical and bio control programs:

Data presented in Table 2 , clearly indicate the following results: High population densities of sucking pests were estimated in cotton fields under chemical control applications as compared to those under

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bio control programs. In 2004 cotton growing season, the average number of the sucking pests reached :112.5, 88.8, 129.6 and 70.5

Table 1: Percentage of reduction in cotton key pests infestation in bio-control and conventional insecticide programs. (Minia, 2004-2006 growing seasons)

Control programs	Year	CLW	PBW	SBW	Avg.%
	2004				
Trichogramma		74.5	82.4	77.8	78.2
Trich. + Agerin		88.0	80.3	75.5	81.3
Agerin		92.3	71.5	66.6	76.8
Avg.		84.9	78.1	73.3	78.8
Conventional		60.5	76.6	75.3	70.8
2005					
Trichogramma		79.0	85.6	80.3	81.6
Trich. + Agerin		88.5	76.9	74.8	80.1
Agerin		90.6	73.4	68.0	77.3
Avg.		86.0	78.1	74.4	79.6
Conventional		74.5	69.6	66.5	70.2
2006					
Trichogramma		66.6	89.5	72.6	76.2
Trich. + Agerin		80.4	83.2	74.1	79.2
Agerin		85.7	69.6	64.0	73.1
Avg.		77.6	84.1	70.2	77.3
Conventional		63.7	74.6	71.3	69.9

Trich.= Trichogramma
 CLW = Cotton leafworm
 PBW= Pink bollworm
 SBW= Spiny bollworm

individual/plant in cotton fields under conventional chemical control program compared to 6.4, 9.8, 11.5 and 5.1 under bio control approach for Aphid, j assid, whitefly and mite, respectively.

The same pattern of abundance was recorded in the following cotton growing seasons (2005 and 2006). Average numbers of sucking pests under chemical control were: 100.4, 90.2 and 89.3 /plant for the three successive cotton seasons compared to 8.2, 9.5 and 7.5 /plant in bio-controlled cotton fields.

In conclusion, based on these results one of the most destructive side effects of using the conventional chemical control in cotton fields was proved to be the outbreaks of sucking pests. Percent of sucking pest increase reached, : 89.2, 80.1,83.7 and 86.5% for Aphid, Jassid,

Table 2: Mean number of certain sucking pests/plant in conventional and bio-control programs for cotton key pests

Year	Pest	Mean number/plant						
		T	T+A	A	Avg.	Conv.	Total	%Inc.
2004	Aphid	5.5	6.3	7.5	6.4	112.5	118.9	89.2
	Jassid	9.5	8.6	11.2	9.8	88.8	98.6	80.1
	Whitefly	11.5	10.6	12.3	11.5	129.6	141.1	83.7
	Mite	3.7	5.5	6.2	5.1	70.5	75.6	86.5
	Avg.	7.6	7.6	9.3	8.2	100.4	108.6	84.9
2005	Aphid	8.7	9.0	6.5	8.06	88.5	96.6	83.2
	Jassid	10.6	12.5	11.7	11.6	66.6	78.2	70.3
	Whitefly	15.3	10.5	13.0	12.9	125.0	137.4	81.6
	Mite	5.5	4.3	6.4	5.4	80.7	86.1	87.5
	Avg.	10.0	9.1	9.4	9.5	90.2	99.7	80.9
2006	Aphid	5.5	7.5	9.3	7.4	90.7	98.1	84.9
	Jassid	7.6	6.5	9.0	7.7	84.5	92.2	83.3
	Whitefly	10.3	8.5	9.6	9.5	104.6	114.1	-83.3
	Mite	5.6	4.6	6.0	5.4	77.5	82.9	78.2
	Avg.	7.3	6.6	8.5	7.5	89.3	96.8	84.5
	Avg.	29.4	23.3	27.2	26.6	297.4	305.1	83.4
	G.Avg.	8.3	7.7	9.1	8.3	99.1	101.7	83.4

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Whitefly and mite, respectively. The same pattern was also, noticed in the following seasons reaching on average of 84.9,80.9 and 84.5%.

These results, concerning the negative side effects of chemical control programs could be explained on the basis of very destructive effects of chemical insecticides against the natural enemy complex and consequently, providing an optimal factors for pest population increase . In contrast, a very low densities of sucking pests recorded in the lower parts of cotton plants under bio control strategies.

Distribution of sucking pests among cotton plant levels in cotton fields under chemical and bio control programs:

Sucking pests showed a very different ways of distribution among cotton plant levels as the most of their populations were recorded on the upper and middle levels in cotton plants under

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

Year	Pests	Control program							
		Bio-control				Chemical control			
		L	M	U	Total	L	M	U	Total
2004	Aphid	5.2	1.0	0.2	6.4	15.6	32.3	64.6	112.5
	Jassid	6.5	2.8	0.5	9.8	12.7	32.6	43.5	88.8
	Whitefly	8.0	3.5	0	11.5	17.1	44.0	68.5	129.6
	Mite	3.8	1.1	0.2	5.1	3.9	27.6	39.0	70.5
	Avg.	5.8	2.1	0.23	8.2	7.7	36.4	56.3	100.4
2005	Aphid	6.2	2.06	0	8.06	13.4	31.5	43.6	88.5
	Jassid	8.4	2.0	1.2	11.6	14.4	21.4	30.8	66.6
	Whitefly	9.5	1.8	0.6	12.9	20.6	44.6	59.8	125.0
	Mite	4.0	1.1	0.3	5.4	6.9	32.5	41.3	80.7
	Avg.	7.0	1.7	0.53	9.5	12.1	33.5	44.6	90.2
2006	Aphid	6.2	0.7	0.5	7.4	16.3	30.4	44.0	90.7
	Jassid	5.5	2.2	0	7.7	3.7	35.6	45.2	84.5
	Whitefly	8.0	0.9	0.6	9.5	14.7	34.6	55.3	104.6
	Mite	3.8	1.4	0.2	5.4	18.7	20.6	38.2	77.5
	Avg.	5.8	1.3	0.32	7.5	13.5	30.6	45.2	89.3
	G.avg.	6.2	1.7	0.36	8.4	11.1	33.5	48.8	93.3

chemical control. The lower level was the most preferred to the same pests in cotton fields under bio control programs. Average number of 56.3 and 36.4 /plant of sucking pest individuals were recorded on the upper and middle plant levels compared to only 7.7 /plant on the lower level. Meanwhile, the opposite was noticed for the same pests under bio control program reaching only to 0.23, 2.1 /plant in upper and middle levels compared to 5.8 /plant on the lower level.

This could be also explained on the basis of severe defects against natural enemies which provided suitable and optimal reproduction factors for the secondary sucking pests in absence of natural enemy populations. At the same time, cotton plants under bio control programs served for high populations of natural enemies that caused high reduction effects on sucking pests and consequently the lower numbers were found to be hidden at the lower parts of cotton. These results are in full agreement with those obtained by Moawad *et al.*, (1992).

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التأثيرات المباشرة وغير المباشرة لبرامج مكافحة باستخدام المبيدات الكيميائية والمكافحة الحيوية على آفات القطن الرئيسية والآفات الثاقبة الماصة في حقول القطن

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أجريت هذه الدراسة الموسعة في حقول القطن بمحافظة المنيا بغرض دراسة
التأثيرات المباشرة وغير المباشرة لبعض نظم مكافحة البيولوجية (ثلاثة نظم)
بالمقارنة بنظام مكافحة التقليدي (استخدام المبيدات الكيميائية) وقد بلغت المساحة
التجريبية حوالي اربعمائة فدان لنظم مكافحة الحيوية ومثلها للمكافحة بالطريق
التقليدي باستخدام المبيدات الكيميائية.وبالنسبة للمكافحة البيولوجية فقد تم استخدام
طفيل البيض التريكوجراما بمفردة في ستة إلى ثمانية إطلاقات متتالية كل عشرة أيام
وبمعدل خمسة وعشرون كارت للفدان (ألف وخمسمائة طفيل لكل كارت) وفي البرنامج
الثاني تم استخدام طفيل التريكوجراما في اربعة إطلاقات بالتبادل مع رشات بالمركب
الحيوي أجرين بمعدل ثلاثمائة جرام للفدان وفي البرنامج الثالث تم استخدام الأجرين
بمفردة (ستة إلى ثمانية رشات وبنفس المعدل السابق).

وفيما يتعلق بالتأثيرات المباشرة فقد أظهرت النتائج المتحصل عليها فعالية
البرامج الحيوية الثلاثة ضد دودة ورق القطن وديدان اللوز القرنفلية والشوكية وكان

البرنامج الأول أكثرها فعالية ضد دودة ورق القطن بينما تعادل تقريباً تأثير البرنامج الثاني والثالث في التأثير على ديدان اللوز القرنفلية والشوكية وكان البرنامج الأول تالياً لهما في حين كان البرنامج التقليدي باستخدام المبيدات الكيميائية هو الأقل فعالية. أما بالنسبة للتأثيرات غير المباشرة على الوفرة العددية من الآفات الثاقبة الماصة ومنها المن والجاسيد والذبابة البيضاء وأكاروس العنكبوت الأحمر فقد أوضحت النتائج زيادة كبيرة في تعداد هذه الآفات في حقول القطن المعاملة باستخدام البرنامج التقليدي وبدا ذلك واضحاً على المستوى العلوي والمتوسط لنباتات القطن المعاملة باستخدام المبيدات الكيميائية فيما حدث العكس تماماً تحت ظروف مكافحة البيولوجية حيث كان التعداد منخفضاً جداً وبدا ذلك واضحاً على المستوى السفلي لنباتات القطن. وقد يفسر ذلك بالنقص الحاد في تعداد الأعداء الحيوية بسبب استخدام المبيدات الكيميائية مما يؤدي إلى تهيئة الظروف المثلى لزيادة الآفات الثانوية وحدث العكس تماماً بزيادة تعداد الأعداء الحيوية بحقول القطن المعاملة باستخدام برامج مكافحة الحيوية مما يؤدي إلى تحجيم تعداد الآفات الثانوية والتي أصبحت ذات تأثير إقتصادي واضح على محصول القطن.