INTERRELATIONS BETWEEN THE POPULATIONS OF SUCKING PESTS AND THEIR ASSOCIATED PREDATORS AS AFFECTED BY EARLY-SEASON INSECTICIDE TREATMENTS IN COTTON FIELDS

Nassef, M.A. and A.M. Nassef
Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza

ABSTRACT

Field experiments were conducted during 2001 and 2002 cotton seasons at Kafr El-Sheikh, Egypt. The effects of early-season insecticide treatments on the interrelations between the early and late-season populations of certain sucking pests and their associated predators were studied.

The data revealed that the correlations between the early-season populations of the sucking pests and their associated predators were positive, while no such correlations existed between the late-season populations of the pests and predators. The interrelations were negative between the early-season populations of the predators and the late-season populations of the sucking pests.

The data also showed that the early-season insecticide treatments reduced the early-season populations of the sucking pests and predators. The effects of the early-season insecticide treatments were extended to the late-season populations of the predators. The increase in the late-season populations of the pests may be due to the decrease in the early-season populations of the predators in the treated fields.

INTRODUCTION

The cotton plant is liable to be attacked throughout its growing season by different serious sucking pests. In this respect, the aphid and whitefly have become increasingly important as pests of cotton. They produce honeydew, which along with associated fungi, have been implicated in the worldwide problem of sticky and dark cotton lint.

The use of pesticides has been the basis of most efforts to control cotton pests. Recently, the Ministry of Agriculture and Land

Reclamation has begun to implement a new strategy for the use of pesticides in pest control. If pesticides have to be used in Integrated Pest Management (IPM) programmes, pesticide spray must be adopted considering the seasonal abundance of natural enemies. Abdel-Rahman *et al.* (1998) concluded that the indigenous natural enemies are capable of controlling both whitefly and aphid effectively when chemical control was applied at the advanced flowering stage of cotton plants. Hafez (1960) studied the effect of insecticides on the predators in cotton fields. Azab *et al.* (1965), Bleih (1987), Brien *et al.* (1991), Boraei *et al.* (1993) and Mesbah (1999) studied the seasonal abundance and correlations between the sucking pests and predators.

Therefore, this work was conducted to investigate the effect of the early-season insecticide treatments on the correlations between the early and late-season populations of certain sucking pests and their associated predators in cotton fields.

MATERIALS AND METHODS

During the two successive cotton growing seasons, 2001 and 2002, the correlations between the early-season and late-season populations of certain sucking pests and their associated natural enemies were evaluated.

Eight experimental cotton plots with one feddan each, at Sidey-Salem, Kafr El-Sheikh Governorate, were planted on March 25th -27th, 2001 and April 2nd-5th, 2002. In early-season, four experimental plots received one insecticidal spray, during mid-May 2001 and 2002, against the cotton sucking pests using the carbamate insecticide carbosulfan (Marshal), WP 25%, at a rate of 300 g/fed. The cotton plants of the same four plots received the second insecticide spray during the first week of June, 2001 and 2002 against the cotton leafworm hatching larvae using the OP compound profenofos (Curacron), EC 72% at a rate of 750 ml/fed. Meanwhile, the other four experimental plots were kept without any insecticidal treatments during the early-season of both years. Hand picking of cotton leafworm egg-masses was fulfilled.

The cotton plants of all the experimental plots received the normal agricultural practices and no insecticidal treatments were applied during the late-season period of 2001 and 2002.

Weekly sampling was carried out from April 23rd to June 11th, 2001 and May 2nd to June 13th, 2002 to estimate the early-season populations of the sucking pests and their associated natural enemies. Sampling of the late-season populations started on June 18th, 2001 and on June 20th, 2002 and continued till the end of the season. Each sample contained 100 cotton plants/plot, in which the early and late-season populations of sucking pests and predators were recorded.

The variations in the populations of the cotton aphid, *Aphis gossypii*, the cotton jassid, *Empoasca* spp., the cotton whitefly (adults), *Bemisia tabaci* and the common red spider mites, *Tetranychus* spp. were followed. The abundance of the prevailing predaceous species of the lacewing, *Chrysoperla carnea*, lady-bird beetles, *Coccinella undecimpunctata* and *Scymnus* spp., minute pirate bug, *Orius* spp., rove beetle, *Paederus alfierii* and true spiders was monitored.

The simple correlation coefficients between the average means of the early-season and late-season populations of the sucking pests and their associated predators in the experimental cotton field plots during 2001 and 2002 were calculated. Statistical analysis of the obtained data was also fulfilled by using t test.

RESULTS AND DISCUSSION

Correlations between sucking pests and predators:

The average numbers of early and late-season populations of sucking pests and their associated natural enemies in the experimental cotton fields during 2001 and 2002 are given in Tables 1 and 2, respectively.

The data in both Tables express the interrelations between sucking pests and predators populations during early and late-season in the experimental cotton fields. The calculated simple correlation coefficients are given in Table 3 using the data in Tables 1 and 2.

In 2001 season, the statistical analyses showed positive correlations between the early-season population of the total recorded predators and the early-season population of sucking pests. The simple correlation coefficients were significant between the early-season population of the total recorded predators and aphid population (0.714), jassid (0.731) and total recorded sucking pests

(0.806), These correlations were insignificant between the early-season population of the predators and whitefly population (0.595) and common red spider mites (0.675). Meanwhile, the correlations between the early-season population of the predators and the late-season populations of the sucking pests were negative. The simple correlation coefficients were highly significant in case of the aphid (-0.899) and total recorded sucking pests (-0.932), while they were significant for the whitefly (-0.752) and common red spider mites (-0.720). The coefficient was insignificant for jassid (-0.280). In all cases, the correlations between the late-season populations of the predators and the early-season populations of sucking pests were positively insignificant. The simple correlation coefficients between the late-season population of the predators and late-season populations of sucking pests were negatively insignificant. It was only significant in the case of aphid (-0.777).

In general, correlation coefficients of 2002 season showed a trend similar to that of 2001. The simple correlation coefficients were positively and highly significant between the early-season population of predators and early-season population of the whitefly (0.838), significant for aphid (0.805) and significant for total recorded sucking pests (0.772). The correlation was negatively significant between the early-season population of predators and the late-season population of the whitefly (r = -0.764). The simple correlation coefficients were also positively and highly significant between the late-season population of the predators and each of early-season population of aphid (0.918), and total recorded sucking pests (0.937), while it was significant for jassid (0.799).

The data in Table 3 showed positive correlation between the early and late-season total predator populations, giving significant relation during 2001 (r = 0.751) and highly significant relation during 2002 (r = 0.895).

Table (1): Average number of sucking pests and their associated natural enemies during 2001 cotton season.

Pests and natural enemies	Average number of sucking pests and natural enemies															
	Early-season								Late-season							
	A				B				A				B			
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Sucking pests:																
A. gossypii	63.8	57.3	61.9	55.0	82.1	68.0	78.8	74.9	431.1	406.0	439.3	391.0	391.2	361.2	371.1	39.6
Empoasca spp.	26.1	22.9	25.8	23.9	29.3	30.1	41.9	38.9	36.4	39.6	46.9	36.7	46.7	39.3	40.2	30.8
B. tabaci	9.1	10.0	9.8	12.1	10.5	11.3	10.9	11.3	178.2	188.1	170.0	161.2	131.8	142.0	153.9	151.2
Tetranychus spp.	8.9	8.9	9.6	11.3	9.3	11.4	13.1	13.6	66.1	62.2	64.8	55.0	44.2	54.1	56.7	56.0
Total	107.9	99.1	107.1	102.3	131.2	120.8	144.7	138.7	711.8	695.9	721.0	643.9	613.9	596.6	621.9	629.6
Predators:																
Ch. carnea	10.6	5.9	12.9	21.1	16.1	16.8	15.0	14.6	17.2	20.6	18.9	26.8	23.3	21.6	18.7	23.1
C. undecimpunctata	46.6	48.8	43.1	44.3	55.8	54.1	63.9	51.3	30.1	23.9	30.2	35.0	35.0	42.7	47.8	35.0
Orius spp.	16.8	15.3	15.1	24.9	20.8	20.0	19.3	20.5	25.2	39.2	26.4	29.8	29.2	26.2	27.2	28.5
P. alfierii	33.1	34.5	24.9	26.3	36.9	45.0	40.3	40.0	139.1	126.3	119.0	114.2	119.2	129.8	136.1	112.0
Scymnus spp.	16.6	13.3	11.5	10.8	15.3	9.9	16.6	17.8	26.9	32.0	26.0	30.6	42.0	34.9	33.7	36.2
True spiders	16.4	19.9	13.3	23.6	20.4	22.0	20.1	20.6	45.0	47.9	39.9	41.7	44.7	51.2	50.8	40.2
Total	140.1	137.7	120.8	151.0	165.3	167.8	175.2	164.8	283.5	289.9	260.4	278.1	293.4	306.4	314.3	275.0

A (1-4) Insecticide-treated plots
B (5-8) Untreated plots.

Table (2): Average number of sucking pests and their associated natural enemies during 2002 cotton season.

Pests and natural enemies	Average number of sucking pests and natural enemies															
	Early-season								Late-season							
	A				B				A				B			
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Sucking pests:																
A. gossypii	100.6	89.9	88.3	88.6	108.3	117.0	103.9	102.7	271.9	284.1	266.8	284.1	271.2	241.0	271.6	269.0
Empoasca spp.	20.4	23.1	35.9	27.1	36.3	43.0	35.0	31.3	44.4	18.1	51.0	25.9	37.8	29.3	19.9	36.2
B. tabaci	10.0	9.0	9.3	8.3	12.1	11.4	8.9	13.4	114.2	122.2	128.1	128.5	116.2	112.0	115.3	111.3
Tetranychus spp.	8.7	15.3	21.9	22.6	13.9	17.9	16.1	14.0	54.6	33.9	52.8	59.9	44.2	49.8	37.8	41.0
Total	139.7	137.3	155.4	146.6	170.6	189.3	163.9	161.4	485.1	458.3	498.7	498.4	469.4	432.1	444.6	457.5
Predators:																
Ch. carnea	15.3	7.7	7.9	8.4	12.7	13.9	16.7	21.0	17.9	17.1	12.3	10.0	13.7	15.9	17.8	19.1
C. undecimpunctata	38.9	56.0	53.4	55.0	55.0	54.9	61.1	53.9	33.0	22.8	28.1	32.7	33.2	35.4	29.7	31.2
Orius spp.	21.4	17.6	16.6	15.3	23.7	22.0	23.0	22.0	18.2	27.1	30.4	17.2	19.8	21.4	25.0	26.3
P. alfierii	51.6	37.9	46.7	35.0	50.1	48.9	41.7	53.0	90.1	89.0	101.9	103.2	114.0	118.9	99.9	101.2
Scymnus spp.	14.0	16.1	17.0	16.7	25.0	18.7	15.7	19.4	28.8	23.1	22.3	19.0	23.1	24.0	32.7	27.3
True spiders	23.3	22.7	26.1	18.0	26.3	28.4	22.6	23.0	33.2	30.4	26.7	33.2	37.5	39.2	34.2	36.5
Total	164.5	158.0	167.7	148.4	192.8	186.8	180.8	192.3	221.2	209.5	221.7	215.3	241.3	254.8	239.3	241.6

A (1-4) Insecticide-treated plots
B (5-8) Untreated plots.

Table (3): Simple correlation coefficients between early and late-season populations of sucking pests and their associated predators during 2001 and 2002 cotton seasons.

Correlations	Parameters	Simple correlation coefficients (r)	
		2001 season	2002 season
YX_1	Y_aX_{1a}	0.714*	0.805*
	Y_aX_{1b}	-0.899**	-0.602
	Y_bX_{1a}	0.465	0.918**
	Y_bX_{1b}	-0.777*	-0.803*
YX_2	Y_aX_{2a}	0.731*	0.661
	Y_aX_{2b}	-0.280	0.156
	Y_bX_{2a}	0.442	0.799*
	Y_bX_{2b}	0.007	0.030
YX_3	Y_aX_{3a}	0.595	0.838**
	Y_aX_{3b}	-0.752*	-0.764*
	Y_bX_{3a}	0.204	0.690
	Y_bX_{3b}	-0.372	-0.740*
YX_4	Y_aX_{4a}	0.675	-0.334
	Y_aX_{4b}	-0.720*	-0.400
	Y_bX_{4a}	0.263	-0.135
	Y_bX_{4b}	-0.401	-0.153
YX_5	Y_aX_{5a}	0.806*	0.772*
	Y_aX_{5b}	-0.932**	-0.618
	Y_bX_{5a}	0.482	0.937**
	Y_bX_{5b}	-0.637	-0.690
Y	Y_aY_b	0.751*	0.895**

Y = Total recorded predators, X_1 = *A. gossypii*, X_2 = *Empoasca* spp., X_3 = *B. tabaci*, X_4 = *Tetranychus* spp., X_5 = Total recorded sucking pests, a = early-season population and b = late -season population. r; N = 8; 0.707, 5%*; 0.834, 1% **

Effect of early-season insecticide treatments:

The present investigation was directed to study the efficiency of early-season insecticide treatments on the population of certain sucking pests and predators in cotton fields during the early and late-seasons of 2001 and 2002. The results obtained are given in Table 4.

Statistical analysis of the data revealed that the early-season insecticide treatments reduced the early-season populations of the sucking pests and predators during the two seasons. In 2001, the

Table (4): General means of sucking pests and their associated natural enemies during 2001 and 2002 seasons.

Pests and natural enemies	General means of sucking pests and natural enemies															
	2001 cotton season								2002 cotton season							
	Early-season				Late-season				Early-season				Late-season			
	Mean ± SD		SE	t	Mean ± SD		SE	t	Mean ± SD		SE	t	Mean ± SD		SE	t
	A	B			A	B			A	B			A	B		
Sucking pests:																
A. gossypii	59.5±3.5	76.0±5.3	±3.7	-4.459**	416.9±19.3	378.8±13.1	±13.5	2.822*	91.9±5.1	108.0±5.6	±4.4	-3.659*	276.7±7.6	263.2±12.9	±8.6	1.570
Empoasca spp.	24.7±1.3	35.1±5.5	±3.3	-3.152*	39.9±4.2	39.3±5.7	±4.1	0.146	26.6±5.9	36.4±4.2	±4.2	-2.333	34.9±13.3	30.8±7.1	±8.7	0.471
B. tabaci	10.3±1.1	11.0±0.3	±0.7	-1.000	174.4±9.9	144.7±8.7	±7.6	3.908**	9.2±0.6	11.5±1.6	±1.0	-2.300	123.3±5.8	113.7±2.1	±3.6	2.667*
Tetranychus spp.	9.7±1.0	11.9±1.7	±1.2	-1.833	62.0±4.3	52.8±5.0	±3.8	2.421	17.1±5.6	15.5±1.7	±3.4	0.471	50.3±9.8	43.2±4.4	±6.2	1.145
Predators:																
Ch. carnea	12.6±5.5	15.6±0.9	±3.2	-0.938	20.9±3.6	21.7±1.8	±2.3	-0.348	9.8±3.2	16.1±3.2	±2.6	-2.423	14.3±3.3	16.6±2.0	±2.3	-1.045
C. undecimpunctata	45.7±2.2	56.3±4.7	±3.0	-3.533*	29.8±3.9	40.1±5.4	±3.8	-2.710*	50.8±6.9	56.2±2.8	±4.3	-1.296	39.2±4.1	32.4±2.1	±2.7	-1.185
Orius spp.	18.0±4.0	20.2±0.6	±2.3	-0.957	30.2±5.5	27.8±1.2	±3.3	0.727	17.7±23	22.7±0.7	±1.4	-3.571*	23.2±5.7	23.1±2.6	±3.6	0.028
P. alferii	29.7±4.2	40.6±2.9	±3.0	-3.633*	124.7±9.4	124.3±9.3	±7.6	0.053	42.8±6.7	8.4±4.2	±4.6	-1.217	98.1±6.5	108.5±8.1	±6.0	-2.067
Scymnus spp.	13.1±2.2	14.9±3.0	±2.1	-0.857	28.9±2.5	36.7±3.2	±2.4	-3.250*	16.0±1.2	19.7±3.4	±2.1	-1.762	23.3±3.5	26.8±3.8	±3.0	-1.167
Two spotted	16.3±3.8	20.8±0.7	±2.2	-1.136	43.6±3.1	46.7±4.6	±3.2	-0.969	22.5±2.9	25.1±2.4	±2.2	-1.182	30.9±2.7	38.9±1.8	±1.9	-3.158*

A = Early -season treated plots B = Early-season untreated plots

SD = Standard Deviation SE = Standard Error

t: $[(n_1+_2) + (n_2 - 1)] = 6$; 2.447, 5%*; 3.707, 1% **

aphid and jassid populations were reduced significantly (t = -4.459 and -3.152), while the reductions were insignificant for whitefly and common red spider mites (t = -1.000 and -1.833). The effects on the populations of the predators were significant for *C. undecimpunctata* and *P. alfierii* (t = -3.533 and -3.633), and insignificant for *Ch. carnea, Orius* spp., *Scymnus* spp. and true spiders (t = -0.938, -0.957, -0.857 and -1.136, respectively). In 2002, the effects of insecticide treatments on the early-season population of aphid were significant (t = -3.659), while they were insignificant for jassid, whitefly and common red spider mites (t = -2.333, -2.300 and 0.471). The effect on the predatory species, *Orius* spp. was also significant (t = -3.571), while it was insignificant for the others.

The effect of the early-season insecticide treatments during 2001 and 2002 extended to the late-season populations of predators. In 2001, significant reductions were observed in the late-season population of the lady-bird beetles, *C. undecimpunctata* and *Scymnus* spp. (t = -2.710 and -3.250). In 2002, the population of the true spiders was also reduced significantly (t = -3.158). Meanwhile, the rest predatory species were insignificantly affected during 2001 and 2002.

Regarding the effect of the early-season insecticide treatments on the late-season populations of the sucking pests, the data presented in Table (4) show significant increase in the population of aphid during 2001 and whitefly during 2001 and 2002 in the treated cotton fields (t = 2.822, 3.908 and 2.667, respectively). The other species were insignificantly affected.

In conclusion, the present findings during the two seasons showed the following:

1. The correlation between the early-season populations of the sucking pests and early-season population of predators was positive as the early-season insecticide treatments reduced the populations of both pests and predators in the treated fields.
2. The correlation between the late-season populations of the sucking pests and late-season population of predators was negative as the reduction in the population of the pests was achieved mainly by the occurrence of high predatory population in the untreated fields.

3. The correlation between the early and late-season populations of the predators was positive which reveals that the adverse effects of insecticides applied early in the season extended to the late-season population.
4. The interaction between the early-season population of the predators and late-season population of the sucking pests was negative. This proves that the increase in the late-season population of the pests may occur by the decrease (due to insecticide treatments) in the early-season population of the predators.

Such observations indicate that the early-season pesticide treatments in cotton fields may suppress the early-season predaceous population and subsequently increase the sucking pests population late in the season.

In this respect, the results of Wilson *et al.* (1991) indicated a significant negative correlation between late-season mite abundance and early-season predators. Weathersbee and Hardee (1993) reported that parasitoids and predators prevailing early in cotton fields are important as natural enemies because they slow down the growth of aphid population.

Therefore, it could be concluded that the insecticidal spray programmes during the early-season may affect negatively the population of predatory species. It is strongly recommended to use insecticides judiciously to conserve the population of such predators in the cotton plantations.

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تأثير المعاملة بالمبيدات في بداية الموسم على العلاقة بين اعداد الحشرات الثاقبة الماصة والمفترسات فى حقول القطن

محمد عبد الفتاح ناصف - على ممدوح ناصف
معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقى - جيزة

أجريت عدة تجارب بحقول القطن فى موسمى ٢٠٠١ ، ٢٠٠٢ بمحافظة كفرالشيخ لدراسة تأثير المعاملة بالمبيدات فى فترة بداية الموسم على العلاقة بين اعداد الحشرات الثاقبة الماصة والمفترسات خلال فترتى بداية ونهاية الموسم.

وقد أوضحت النتائج وجود علاقة موجبة بين اعداد الحشرات الثاقبة الماصة والمفترسات فى فترة بداية الموسم. بينما كانت هذه العلاقة سالبة فى فترة نهاية الموسم. كما كانت العلاقة أيضا سالبة بين تعداد المفترسات فى بداية الموسم واعداد الحشرات الثاقبة الماصة فى نهاية الموسم.

واظهرت النتائج أن المعاملة بالمبيدات فى بداية الموسم قد أدت الى خفض اعداد الحشرات الثاقبة الماصة والمفترسات فى الحقول المعاملة وامتد هذه التأثير أيضا إلى فترة نهاية الموسم فلوحظ انخفاض فى اعداد المفترسات فى هذه الفترة فى الحقول المعاملة أدى الى زيادة فى اعداد الحشرات الثاقبة الماصة فى نهاية الموسم.