

THE TRIANGLE RELATIONSHIP BETWEEN KEY PESTS,
RELATED BIOLOGICAL AGENTS AND SPECIFIC
CHEMICALS AS FACTORS GOVERNING
THE COTTON IPM PROGRAMME.

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(Manuscript received 5 November 1997)

Abstract

The present field study was carried out at Sharkia Governorate during two successive cotton growing seasons. Weekly samples of the predatory fauna were collected from cotton fields treated by pheromones throughout and compared with the corresponding fauna collected from insecticide treated cotton fields.

Samples were taken from cotton fields before the application of either pheromone or insecticide. The data reveal the reliable occurrence of six predators groups namely *Scymnus* spp., *Orius* spp., *Paederus alfieri*, *Coccinella undecimpunctata*, *Chrysopa carnea* and *Syrphus* spp. in cotton fields during the two tested seasons. The obtained results confirmed that predator densities were three times more numerous in the pheromone treated fields than the corresponding cotton fields treated with recommended insecticides.

INTRODUCTION

Cotton is grown in Egypt on about 25% of the land under cultivation, and commonly attacked by *Spodoptera littoralis* (Boisd.), *Pectinophora gossypiella* (Saunders) and *Earias insulana* (Boid.). Several authors have determined the population densities of related predators in cotton fields and studied their role in regulating the population of cotton pests in Egypt, Ali et al. (1975), Awadalla et al. (1976), Fayad and Ibrahim (1980), Pickett et al (1984), El-Adl and Ghanem (1986), El-Heneidy et al. (1987) and Moawad et al. (in press). The recent widespread application of pesticides for control of the cotton pests has in many cases bad effects on the the population densities of natural enemies in this country, leading to considerable agricultural problems in the situation of cotton pests.

During the last few years, attempts towards establishing an integrated control programme for cotton pests was conducted with the aim of restoring the natural balance and attaining better pest control measurement with less need for pesticidal control.

The present work conducted to study the triangle relationship between biological agents and specific chemicals (synthetic sex pheromones and chemical insecticides) and host plant.

MATERIALS AND METHODS

During two successive cotton growing seasons (1994 and 1995) the changes in the population density of six predator groups were studied depending on the weekly counts in cotton sampled from fields treated with either pheromone or/and with recommended insecticides.

From the 2nd half of June 1994 and 1995 until the end of cotton growing season, samples were weekly taken from four selected localities (Menia El-Kamh, Abo Kebeer, Kafr Sakr and Faqous) at Sharkia Governorate in the pheromone treated area, versus one treated with the recommended insecticide at El-Zgazig district.

Treatments: During 1994 cotton growing season, P.b. Rope pheromone [(1:1 mixture of (Z,Z) and (Z,E.)-7, 11-hexdecadien acetate (300 dispenser/feddan) each dispenser contain (0.72 mg.)] was fixed to cotton plants on early June (one time-Full dose). Weekly numbers of captured beneficial insects were recorded and data were kept all over the cotton growing season, for comparable with the corresponding fields treated with insecticides.

For 1995 cotton growing season, P.b. Rope [1:1 mixture of (Z,Z) and (Z.E.) - 7,11 - hexdecadien acetate (300 dispenser/feddan)] was hanged to cotton plants on 8 th of June (one time-full dose). Cotton fields in Sharkia were treated with the recommended insecticides starting from 10th of July (Catabon 0.75 liter/feddan) and continued during 24th of July (Meothrin 0.75 liter/feddan) and 4th of August 1994 (Larvin D.F. 80%, 0.5 liter/feddan), while it was on 23rd of June (Delfos 1 liter/feddan), 10th of July (Larvin D.F. 80%, 0.5 liter/feddan) and 24th of August 1995 (Coraccron, 0.75 liter/feddan).

Sampling technique: Sampling procedure was carried out from late May up to the second half of September during 1994 and 1995 seasons. The changes in the population density of predators were studied depending on the weekly counts from the 2nd half of June until the end of cotton growing season from the fields treated with pheromone or insecticides.

Samples were taken from four pheromone treated area, Menia El-Kamh, Abo Kebeer, Kafr Sakr and Faqous at Sharkia Governorate versus one from the insecticide treated area at El-Zagazig district.

The D-Vack suction machine was used for sampling of predators as follow: The sampler walked slowly two 50 meters (the first cross with the second) holding the mouth of the D-Vack, so that it "scraped" along the top of cotton canopy. The samples were collected into bags, be identified, counted and recorded in the same day.

RESULTS AND DISCUSSION

Cotton season 1994

Table 1 indicate that the occurrence of predators expressed as number of individuals was as follows: *Scymnus spp.* (6.5), *Orius spp.* (32), *Paederus alfieri* (12.5), *Coccinella undecimpunctata* (25.25), *Chrysopa carnea* (4.75) and *Syrphus spp.* (4.25/100 meters) from the 2nd half of May 1994, and increased drastically reaching a peak during the 1st half of June. From this time onward predators activity declined gradually until mid June on which the first application of pheromone was carried out on 19-20 th June i.e. just before the second peak could manifest itself on 29 th June.

During July and the first half of August 1994 a remarkable and gradual decline in the population densities of these predators occurred and continued up to 7 September.

Samples were collected from Zagazig district demonstrate the same trend of occurrence, Table 2. It is obvious, however, that the population density of *Scymnus spp.* and *Syrphus spp.* demonstrated very low occurrence during the whole experimental period in cotton fields.

A remarkable decrease in predators density was detected as indicated by weekly samples following the insecticides application from mid July till mid August 1994. However, during the last two weeks of August, the predators disappeared completely. One week later, sampling revealed a slight increase in predator population.

Cotton growing season 1995

1. Field treated with pheromone

Table 3 shows the changes in the population density of the tested predators in

Table 1. Total number of predators/100 meters in cotton field treated with pheromone in Sharkia Governorate during 1994 cotton growing season.

Date of collection	<i>Scymnus</i> spp.	<i>Orius</i> spp.	<i>Paederus affierii</i>	<i>Coccinella undecimpunctata</i>	<i>Chrysopa carnea</i>	<i>Syrphus</i> spp.	Total
25/5/1994	6.50	32.00	12.50	25.25	4.75	4.25	85.25
1/6	20.50	55.00	28.25	53.25	9.50	7.25	173.75
8	15.0	55.00	20.25	48.00	5.50	4.50	148.25
15	10.50	34.50	13.25	24.75	4.00	1.25	88.25
22	6.00	51.50	14.00	25.00	3.00	3.00	102.50
29	28.75	88.25	32.25	44.00	7.50	5.25	206.00
6/7	11.75	23.50	11.75	23.00	5.25	3.25	78.50
13	5.50	18.50	7.50	5.75	4.50	1.25	43.00
20	6.25	15.00	4.50	7.75	2.00	2.00	37.50
27	2.75	6.00	5.00	2.50	0.75	3.25	20.25
3/8	3.75	3.00	2.50	2.00	1.25	0.75	13.25
10	2.50	6.25	1.50	1.50	1.25	0.75	13.75
17	0.00	1.50	0.75	0.00	0.00	1.00	3.25
24	0.50	1.25	0.75	1.00	0.75	0.75	5.00
31	0.00	0.25	1.00	0.00	0.00	0.00	1.25
7/9	1.50	0.50	1.00	1.75	0.50	0.25	5.50
14	4.25	1.75	1.00	2.75	1.00	1.00	11.75
Total	126	393.75	157.75	268.25	51.50	39.75	1037

Table 2. Total number of predators/100 meters in cotton field treated with insecticides in Sharkia Governorate during 1994 cotton growing season.

Date of collection	<i>Scymnus</i> spp.	<i>Oritus</i> spp.	<i>Paederus alfieri</i>	<i>Coccinella undecimpunctata</i>	<i>Chrysopa carnea</i>	<i>Syrphus</i> spp.	Total
25/5/1994	0	13	4	32	2	1	52
1/6	2	88	9	94	7	2	202
8	1	37	12	51	5	1	107
15.	3	17	13	30	6	0	69
22	4	28	18	41	7	1	99
29	5	52	12	28	4	4	105
6/7	7	78	32	24	12	5	158
13	2	11	5	6	4	0	28
20	1	2	0	3	0	2	8
27	0	2	0	1	1	2	6
3/8	0	0	0	0	0	0	0
10	1	0	1	1	1	0	4
17	0	2	2	0	0	1	5
24	0	0	0	0	0	0	0
.31	0	0	0	0	0	0	0
7/9	1	5	2	2	0	1	11
14	3	14	4	3	1	1	26
Total	30	349	114	316	50	21	880

Table 3. Total number of predators/100 meters in cotton field treated with pheromone in Sharkia Governorate during 1995 cotton growing season.

Date of collection	<i>Scymnus</i> spp.	<i>Orius</i> spp.	<i>Paederus alfieri</i>	<i>Coccinella undecimpunctata</i>	<i>Chrysopa carnea</i>	<i>Syrphus</i> spp.	Total
17/5/1995	0.50	23.00	1.00	13.00	4.25	6.50	48.25
24	0.00	35.50	1.00	28.75	8.50	4.75	78.50
31	2.00	103.00	7.75	80.75	8.50	7.00	209.0
7/6	1.50	44.75	3.75	25.50	4.50	5.50	85.50
14	1.75	22.50	2.75	20.00	14.00	3.25	64.25
21	1.75	12.00	3.50	19.25	5.25	1.50	43.25
28	3.75	12.50	9.50	39.00	6.75	3.25	74.75
5/7	2.00	7.25	7.25	11.75	7.25	3.25	38.75
12	1.50	3.50	1.75	9.50	2.00	3.75	22.00
19	0.50	2.75	1.25	6.75	4.75	2.00	18.00
26	0.25	5.50	3.25	6.25	2.00	2.75	20.00
2/8	0.50	11.50	4.00	4.50	1.50	1.25	23.25
9	1.50	12.25	2.75	1.50	0.50	0.50	19
16	0.25	2.25	1.25	0.00	0.25	0.25	4.25
23	0.75	1.50	0.25	0.50	0.75	1.00	4.75
30	0.25	1.00	0.00	0.50	0.00	0.00	1.75
6/9	1.25	7.00	1.25	0.00	0.00	0.25	9.75
13	2.25	9.00	2.75	0.50	0.75	1.00	16.25
20	2.75	19.25	3.25	2.50	1.50	1.75	31.00
Total	25	336	58.25	270.50	73	49.50	812.25

the four localities at Sharkia Governorate during 1995 cotton growing season. The population abundance of prevailed predators occurred in scarcely numbers within the 2nd half of May, 1995 after which the population density increased gradually, thus forming a peak during the 2nd half of May and early June. However, gradual decrease was achieved during the two following weeks. Low numbers were recorded during the 1st half of June, and decrease continued until late June.

Samples collected during July and mid of August reveal that the population density tend to decline almost sharply, with the exception of *Orius spp.*, where a third small peak manifested itself during the first two weeks of August. A relatively slight increase occurred during late September.

Data presented in Table 4 indicate that the initial occurrence of related predators in cotton fields was comparatively in low numbers during the 2nd week of May, except for *Orius spp.*

2. Cotton fields treated with insecticides

The counted numbers of predators increased gradually thus forming the first peak at the end of May, following by a remarkable decline during the first two weeks of June. A second peak only *Orius spp.* and *Paederus spp.* occurred on 21 June just before the first application by insecticides. The population density of tested six predators decreased remarkably during late June, just after the first spray of insecticides.

From Table 4 it appears that the prevailed predators underwent remarkable suppression in numbers during the period from late June up to the last spray of insecticides on 6th September. However, on 20 September a slight increase in predator numbers, particularly for *Orius spp.* occurred, it was obvious that *Syrphus spp.* disappeared completely until the end of season.

As a general conclusion, the data in Table 1-4 indicated that the changes in the population densities of the considered predators varied greatly due to the season. In general, insect species and predators started to increase during June because of the remarkable migration from clover fields to the neighborhood cotton plants suitable for feeding and egg oviposition. This is in agreement with that found by El Heneidy et al. (1978-1979). However, most predatory arthropods during June-July in the untreated cotton fields give evidence to the occurrence of strong relationship between predatory arthropods and *Spodoptera littoralis* egg masses. Data collected from

Table 4. Total number of predators/100 meters in cotton field treated with insecticides in Sharkia Governorate during 1995 cotton growing season.

Date of collection	<i>Scymnus</i> spp.	<i>Orius</i> spp.	<i>Paederus affeiri</i>	<i>Coccinella undecimpunctata</i>	<i>Chrysopa carnea</i>	<i>Syrphus</i> spp.	Total
17/5/1995	3	27	2	8	2	0	42
24	1	64	6	17	11	0	99
31	2	103	10	48	12	1	176
7/6	2	31	9	37	3	2	84
14	3	52	5	16	4	2	82
21	2	90	7	10	2	1	112
28	0	10	3	2	0	0	15
5/7	0	7	0	1	1	4	13
12	0	8	1	2	1	0	12
19	2	2	0	1	0	2	7
26	0	7	0	2	0	1	10
2/8	1	4	2	6	2	1	16
9	0	2	0	1	0	3	6
16	2	0	3	4	1	0	10
23	1	4	3	5	1	0	14
30	0	2	0	1	0	0	3
6/9	0	5	2	1	1	0	9
13	3	6	1	4	1	0	15
20	4	12	2	3	4	0	25
Total	26	436	56	169	46	17	750

Sharkia Governorate indicate the obvious occurrence of *Scymnus* spp. beetles in relatively high numbers from end of June to early July 1994, Table 5 and the relatively low occurrence during June-July 1995. Peak cycle usually occurred after peak of square production, which normally took place from mid to late July. Predator populations in cotton fields treated with pheromones were declined, but not as sharply as the corresponding ones in insecticides treated cotton fields.

The precise and better understanding of the change in the population density of the predators in cotton fields resulted after the application of either pheromones or insecticides during 1994 and 1995 seasons was expressed as shown in Table 5, degree of infestation by number of *Spodoptera littoralis* egg-masses in both seasons. This effect was in agreement with the findings of Wiseman (1955), who stated that *Scymnus* spp. were numerous in June, feeding on aphids and eggs of *S.littoralis*. Similarly, previous study was carried out by Willcocks and Bahgat (1937) and Ahmed (1957).

Table 5. Total weekly numbers of *Spodoptera littoralis* egg-masses collected from cotton fields of 4 localities at Sharkia Governorate during 1994 and 1995 cotton growing seasons.

Date	Total weekly collected egg-masses at indicated area cotton season of 1994					
	Menia El-Kamh	Abo Kebeer	Kafr Sakr	Faqus	Total	Average
25/5	5.412	3.719	6.875	12.14	28.146	7.037
1/6	18.51	13.429	36.286	29.417	97.642	24.411
8/6	22.612	16.537	96.857	68.857	204.683	51.171
15/6	75.71	86.571	180.0	204.571	546.852	136.713
22/6	119.521	123.0	202.0	214.50	659.021	164.755
29/6	15.223	18.286	37.428	26.430	97.377	24.344
6/7	0.414	0.5	1.212	1.583	3.709	0.927
	Cotton season of 1995					
17/5	5.112	4.75	3.611	4.91	18.383	4.596
24/5	9.213	7.114	21.65	14.786	52.763	13.191
31/5	21.818	17.15	33.714	35.357	108.039	27.01
7/6	35.201	23.714	36.929	42.214	138.058	34.515
14/6	92.44	69.833	110.5	95.167	367.94	91.985
21/6	147.161	113.335	220.143	229.786	710.425	177.606
28/6	21.37	16.478	18.571	25.357	81.776	20.444
5/7	2.612	1.571	2.792	3.421	10.396	2.599

Table 6. The weekly average and percent changes (+,-) in the population of arthropod predators, before, within and after application of either sex pheromone or insecticides during 1994 season at Sharkia Governorate.

Predator insects	Population of predators, before, within and after treatment								
	Pheromone treatments								
	Before treatment (7 weeks)		Within treatment (5 weeks)		Within treatment (5 weeks)		Changes (+,-%)		
	Total	Weekly average	Total	Weekly average	Total	Weekly average	Changes (+,-%)	Changes (+,-%)	
<i>Scymnus</i> spp.	99	14.14	20.75	4.15	6.25	1.25	-70.65	-69.87	
<i>Orius</i> spp.	339.75	48.53	48.75	9.75	5.25	1.05	-79.9	-89.23	
<i>Paederus alferii</i>	132.25	18.89	21	4.2	4.50	0.90	-77.76	-78.57	
<i>C.undicipunctata</i>	243.25	34.75	19.5	3.9	5.50	1.10	-98.39	-71.79	
<i>Chrysopa carnea</i>	39.5	5.64	9.75	1.95	2.25	0.45	-65.42	-76.92	
<i>Syrphus</i> spp.	28.75	4.10	8.0	1.6	3.0	0.60	-60.97	62.5	
Total	782.5	111.78	127.75	25.55	27.75	5.55	-77.14	-78.27	
			Insecticide treatments						
<i>Scymnus</i> spp.	22.0	3.14	4	8	4	8	-74.52		
<i>Orius</i> spp.	313	44.71	15	3	21	4.2	-93.29	40	
<i>Paederus alferii</i>	100	14.28	6	1.2	8	1.6	-91.59	33.33	
<i>C.undicipunctata</i>	300	42.85	11	2.2	5	1	-94.86	-54.54	
<i>Chrysopa carnea</i>	43	6.14	6	1.2	1	0.2	-80.45	-83.33	
<i>Syrphus</i> spp.	14	2	4	0.8	3	0.6	-60	-25	
Total	792	113.14	46	9.2	42	8.4	-91.86	-8.69	

Table 7. The weekly average and percent changes (+,-) in the population of arthropod predators, before, within and after application of either sex pheromone or insecticides during 1995 season at Sharkia Governorate.

Predator insects	Population of predators, before, within and after treatment								
	Before treatment (7 weeks)			Pheromone treatments					
	Total	Weekly average	Changes (+,-%)	Total	Weekly average	Changes (+,-%)			
<i>Scymnus</i> spp.	7.5	1.25	8	1.6	28	4.5	0.75	-53.12	
<i>Orius</i> spp.	240.75	40.12	35.5	7.1	-82.3	3.55	5.91	-16.76	
<i>Paederus alferii</i>	19.75	3.29	23	4.6	39.8	9.5	1.58	-65.65	
<i>C.undicimpunctata</i>	187.25	31.2	73.25	14.65	-53.04	7	1.16	-92.08	
<i>Chrysopa carnea</i>	45	7.5	22.75	4.55	-39.33	3	0.5	-89.01	
<i>Syrphus</i> spp.	28.5	4.75	15	3	-36.84	3.25	0.54	-82	
Total	528.75	88.12	177.5	35.5	59.71	63.25	10.54	-70.3	
			Insecticide treatments						
<i>Scymnus</i> spp.	13	2.16	2	0.4	-81.48	4	0.66	65	
<i>Orius</i> spp.	367	61.16	34	6.8	-88.88	17	2.83	-58.38	
<i>Paederus alferii</i>	39	6.5	4	0.8	-87.69	10	1.66	-107.5	
<i>C.undicimpunctata</i>	136	22.66	8	1.6	-92.93	18	3	87.5	
<i>Chrysopa carnea</i>	34	5.66	2	0.4	-92.93	5	0.83	107.5	
<i>Syrphus</i> spp.	6	1	7	1.4	40	4	0.66	-52.85	
Total	595	99.16	57	11.4	-88.5	58	11.4	-15.26	

The total number of population predators sampled from cotton fields in 1994 before pheromonal treatments, during 7 peaks period started from 25th May till 6th July are shown in Table 6-7. This was almost similar to that reached during the same period in insecticidal treatment. During a period of 5 weeks (from 13 th July till 16 th August) the population of predators drastically decreased.

It was obvious that the counted numbers dropped from 111.78 before pheromonal treatment to 25.55 within pheromone treated period, and though resulting in 77.14% reduction, thenafter.

On the other hand, the population density dropped from 113.14 before insecticidal to 9.2 after application and though resulting in reduction of 91.86%.

It was obvious that in both areas, a remarkable reduction in population of predators prevailed during insecticide and pheromone treatments. The same trend of results occurred in 1995, Table 7.

Generally, it was thought of interest to note here that the reduction percentages in population density within treatment period during both season were relatively lower in pheromone area than insecticide area as demonstrated by 77.14% versus 91.86% during 1994 season and 59.71% versus 88.5% during 1995 cotton season. However, it is of interest to mentioned out here that the total or/and the weekly average in pheromone treated area was around 3% times more than that in insecticide treated area during the five weeks of 1994 season when either pheromone or insecticides were applied. In 1995 season the total or/and weekly average readings of predators were again found obviously greater in pheromone areas (3.11 times) than in insecticide treated one.

The obtained results reported here showed that predators were three times more numerous in the pheromone treated fields than the corresponding cotton fields treated with insecticides. However, it can be concluded that greater numbers of beneficial insects were found in cotton area treated with sex pheromone thus dominated the population densities of predators occurred in treated cotton fields with conventional insecticides.

It appears from the above results that the general principle for the control of pink and spiny bollworms in Egypt, is the periodical spraying of cotton plants with pheromones and chemical pesticides whenever or before the infestation damage threshold level reaches 3-5% for the 1st spray and 5-8% for the second. The choice

at that level was based on numerous field observations and well varified statistical data (El-Saadany *et al.*, 1975). During the last ten years pheromones were tried and recommended as new strategy for controlling cotton bollworms in Egypt (Hosny *et al.*, 1978). It was therefore of interest to test conventional insecticides and pheromones to estimate the side effect of each method on the population density of related biological agents based on numerical data. The data obtained showed the excellent role of pheromones in activating the population growth of natural enemies towards the highest levels of abundance as compared with the corresponding bad role of insecticides in this respect.

These results are in harmony with the findings of Ibrahim (1962), Ismail (1974), Ali (1975), Awadalla (1976), El-Heneidy (1979), Naguib (1979) (Fayad *et al.* (1980), Abdel-Kawi (1983), El-Adl and Ghanem (1986), El-Heneidy (1987), and Moawad *et al.* (in press).

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العلاقة بين آفات القطن والاعداء الحيوية والمواد الكيماوية المتخصصة واستخدامها في برامج مكافحة المتكاملة

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أجريت هذه الدراسة بمحافظة الشرقية لمدة موسمين متتاليين (١٩٩٤ ، ١٩٩٥). جمعت عينات اسبوعية من المفترسات المنتشرة في حقول القطن المعاملة بالفرمونات في مقارنة مع الاخري التي جمعت من الحقول المعاملة بالمبيدات الحشرية. وقد جمعت هذه العينات قبل وبعد المعاملة بالمبيدات والفرمونات. وقد بينت الدراسات انتشار ستة مجموعات هامة خلال موسمي الفحص من المفترسات هي حشرات الاسكيمنس والاوريس وابرة العجوز وأبو العيد ١١ نقطة وأسد المن ونجاسة السرفس. وقد أوضحت الدراسة أن نسبة الكثافة العددية لهذه المفترسات في حقول القطن المعاملة بالفرمونات الي تلك المعاملة بالمبيدات كنسبة ٣ : ١ .