PEST-PREDATOR INTERACTIONS IN UNTREATED COTTON FIELDS AT THREE PLANT GROWTH STAGES. 2- PLANTING DATE IMPACT

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Abstract

Impact of planting dates in different agro-ecosystems on pest-predator interactions in untreated cotton fields at three plant growth stages; Plant Establishment (PE), Fruit Formation (FF) and Fruit Maturation (FM) was studied in Egypt at Mallawi and Sakha Research stations in the two successive cotton seasons 1992 and 1993. Direct counts of pests and predators were taken weekly from the two planting dates/ location/season. Population of cotton pests and their associated predators was substantially different in the two areas and in the two planting dates; Early (E) and Late (L). Highest infestation rates by secondary pests were recorded in E and L plantings at Mallawi and Sakha, respectively in the two seasons. L plantings received higher populations of the key pests; CLW, SBW and PBW than the E plantings in the two locations and seasons except at Mallawi, 92 in case of the CLW. Generally, predators population was almost higher at sakha than at Mallawi as well as in the E plantings than the L ones in the two seasons. Highest population of predators was recorded during FF stage (by mid-season). Statistical analyses showed different significant interactions between most of predators and both secondary and primary insect pests of cotton during various plant growth stages. The interactions were obviously more significant at Sakha.

Key words : Cotton, pest-predator, interaction, planting-date, Egypt.

INTRODUCTION

The relative value of beneficial insects in cotton agroecosystems is increasingly recongnized, although much more quantification of their value is still needed. This is particularly true with regard to the relation of total populations of the complex of the beneficial species to pest populations in the cotton fields.

The problem with the utilization of indigenous parasitoid and predator species is a general lack of understanding of the details of their role in cotton agroecosystems. The time of their impact on the pest poulation is of considerable importance .

Certainly, there is no benefit from the biocontrol agents, when pesticides are applied. In Egypt, the widespread and intensive use of insecticides to control the bollworms; the spiny bollworm (SBW), *Earias insulana* (Boisd.) and the pink bollworm (PBW), *Pectinophora gossypiella* Saund., the major cotton pests, has eliminated or greatly reduced the impact from the native beneficial complex during the season, especially parasitoids (Hamed, 1984) .

Many studies have shown that the native predators are the most effective biocontrol agents in Egyptian cotton fields. Their active roles continue until the scheduled spraying of cotton, that starts by early July. At this time, a decline (up to 80%) in the predator population usually occurs (EL-Heneidy *et al.*, 1978, Fayad and Ibrahim, 1981, Hamed *et al.*, 1983 and El-Heneidy *et al.*, 1987).

Acquiring quantitative information about the cotton agroecosystem and plant-pest-natural enemies interactions in particular is a preliminary phase of any basic or applied work in Pest Managment Programs .

The present study was carried out as an Egyptian-American collaborative program on cotton IPM under the National Agricultural Research Project (NARP) financed by USAID. In this study, the authors focused on pest-predator-interactions in untreated cotton fields in Egypt, a series started with the location impact (EL-Heneidy *et al.*, 1995) and continued with the present study on planting date impact.

METHODS AND TECHNIQUES

Two experimental plots per location were chosen in 1992 and 1993 cotton growing seasons in two research stations; 12 feddans were planted at Sakha (Kafr El-Sheikh Governorate (north of Egypt) and 4 feddans were planted at Mallawi

(Menia Governorate (middle-upper Egypt). These are two distinct geographically agro-ecosystems (Taher *et al.*, 1978 and El-Heneidy *et al.*, 1995). Experimental plots were purposely surrounded by clover and wheat during winter seasons prior to cotton and maize during summer seasons to enhance native levels of biocontrol species. Cotton was planted as early (recommended planting dates) (E) and late (L) planting, 3-4 weeks intervals in each of the two areas and in the two seasons. Giza 68 and Giza 83 were the recommended cotton varieties planted at Sakha and Mallawi experimental plots, respectively. Regular cultural practices were conducted throughout the season. In order to evaluate the natural pest-predator interactions, no insecticides were applied to the tested fields. Evaluations were done at three distinct plant growth stages : Plant Establishment (PE) (from planting date to 1st square), Fruit Formation (FF) (from 1st square to 1st open boll), and Fruit Maturation (FM) (from 1st open boll to harvest) (Falcon, 1972; Garcia *et al.*, 1982; Gonzalez and Wilson, 1982; El-Heneidy *et al.*, 1995).

Weekly visual counts of pests and their associated predaceous species were taken on the same plant, started few days after seed germination. The total area sampled (each week in each plot of the early and late planting/location/season) was 25 meters (= 100 hills = 200 plants). A stratified sampling technique was used (Legaspi *et al.*, 1989; Ellington, 1990) .

Counts of thrips, aphids, whiteflies and jassids were estimated to be either less or more than 10 individuals/leaf. Three leaves were sampled in each plant, one from top, middle and lower part of each plant. The percentage of infested leaves was calculated from 600 leaves /200 plants. Actual numbers were counted for the cotton leafworm (CLW), *Spodoptera littoralis* (Boisd.), SBW and PBW.

Furthermore, direct counts of common predators were also carried out. Counts of both immature and adult stages of the following predators were recorded; the two coccinelids; *Coccinella undecimpunctata* L. and *Scymnus interruptus* L., the chrysopid; *Chrysoperla carnea* Steph., the anthocorid; *Orius* spp., the staphilinid; *paederus alfierii* koch, ants and four groups of true spiders; Lunx, Jumping, Webbing and Crab.

Rate of cotton boll infestation was estimated weekly by dissecting 100 random green bolls collected from each of the early and late planting plots in the two locations and the two seasons, from mid-FF stage, and continued up to harvesting.

Multiple regression analyses were used between each predator species (using

combined numbers of feeding immature stages and / or of adults) and the total numbers of each prey species, in each plant growth stage in the two locations and in the two seasons (cite lit. method for analyses used). Statistical analysis was presented by predator/growth stage / prey.

RESULTS AND DISCUSSION

Pests and predators incidencies during cotton plant growth stages

1- Plant Establishment (PE) stage

This stage lasted about 9 and 7-8 weeks at Sakha in E and L plantings, respectively, in correspondence to 8 and 7 weeks at Mallawi in the two seasons. Germinated seeds and seedlings of E and L cotton in the two locations were liable to be attacked by cutworms and mole-cricket and the foliage sucking insects; thrips, aphids, mites, whiteflies and jassids. During this period, higher rates of infestation were found at Mallawi, 92, particularly in E planting, except that of thrips at Sakha in the two planting dates of the two seasons (Table 1). Furthermore, highest rates of infestation by secondary pests (aphids, whiteflies and jassids) were estimated as 16.3, 23.8 and 42.1% in E planting at Mallawi, 92. None of the primary insect pests: CLW, SBW and PBW was found during this stage in the two locations .

Most of the predaceous species were counted during the PE stage in the two areas and in the two seasons, except the green lacewings, *C.carnea* and partly the rove beetle, P.alfierii and S.interruptus. As shown in Table 2, true spiders and *C. undecimpunctata* were the most abundant species during this stage. Except sakha, 93 E plantings received more predators compared with L ones. Generally, number of predators was relatively higher at Mallawi than at Sakha in 1992 season and vise versa in 1993 season (Table 2).

2- Fruit formation (FF) stage

This stage lasted about 12 and 11 weeks at Sakha in E and L plantings, respectively, in correspondence to 10 and 9 weeks at Mallawi in the two seasons. The FF stage is the most critical growth stage of the cotton plant because pests attack the sensitive plant parts such as squares, flower buds and flowers. Damages usually lead to the reduction in boll formation or the increase in fruit drop (Abul-Nasr *et al.*, 1978). In both cases, crop yield is adversley affected.

Table 1. Multiple regression analyses among cotton predators and pests at the three growth stages of cotton plant in early planting at Mallawi in 1992 and 1993.

Coccinella	PR : Aphids*, whiteflies*	
	FF : Aphids***	
	FM : Aphids**, SBW	
Chrysoperla	PR : ----------	
	FF : Aphids***, whiteflies*, Jassids**, SBW***	
	FM : Aphids**, SBW	
Orius	PR : ----------	
	FF : Aphids***, Whiteflies*, Jassids**	
	FM : Aphids**, Whiteflies***, Jassids**, PBW*	
Paederus	PR : Thrips*	
	FF : Aphids*, Whiteflies*	
	FM : Aphids**, Whiteflies***, Jassids**, PBW*	
Ants	PR : Thrips*	
	FF : Aphids**, Whiteflies*	
	FM : Aphids***, Whiteflies*, Jassids*, PBW*	
Scymnus	PR : ----------	
	FF : ----------	
	FM : Aphids**, Whiteflies***, Jassids**, SBW*	
True spiders	PR : Thrips**, Aphids*, Whiteflies***	
	FF : Aphids*, Whiteflies*, Jassids**	
	FM : Aphids**, Whiteflies**, Jassids*, SBW*	

* Significant at P. = 0.1
** Significant at P. = 0.05
*** Significant at P. = 0.01

Table 2. Multiple regression analyses among cotton predators and pests at the three growth stages of cotton plant in early planting at Mallawi in 1992 and 1993.

Coccinella	PE : Thrips*, Aphids*, Jassids**
	FF : Thrips**, Aphids***, Whiteflies***, Jassids***, CLW**, SBW***
	FM : Aphids**, Jassids*, CLW*, SBW
Chrysoperla	PE : ----------
	FF : Thrips**, Aphids***, Whiteflies***, Jassids***, CLW**, SBW***
	FM : Aphids**, Whiteflies**, Jassids**, CLW***, SBW**, PPBW*
Scymnus	PE : Thrips**, Aphids*, Whiteflies*, Jassids**
	FF : Thrips**, Aphids***, Whiteflies***, Jassids***, CLW**, SBW***
	FM : Aphids**, Whiteflies***, PBW*
Orius	PE : Thrips*, Aphids*, Whiteflies*
	FF : Thrips**, Whiteflies*
	FM : Aphids**, Whiteflies***, Jassids**, PBW*
Peaderus	PE : ----------
	FF : Thrips***, Aphids*, Whiteflies*
	FM : Aphids***, Whiteflies**, Jassids**, CLW*, SBW*,PBW*
Ants	PE : ----------
	FF : Thrips***, Aphids*, SBW**
	FM : Aphids**, Jassids**, SBW*
True spiders	PE : Thrips*
	FF : Thrips*, Aphids**, Whiteflies**, Jassids**, CLW**
	FM : Aphids**, Whiteflies**, Jassids*, SBW*, PBW*

* Significant at P. = 0.1
** Significant at P. = 0.05
*** Significant at P. = 0.01

Table 3. Multiple regression analyses among cotton predators and pests at the three growth stages of cotton plant in early planting at Mallawi in 1992 and 1993.

Coccinella	PE : Aphids***	
	FF : Thrips**, Aphids***, Whiteflies**, Jassids***, CLW**, PBW***	
	FM : Jassids*, CLW**, PBW**	
Chrysoperla	PE : ----------	
	FF : Whiteflies ***, SBW**	
	FM : Aphids**, Whiteflies**, Jassids**, SBW**	
Scymnus	PE : Thrips**, Aphids*, Whiteflies*, Jassids**	
	FF : Thrips**, Aphids***, Whiteflies***, Jassids***, CLW**	
	FM : PBW*	
Orius	PE : Thrips**, Aphids*, Whiteflies*, Jassids*	
	FF : Aphids**, Jassids*, CLW***	
	FM : Whiteflies*, Jassids***, SBW**	
Peaderus	PE : Thrips**, Aphids*, Whiteflies*, Jassids*	
	FF : Aphids**, Jassids*, CLW***	
	FM : Whiteflies*, Jassids***, SBW**	
Ants	PE : ----------	
	FF : ----------	
	FM : Aphids**, Whiteflies**, Jassids*, SBW**, PBW*	
True spiders	PE : Thrips**, Jassids*	
	FF : Aphids**, Whiteflies*, CLW**	
	FM : Jassids*	

* Significant at P. = 0.1
** Significant at P. = 0.05
*** Significant at P. = 0.01

Table 4. Multiple regression analyses among cotton predators and pests at the three growth stages of cotton plant in early planting at Mallawi in 1992 and 1993.

Coccinella	PE	Thrips**, Aphids***, Whiteflies***, Jassids***
	FF	p0Thrips**, Aphids***, Whiteflies**, Jassids***, CLW**, SBW**, PBW***
	FM	Aphids*
Chrysoperla	PE	----------
	FF	Thrips**, Aphids***, whiteflies***, Jassids***, CLW*, SBW***, PBW*
	FM	Aphids**, Whiteflies**, Jassids**, CLW*, SBW**
Scymnus	PE	Thrips**, Aphids*, Whiteflies*, Jassids**
	FF	Thrips**, Aphids***, Whiteflies***, Jassids***, CLW**
	FM	PBW*
Orius	PE	Thrips**, Aphids*, Whiteflies*, Jassids*
	FF	Aphids**, Jassids*, CLW***
	FM	Whiteflies*, Jassids***, SBW**
Peaderus	PE	Thrips**, Aphids*, Whiteflies*, Jassids*
	FF	Aphids**, Jassids*, CLW***
	FM	Whiteflies*, Jassids***, SBW**
Ants	PE	Thrips*
	FF	Thrips*, Aphids*, Whiteflies*
	FM	CLW*, SBW*, PBW*
True spiders	PE	Thrips**, Aphids*, Whiteflies*, Jassids***
	FF	Thrips*, Aphids*, Whiteflies***, Jassids***, CLW***, SBW***, PBW***
	FM	Aphids**, Jassids**, CLW*, SBW**

* Significant at P. = 0.1
** Significant at P. = 0.05
*** Significant at P. = 0.01

Diagram 1. Percentages of foliage infestation by secondary pests and mean number of the key pests (larvae/100 hills) in three cotton plant growth stages in untreated cotton fields, in two different planting dates, at Mallawi and Sakha Research Stations in seasons 1992 and 1993.

Pest Species		MALLAWI, 92			SAKHA, 92			MALLAWI, 92			SAKHA, 92		
		PE	FF	FM	PE	FF	FM	PE	FF	FM	PE	FF	FM
Thrips	E	15.0	1.5	0.0	12.3	7.8	0.0	13.8	1.5	0.0	16.1	4.8	0.0
	L	9.1	0.3	0.0	20.3	2.6	0.0	10.4	2.3	0.0	14.0	2.6	0.0
Aphids	E	16.3	1.1	5.8	0.3	8.9	18.9	5.0	1.3	5.2	8.0	3.8	15.8
	L	4.6	0.9	7.6	0.0	11.6	19.1	4.1	0.6	4.6	2.8	3.6	26.3
Whiteflies	E	23.8	5.5	14.1	4.4	5.3	21.5	0.0	5.0	15.8	1.1	10.0	20.5
	L	8.9	4.3	11.8	1.3	9.1	21.7	2.5	3.3	20.8	2.4	10.9	33.9
Jassids	E	42.1	20.3	20.8	4.1	15.9	15.4	6.3	4.8	18.8	3.3	14.8	21.6
	L	18.8	15.1	15.4	2.0	17.4	12.8	3.4	0.0	17.0	4.8	16.0	25.1
CLW	E	0.0	2.3	1.4	0.0	51.8	5.9	0.0	0.0	2.3	0.0	14.3	7.0
	L	0.0	0.8	1.3	0.0	58.8	4.5	0.0	0.0	2.7	0.0	23.1	11.8
SBW	E	0.0	0.5	2.4	0.0	3.1	8.3	0.0	0.0	2.6	0.0	2.3	6.8
	L	0.0	0.4	3.9	0.0	3.5	8.1	0.0	0.0	2.9	0.0	3.1	5.8
PBW	E	0.0	0.0	0.4	0.0	0.1	1.1	0.0	0.0	0.6	0.0	1.7	3.3
	L	0.0	0.0	2.0	0.0	6.3	8.9	0.0	0.0	3.0	0.0	0.9	6.4

PE = Plant Establishment, FF = Friut Formation, FM = Fruit Maturation

E = Early Planting, L = Late Planting

Diagram 2. Mean number of predatory species/100 hills in three cotton plant growth stages in untreated cotton fields, in two different planting dates, at Mallawi and Sakha Research Stations in seasons 1992 and 1993 .

Predator Species		MALLAWI, 92			SAKHA, 92			MALLAWI, 92			SAKHA, 92		
		PE	FF	FM	PE	FF	FM	PE	FF	FM	PE	FF	FM
Coccinella	E	6.6	15.5	8.9	5.9	13.5	16.6	10.0	16.8	7.9	4.3	12.8	13.0
	L	5.9	9.8	9.4	3.0	17.1	18.8	5.9	14.0	6.1	4.6	11.1	13.4
Chrysop-	E	0.0	0.6	1.5	0.0	0.4	3.0	0.0	1.0	0.4	0.0	0.5	5.5
erla	L	0.0	0.8	2.0	0.0	1.4	2.5	0.0	0.9	1.3	0.0	0.9	7.4
Scymnus	E	0.0	16.9	12.0	0.0	20.3	20.5	1.3	9.8	14.6	3.3	26.3	27.5
	L	2.5	13.9	10.1	2.3	30.4	20.4	0.0	11.6	10.1	3.9	29.3	26.8
Orius	E	0.0	8.9	19.9	2.8	16.9	10.6	2.5	10.0	6.1	1.1	7.0	5.0
	L	1.3	12.4	15.6	2.3	18.1	8.6	0.9	7.3	6.4	3.9	5.0	5.5
Paederus	E	5.9	12.5	14.5	0.0	33.0	13.5	0.0	16.3	11.5	0.0	34.6	14.9
	L	2.5	10.8	18.3	2.4	34.6	8.6	0.0	18.5	11.9	4.8	38.1	11.8
Ants	E	-	-	-	-	-	-	0.3	1.0	1.4	4.9	8.4	6.6
	L	-	-	-	-	-	-	1.3	2.0	4.9	3.4	7.7	5.4
True	E	13.8	17.5	18.6	7.4	18.5	16.3	8.8	14.3	8.8	12.0	13.3	8.3
Spiders	L	10.0	18.3	17.3	6.0	24.9	16.1	6.3	15.3	6.6	12.4	11.3	7.4

PE = Plant Establishment, FF = Friut Formation, FM = Fruit Maturation

E = Early Planting, L = Late Planting

During this stage, all secondary insect pests were recorded in the experimental plots. Generally, higher infestation rates were relatively found at Sakha (Diagram 1). A sharp decline in infestation rates in most of secondary pests, especially at Mallawi, 92, but the obvious decline was in case of thrips in the two areas during this period. Except Mallawi, 92, an obvious build up of infestation rates of most of these pests was found in E plantings at Mallawi, 93 as well as L plantings at Sakha in the two seasons. The three principal insect pests, except the PBW at Mallawi were recorded during this stage. CLW predominated the others in this FF stage. SBW occurred early during this period in the two areas. Apparently, the populations of these key pests were higher at Sakha than at Mallawi and particularly, in L plantings (Diagram 1).

As shown in Diagram 2, highest numbers of most of the predaceous species and / or groups except *C.carnea*, were recorded during this stage. The coccinellids, *C.undecimpunctata* and *S.interruptus*, the true spiders and the rove beetles, *P.alfierii*, particularly at Sakha, were the most abundant species in the two locations during FF stage. No pattern can be obtained for the abundance of predator species in the two planting dates in the two working sites during this stage .

3- Fruit maturation (FM) stage

This stage lasted about 9 and 8 weeks at Sakha in E and L plantings, respectively, in correspondence to 7-8 and 7 weeks at Mallawi. Most of insect damage during this period is sustained on green bolls.

Highest rates of infestation by secondary pests throughout the study were recorded during this stage in the two locations, except jassids at Sakha, 92. Thrips disappeared completely during FM period. L plantings received mostly the highest rates with these species, except the jassids. CLW population decreased during this stage. Highest numbers of the two bollworms, SBW and PBW were recorded in L plantings during this period, especially at Sakha in the two seasons (Diagram 1) .

Although the predators population was recorded in relatively high numbers during this stage, the total number was decreased compared with FF stage. Slight difference, in numbers of each of the predaceous species, was found between the two planting dates during this period. C.carnea continued the season as the lowest population among the predator species. P.alfierii, which is recognised as mid-season predator, increased at Mallawi, 92 in the two planting dates during this stage. Except Mallawi, 92, S. interruptus predominated all the other predaceous species in

the two locations.

Statistical analyses of pest-predator interactions in the two planting dates at each of Mallawi and Sakha in the two seasons of work, 1992 and 1993, are summarized in Tables 1,2,3 and 4 .

As shown in the diagrams, generally, most of the predaceous species and/or groups, except *C.carnea* and ants during PE stage, interacted significantly with secondary and primary insect pests during various growth stages of the cotton plant. Highly significant interactions were found between predators and secondary pests in the two planting dates of the two areas, except thrips, particularly at Mallawi .

Predators interacted significantly with CLW, mainly during FF stage, when the highest population of the pest was recorded, with SBW during FM and FF, and FM at Mallawi and Sakha, respectively in the two planting dates, and with PBW, mainly during FM in the two locations, except L plantings at Sakha, when the interaction was found during FF stage. Predators did not interact with CLW in E plantings at Mallawi because of its low population (Table 1). Less interaction was found also at Mallawi with PBW in L plantings (Table 3).

Highly significant interactions among predaceous species were found by the coccinellids, *C.undecimpunctata* and *S.interruptus*, the chrysopid, *C.carnea*, the anthocorids, Orius spp. and the true spiders, particularly at Sakha in the two planting dates. Although *C.carnea* was found in very low population throughout the study, it interacted significantly with all of the considered insect pests of cotton, especially at Sakha (Tables 2 and 4) .

Rate of Natural Infestation in the Green Bolls

Levels of infestations are given in terms of percentage infestation in green bolls. The percentage infestation increased during the season and the highest infestation figures were obtained at the end of the seasons in the two planting dates in the two locations, in particular at Sakha (Abdel-Salm *et al.*, 1991). Data shown in figure (1) were derived from collections of green bolls at weekly intervals starting by mid-FF stage up to harvest in each season. Clearly, trends of infestation increased sharply towards the end of the season. Highest percentages infestation were recorded in L plantings of the two working sites in FF and FM stages and in the two seasons (Fig. 1). Generally, percentages infestations were higher at Sakha than at Mallawi and in season 1992 than in 1993.

Generally, it could be concluded from the data obtained and the statistical analyses that :

- The population of pests and natural enemies, particularly predators was substantially different at the two sites (north and middle-upper Egypt) as well as in the two planting dates, therefore no patterns can be obtained. (Taher *et al.*, 1978 and El-Heneidy *et al.*, 1995).

- An evaluation of pest-predator interactions during the three cotton plant growth stages; PE,FF and FM was done exclusively because every stage has distinct morphological and physiological plant characteristics. Considering these differnces the re1ationship between natural enemies and their pest species and numbers is greatly affected (Legaspi *et al.*,1989). E and L plantings have affectad also the incidence of different pest and predator species as well as their interactions.

Infestation rates of secondary pests, except thrips (PE stage pest) increased from mid-seaon (FF stage) by the end of the season to reach their maximum at FM stage. Moderate rates of infestation by secondary pests were recorded at Mallawi in the two seasons , while they were higher at sakha, particularly in season I993 . In the two seasons, secondary pests` infestation at Mallawi was mostly higher in E planting than in L one , the contrary of what was found at sakha.

- These pests are considered of minor economic importance during this stage because the presence of relatively large numbers feeding on foliage didn`t significantly affect crop yield or quality. On the other hand, they provided abundant food for predators that enter cotton fields and then enhanced them build up their populations. This suggests that insecticide applications are not recommended during this period.

- CLW is mostly a mid- season pest (FF stage) . CLW numbers were always higher in L plantings in the two seasons and areas, except E planting at Mallawi (season 1992) . Among the bollworms, SBW usually occurred first in cotton fields followed by PBW. PBW was not recorded at all during FF stage at Mallawi in the two seasons. Bollworm infestion and damage increased towards the end of the season. It was higher in L plantings than E ones in the two areas.

- Predators population peaked by mid-season (FF stage) in the two locations and continued relatively high through the season (Fig. 1) (El-Heneidy *et al.*, 1995). Further studies are needed to find reasons for predator population decline in the few

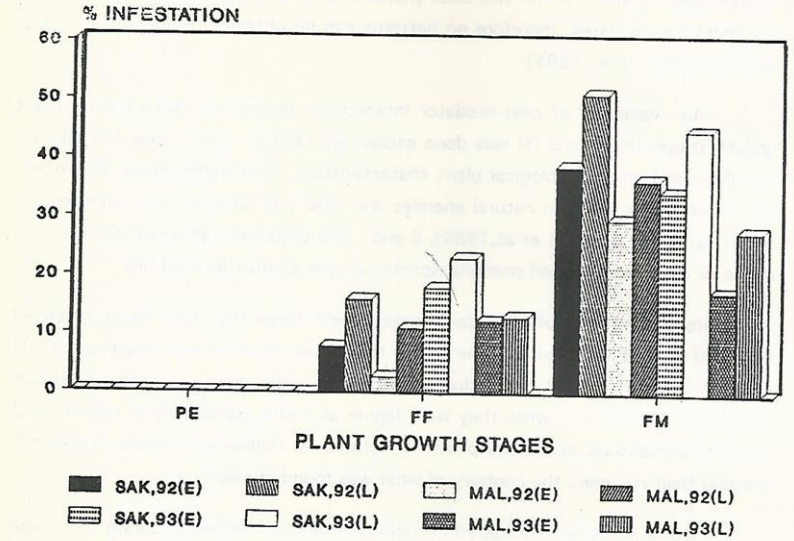

Fig. 1. Percent of green boll infestation by bollworms in three cotton plant growth stages in two planting dates, in untreated cotton fields at Sakha and Mallawi research stations in 1992 and 1993 seasons.

weeks before harvest as occurred in the present study despite of no chemical applications and abundance of available prey.

- Numbers of predators counted at Sakha were larger than that of Mallawi to coincide with the higher pest populations at Sakha (EL-Heneidy *et al.*, 1995). Numbers were generally higher in E plantings than in L ones. Highest total population of predators was recorded always in FF stage and then slight decline was observed in FM stage in the two sites and seasons (Fig. 2). Relative increase in numbers was found in L planting at Sakha.

- *C.undecimpunctata*, true spiders and *S.interruptus* were the most abundant predaceous species throughout the seasons. *P.alfierii* predominated all the other predaceous species during FF stage. True spiders population built up throughout the season. These results were in contrary with the findings of El-Heneidy *et al.* (1995). Lynx group was the most common one among the promising four groups of true spiders, particularly at PE stage.

- Statistical analyses, showed that the interaction between pests and predators was more significant at Sakha than at Mallawi. Generally, pest and predator numbers at Sakha were higher. Although *C.carnea* occurred in low numbers in the two areas during this study, it was one of the most efficient species in interacting with both secondary and principal pests at FF and FM stages at Sakha and Mallawi, respectively, the efficiency is not related to the density. Ants interacted significantly mainly with bollworms, especially at FF and FM at Sakha and Mallawi, respectively.

- Synchronous plantings are clearly important in areas where climatic factors allow continual development of pest infestation, and late crops are always more severely infested than those sown early.

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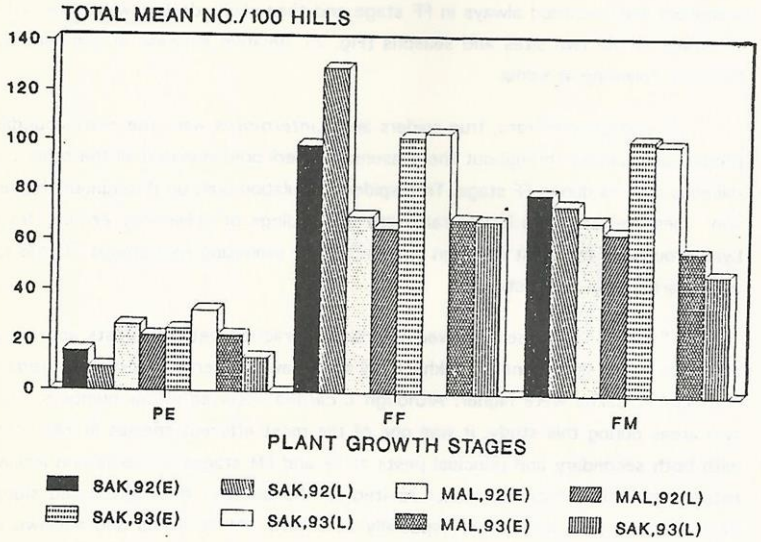

Fig. 2. Total mean number of arthropod predators / 100 hills in three cotton plant growth stages in two planting dates, in untreated cotton fields at Sakha and Mallawi research stations in 1992 and 1993 seasons.

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العلاقة ما بين الآفة والمفترس بحقول القطن غير المعاملة بالمبيدات خلال ثلاثة مراحل للنمو ٢ - تأثير ميعاد الزراعة

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تم دراسة تأثير مواعيد الزراعة على العلاقة بين تعداد الآفات والمفترسات فى حقول القطن غير المعاملة بالمبيدات فى ثلاثة مراحل مختلفة من عمر نبات القطن وهى مرحلة الانبات المبكر - مرحلة تكوين الثمار - مرحلة نضج الثمار بكل من محطة بحوث ملوى ومحطة بحوث سخا خلال موسمى ١٩٩٢ ، ١٩٩٣ . أخذت النتائج بطريقة العد المباشر لكل من الآفات والمفترسات أسبوعيا لكل من المعاملات المختلفة (مواعيد الزراعة - المنطقة - الموسم) . وقد أظهرت النتائج وجود اختلاف فى أعداد الآفة والمفترسات المصاحبة لها باختلاف المنطقة وموعد الزراعة المبكرة والمتأخرة.

وقد سجل أعلى تعداد للآفات الثانوية فى الزراعة المبكرة والمتاخرة على التوالى بكل من ملوى وسخا خلال موسمى الدراسة باستثناء دودة ورق القطن بملوى عام ١٩٩٢ حيث سجلت الزراعات المتأخرة تعداد اكبر من الافات الرئيسية (دودة ورق القطن ودودة اللوز الشوكية ودودة اللوز القرنفلية) عن الزراعات المبكرة بالمنطقتين خلال الموسمين . وقد كان تعداد المفترسات بصفة عامة فى سخا أعلى من مثيله فى ملوى وكذلك فى الزراعة المبكرة عن المتأخرة خلال الموسمين كما سجل أعلى تعداد للمفترسات خلال مرحلة تكوين الثمار (منتصف الموسم).

أوضح التحليل الاحصائى اختلاف المعنوية فى تفاعل معظم المفترسات وكل من آفات القطن الثانوية و الآفات الرئيسية خلال مختلف مراحل نمو النبات. وكانت التفاعلات أكثر معنوية فى سخا.