SEASONAL ABUNDANCE OF CERTAIN PREDATORS AS INFLUENCED BY COTTON PLANTING DATES AND WEATHER FACTORS

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Abstract

The present study was carried out at Sakha Agric. Res. Station to evaluate the effect of four cotton planting dates (March 16, April 2, April 16 & May 1 during 1990 and March 11, March 26, April 8 & April 22 during 1991 season), on the population density of certain predators as well as the effect of three prevailing weather factors (temperature, relative humidity and wind speed) on the population changes of such predators.

Results obtained could be summarized in the following points :

- Three peaks of abundance were observed for *C.undecimpunctata, Ch.carnea, Scymnus* spp and *Orius* spp. during the period of study from May to October.
- *P.alfierii* was the dominant predator and its population occurred throughout the whole period of cotton season recording two peaks of abundance during July and August.
- The seasonal abundance of true spiders showed two peaks during June and July.
- The total population of predators fluctuated and recorded three peaks of abundance during June, July & August (1990) and July, August & September (1991 season).
- The population of *C.undecimpunctata* (1990 season), *Ch.carnea, P.alfierii, Scymnus* spp., true spiders (1991 season) were insignificantly affected by planting dates. Meanwhile, the population density of *C.undecimpunctata* (1991 season) and *Orius* spp. were affected significantly by sowing dates.
- Temperature and wind speed were the main weather factors affecting the population changes of *C.undecimpunctata, Ch.carnea ,Orius* spp. and *Scymnus* spp. Meanwhile, temperature and relative humidity played an important role in the population changes of true spiders. Also, temperature factor was positively highly significant on the population changes of P.alfierii and the total population of predators.

INTRODUCTION

It is well known that the use of pesticides has been the basis of most efforts to control cotton pests regardless any other considerations. Recently, the Ministry of Agriculture began to implement new strategies for the conscious use of pesticides in pest control management. Among these strategies: the biological control of certain serious pests attacking cotton plants .

The study of fluctuation of the population densities of the predators is believed to be of utmost importance in enlightening integrated control. Studies on predators occurring in cotton fields have been conducted by several authors (Hafez, 1960; Azab et al., 1965. Samy, 1972; Ali et al., 1975; Barania, 1979 and Boraei *et al.* 1993).

The aim of the present investigation is to evaluate the effect of cotton planting date on the population fluctuation of six predators occurring in cotton fields as well as the effect of three prevailing weather factors (temperature, relative humidity and wind speed) on the seasonal abundance of such predators.

MATERIALS AND METHODS

Experimental design :

The present investigation was carried out at the farm of Sakha Agric. Res. Station, Kafr El-Sheikh Governorate, during 1990 and 1991 cotton seasons. One area of 16 feddans was divided into 16 plots of 1 feddan each. The field was planted with Giza 75 cotton variety on March 17, April 2, April 16 and May 1 during 1990 season and March 11, March 26, April 8 and April 22 during 1991 season. The normal agricultural practices were followed and no insecticidal treatments were applied during the whole experimental period. Complete randomized blocks design with 4 replicates for each date was adopted.

Population density of natural enemies :

Direct count on the spot, of the arthropod predators in cotton fields was carried out in weekly samples of 25 plants for each plot to determine the abundance of the prevailing predaceous species according to Hafez (1960) technique. Samples were chosen at random from both diagonals of the inner square area of each plot. Sampling started form the first half of May during 1990 season and late in April

during 1991 season and continued till the end of the season.

The predators species of lady-bird beetles, *Coccinella undecimpunctata* (Reiche) and *Scymnus* spp., aphid lion, *Chrysoperla carnea* (Stephens); rove beetle, *Paederus alfierii* (Koch); anthocorid bug; *Orius* spp. and true spiders were taken into account. The number of each species per plant was recorded.

Duncan's multiple range test was used to partition the means into significant ranges (Snedecor, 1956), also computer program (MREG2) was used for estimating the simple correlation coefficients between the prevailing climatic factors (temperature, relative humidity and wind speed) and the population of these predators. The partial regression coefficients were used to emphasize the relative importance of each factor.

RESULTS AND DISCUSSION

Data presented in Table (1) indicate the population density of certain predators which occurred in cotton fields as influenced by dates of planting during 1990 and 1991 cotton growing seasons .

1. Lady-bird beetle, *C.undecimpunctata* :

During 1990 season, data showed that the population of such insect fluctuated during the period of study showing two peaks. The first one occurred on August 3 in plots planted at the second and third sowing dates, whereas it occurred one week later in that planted at the first and fourth dates of planting representing 60, 52, 63 and 60 beetles/100 plants, respectively. The second peak was reached on September 14 in plots planted on the first, third and fourth dates of planting, and one week later in that planted at the second date of sowing recording 83, 79, 71 and 74 beetles/100 plants, respectively.

In 1991 season, three peaks were observed in plots of the first two planting dates, while the rest two planting dates revealed two peaks only. The three peaks of the first and second planting dates occurred on May 17 & 24, August 23 & 16 and September 20 representing 112 & 79, 89 & 75 and 102 & 84 beetles/100 plants, respectively. Cotton plants of the third and fourth planting dates harboured two peaks which occurred on August 16 and September 27 represented by 82 and 80 beetles (the first peak) and 85 and 89 beetles/100 plants (the second peak).

Statistical analysis of the data revealed no significant differences in 1990 cotton season. On the contrary, a significant difference between the first planting date and the other three dates in 1991 season was recorded.

The mean population densities of the predator on plants of the four planting dates in 1990 were 57.38, 51.76, 47 and 45.72 beetles/100 plants, while those in 1991 were 55.13, 47.8 and 43.65, respectively (Table 1).

Table 1 . The effect of planting date on the population density of six predators occurring on cotton plants at Sakha region, Kafr El-Sheikh Governorate, during two successive cotton seasons 1990 and 1991.

Predators	Planting date							
	1990 Season				1991 Season			
	March 17	April 2	April 16	May 1	March 11	March 26	April 8	April 22
C.undecimpunctata	57.38	51.76	47.00	45.72	55.13 a	47.68 b	47.80 b	43.65 b
Ch.carnea	11.95	12.10	11.84	11.44	13.78	13.50	12.86	12.95
P.alfierii	91.29	86.62	89.68	77.00	64.04	63.18	55.95	58.35
Scymuns spp.	41.29	39.62	39.11	36.06	41.43	43.05	39.95	39.45
Orius spp.	21.38 a	18.67 ab	17.89 ab	15.89 b	22.43 a	20.23 ab	18.48 b	17.95 b
True spiders	35.76 a	34.33 a	31.68 ab	27.67 b	36.87	35.36	34.43	29.85
Total	259.05 a	243.10 ab	23.21 b	213.78 c	233.70 a	223.00	209.48 bc	202.20 c

Means followed by the same letter are not singificantly different at 5% level.

2. Aphid lion *Ch.carnea* :

Results in Table (1) show that the mean numbers of the predator harboured by cotton plants of the four planting dates tested were 11.95, 12.1, 11.84 and 11.44 individuals/100 plants in 1990, while it reached 13.78, 13.5, 12.86 and 12.95 in 1991, respectively. There were no significant differences between the aforementioned predator numbers.

The population of aphid lion revealed three peaks in both seasons. In 1990, the first peak appeared on June 22 in plots planted at the first date of planting, while at the other three dates the peak appeared one week later. The second peak was recorded on August 24 in plots of the first and second planting dates and one week later in that of the third and fourth dates. The third peak was noticed on September 28 in plots of the first, third and fourth planting dates, and on October 5 in that of the

second planting date.

In 1991, the population showed the same trend of fluctuation as the previous season.

3. Rove beetle *P.alfierii* :

Concerning the effect of planting date on the population density of P.alfierii, the statstical analysis of the data induced no significant differences between means of the predator harboured by cotton plants of the four tested planting dates during 1990 and 1991 seasons. The mean numbers of rove beetles per 100 plants were 77 to 91.29 in 1990 and 55.95 to 64.04 in 1991 (Table 1).

The predator population revealed two peaks in both seasons. In 1990, the first peak was observed on July 20 in plots of the first, third and fourth planting dates, while it was on July 27 in that of the second planting date recording 297, 254, 226 and 247 beetles/100 plants, respectively. The second peak was noticed on August 24 on cotton plants cultivated at the first, second and fourth dates, while it occurred one week later on that of the third planting date, represented by 194, 215, 173 and 189 beetles/100 plants, respectively.

Regarding the population of the predator in 1991, the first peak was observed on July 5 on plants sown at the first, second and fourth planting dates, while it was on June 28 for the third date, recording 227,192, 170 and 183 beetles/100 plants, respectively. The second peak occurred on August 23 on plants sown at the first and third dates, while it was noticed one week later on that sown at the second and fourth dates. recording 103, 115, 91 and 78 beetles/100 plants, respectively.

4. Lady-bird beetle, *Scymnus* spp. :

According to Duncan's multiple range test, the differences between the means of the predator population at the four planting dates were not significant in both seasons. It ranged between 41.29 to 36.06 and 43.05 to 39.45 beetles/100 plants for 1990 and 1991 cotton seasons, respectively.

The population, in both seasons, exhibited three peaks. In 1990 the first peak was observed on June 22 in cotton fields planted at the first and third planting dates, whereas it was found one week later on that planted at the second and fourth planting dates recording 76.70, 84 and 63 beetles/100 plants, respectively. The second peak was observed on July 20 on plants of the first planting date and one week later on that of the other three dates of planting represented by 39,29,40 and 33 beetles/100 plants, respectively. The third peak was found on August 31 on

plants cultivated on April 16 and one week later on that cultivated on March 17, April 2 and May 1 showing 73, 92, 87 and 67 beetles/100 plants, respectively.

With regard to 1991 cotton season, in each date, the three peaks occurred during the last ten days of June, first ten days of August and Second ten days of September.

5. Anthocorid bug, *Orius* spp :

The mean number of the population in 1991 season was 22.43, 20.23, 18.48 and 17.95 bugs/100 plants of the four planting dates, respectively, while the respective numbers reached 21.38, 18.67, 17.89 and 15.89 bugs/100 plants in 1990 season. Also, the statistical analysis of the data show significant differences between the mean numbers of bugs in the fields of the four planting dates in both seasons (Table 1).

Regarding the population in 1990, three peaks were observed on the four planting dates except with that sown on May 1, two peaks only were recorded. The first one occurred on June 8 repesented by 25,23 and 19 bugs/100 plants on plants of the first three planting dates, respectively. The second peak occurred in the first half of July represented by 47, 37 , 36 and 37 bugs/100 plants, respectively, whereas the third peak was found on September 7 recording 43, 35, 32 and 31 bugs/100 plants, respectively.

Also, the population in 1991 showed three peaks on all planting dates studied. The first peak occurred during second ten days of June, the second peak during the third ten days of July and the third peak was recorded during the second ten days of September.

6. True spiders :

Data presented in Table (1) show the occurrence of true spiders in cotton fields cultivated at four planting dates in 1990 and 1991 cotton seasons. The statistical analysis revealed significant differences between the means of the true spiders at the four tested planting dates during the first season, but no significant differences were observed in the second season. The mean numbers of the predator in cotton fields cultivated at four planting dates in 1990 season were 35.76, 34.33, 31.68 and 27.67 spiders/100 plants and those of 1991 were 36.87, 35.36, 34.43 and 29.85 spiders/100 plants respectively.

Regarding the population fluctuation of true spiders in 1990 season, it is obvious that two peaks were recorded, the first one was observed during the third week

of June and represented by 64,57, 57, 59 and 43 spiders/100 plants of the first, second, third and fourth planting dates, respectively, while the second peak was observed during the third ten days of July and the respective numbers were 81,66, 67 and 59 spiders/100 plants.

In 1991, the population fluctuation followed the same trend as that of 1990 recording two peaks. The first peak was observed during the second week of June represented by 93, 69, 69 and 62 spiders/100 plants. The second peak was noticed during the third ten days of July recording 75,65,59 and 43 spiders/100 plants, of the first, second, third and fourth planting dates, respectively.

It is obvious that in both seasons, the population of spiders began to increase again from the last week of September till the second week of October.

7. Total natural enemies :

The population fluctuation of natural enemies counts were achieved during a period started in late April and extended to late October. Such population started to appear in relatively low numbers in both years and then fluctuated during the period of study exhibiting three distinct peaks. In 1990, the three peaks appeared in mid June, the third ten days of July and the third ten days of August. The three peaks of predators in 1991 were noticed during late June and early in July; the third ten days of August and the second ten days of September (Table 2).

Regarding the effect of planting date on the population density of total natural enemies (Table 1), statistical analysis of the data revealed highly significant differences between means of the total natural enemies harboured by cotton plants of four planting dates in 1990 and 1991 cotton seasons. In both seasons, cotton plants of the first planting date harboured the highest mean number of total natural enemies followed descendingly by that sown at the second, third and fourth dates recording 259.05, 243.1, 237.21 and 213.78 predators/100 plants (in 1990), respectively, while it was represented by 233.7, 223,209.48 and 202.2 individuals/100 plants (in 1991), respectively.

From the aformentioned results, it could be concluded that the population densities of the predators were affected by the planting date. Cotton plants cultivated early (first and second planting dates) harboured higher number of predators than that sown lately (third and fourth planting dates). This result was clearly noticed in case of *Orius* spp. in both two seasons, *C. undecimpunctata* in 1991 and true spiders in 1990 season. Also, the population of the total natural enemies was affectd significantly by the planting date during the two cotton seasons.

Table 2 . Population density of total natural enemies as influenced by planting dates.

Planting date	Number of predators/100 plants at indicated dates of inspection (1990 contton season)																															
	May			June					July				August					September				October										
	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14	21	28	5	12									
Mar. 17	155	151	153	172	236	249	245	240	252	324	467	362	291	263	278	354	304	287	233	222	202											
Apr.2		153	138	171	219	227	229	241	268	297	354	398	326	227	253	353	247	254	214	180	158	198										
Apr.16				132	189	224	217	198	231	273	389	348	269	197	212	279	367	265	201	192	173	156										
May 1						160	182	198	223	241	348	321	249	197	209	285	242	231	169	137	164	149	143									

Planting date	Number of predators/100 plants at indicated dates of inspection (1991 contton season)																															
	Apr	May					June				July				August					September				October									
	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	6	13	20	27	4	11	18						
Mar. 17	109	128	143	178	160	212	218	286	303	326	355	269	261	259	217	219	231	271	219	197	246	321	247									
Apr.2			117	139	189	197	222	251	269	269	305	270	235	201	170	194	202	220	251	233	270	246	240	216								
Apr.16					142	142	162	221	229	305	228	204	210	186	168	209	212	251	202	192	240	262	250	205	179							
May 1							137	194	220	267	271	228	175	168	172	179	199	200	211	190	203	280	252	213	162	123						

Data also revealed that the common dominant predator recorded on cotton plants of four planting dates during the two seasons was *P.alfierii.* The other predators could be arranged descendingly according to their mean numbers as follows : *C.undecimpunctata, Scymnus* spp., *true spiders, Orius* spp. and *Ch.carnea.*

Effect of the prevailing weather factors on the seasonal abundance of natural enemies :

The correlation between the three prevailing climatic factors and natural enemies associated with cotton plants sown early on March 17, 1990 and March 11,1991 was estimated. The results obtained are given in Tables (3 and 4).

In 1990 season, it was found that the simple correlation coefficients of temperature and relative humidity with the total recorded natural enemies were highly significant and positive, whereas it was significant and negative for wind speed (Table 3). It should be noticed that the multiple coefficient of determination was 0.5357 for the temperature, 0.1494 for the relative humidity and only 0.027 for wind speed (Table 4). This means that the three climatic factors were responsible for 71.21% of the population changes of natural enemies. Meanwhile, the simple correlation coefficients of 1991 season reveal that the effect of temperature was highly significant and positive while the effect of relative humidity and wind speed was insignificant and positive. The three climatic factors were responsible for 71.33% of the population changes.

Temperature seemed to be the most important factor affecting the population density of the total recorded predators in cotton fields, as it was responsible for 53.57 and 66.39% of the population changes in 1990 and 1991. Relative humidity and wind speed have a weak effect.

In both seasons, the effect of temperature on the population changes of the natural enemies was significant with all studied predators except with *Ch.carnea* (in 1990 and 1991) and *Scymnus* spp. (in 1990), insignificant effect was observed. Moreover, temperature affect positively the population changes of all predators studied except with *C.undecimpunctata*, the effect was negative.

Relative humidity induced insignificant effect on the population changes of all predators studied except with *P.alfierii* and *Orius* spp., the effect was significant positively 1990.

With respect to the effect of wind speed, on the population changes of all predators, insignificant effect was observed with all predators except with Scymnus spp. and *Orius* spp. (in 1990) and *C.undecimpunctata* and *Ch.carnea* (1991), signifi

Table 3 . Simple correlation coefficients between natural enemies populations (Y) and daily averages of prevailing temperature (X1), relative humidity (X2) and wind speed (X3).

1990 cotton season

Character	Simple correlation coefficients (r)						
	C.undecim punctata	*Ch. carnea*	*P. alfierri*	*Scymnus spp.*	*Orius spp.*	True spiders	Total natural enemies
X_1 Y	-0.675**	0.261	0.691**	0.424	0.571**	0.541*	0.732**
X_2 Y	-0.225	0.247	0.574**	0.381	0.471*	-0.078	0.644**
X_3 Y	0.211	-0.415	-0.334	-0.449*	-0.610**	-0.007	-0.458*

1991 cotton season

Character	Simple correlation coefficients (r)						
	C.undecim punctata	*Ch. carnea*	*P. alfierri*	*Scymnus spp.*	*Orius spp.*	True spiders	Total natural enemies
X_1 Y	-0.492*	0.413	0.679**	0.572**	0.436*	0.566**	0.815**
X_2 Y	0.082	0.213	0.199	0.185	0.166	-0.190	0.139
X_3 Y	-0.482*	-0.425*	0.390	-0.236	-0.053	0.368	0.137

* Significant at 5% level ** Significant at 1% level.

Table 4 . Direct and joint effect of temperature, relative humidity and wind speed on the populations of natural enemies .

1990 cotton season

Source of variation	Coefficient of determination (R^2)						
	C.undecim punctata	*Ch. carnea*	*P. alfierri*	*Scymnus spp.*	*Orius spp.*	True spiders	Total natural enemies
Temperature	0.4551	0.0123	0.4775	0.0684	0.1219	0.2931	0.5357
Relative humidity	0.0002	0.0102	0.1069	0.0004	0.0021	0.1013	0.1494
Wind speed	0.0057	0.1725	0.0749	0.2020	0.3717	0.0001	0.0270
Joint effect	0.4610	0.1950	0.6593	0.2708	0.4957	0.3945	0.7121
	0.5390	0.8050	0.3407	0.7292	0.5043	0.6055	0.2879

1991 cotton season

Source of variation	Coefficient of determination (R^2)						
	C.undecim punctata	*Ch. carnea*	*P. alfierri*	*Scymnus spp.*	*Orius spp.*	True spiders	Total natural enemies
Temperature	0.2420	0.2328	0.4609	0.3276	0.1903	0.3208	0.6639
Relative humidity	0.0003	0.1558	0.0481	0.1286	0.0115	0.1795	0.0280
Wind speed	0.1699	0.1809	0.0847	0.1066	0.0145	0.0003	0.0214
Joint effect	0.4122	0.5695	0.5937	0.5628	0.2163	0.5006	0.7133
	0.5878	0.4305	0.4063	0.4372	0.7837	0.4994	0.2867

cant and negative effect was recorded.

The direct and joint effect of the three climatic factors on the population changes of the six predator species under inspection in 1990 reached 46.1 , 19.5, 65.93, 27.08, 49.57 and 39.45 % for *C.undecimpunctata*, reacled, *P.alfierii*, *Scymnus* spp., *Orius* spp. and true spiders, respectively. The respective values of joint effect in 1991 were 41.22, 56.95, 59.37, 56.37, 56.28, 21.63 and 50.06%, respectively.

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تأثير مواعيد زراعة القطن والعوامل الجوية السائدة على الكثافة العددية لبعض الأعداء الحيوية

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أجريت هذه الدراسة فى محطة البحوث الزراعية بسخا - كفر الشيخ بهدف دراسة تأثير أربعة مواعيد لزراعة القطن (١٧ مارس - ٢ إبريل - ١٦ إبريل - ١ مايو موسم ١٩٩٠، ١١ مارس - ٢٦ مارس - ٨ إبريل - ٢٢ إبريل موسم ١٩٩١) وكذلك تأثير العوامل الجوية (الحرارة والرطوبة النسبية وسرعة الرياح) على الكثافة العددية لبعض الأعداء الحيوية.

وقد أوضحت النتائج ما يلى :-

١- كانت هناك ثلاث فترات نشاط لكل من المفترسات أبو العيد ١١ نقطة وأسد المن وحشرة الأسكيمنس وبقة الأوريس على نباتات القطن على مدار الموسم . فى حين أن للمفترسات الحشرة الرواغة (الاكثر سيادة) فترتى نشاط خلال شهرى يوليو وأغسطس كذلك للعناكب الحقيقة خلال شهرى يونيو ويوليو.

٢- تأثير ميعاد الزراعة على تعداد كل من المفترسات أبو العيد ١١ نقطة (موسم ١٩٩٠) وأسد المن والرواغة والأسكيمنس والعناكب الحقيقة (موسم ١٩٩١) غير معنوى بينما كان هذا التأثير معنويا على كل من أبو العيد ١١ نقطة (موسم ١٩٩٠) والعناكب الحقيقة (موسم ١٩٩٠) وبقة الأوريس.

٣- كانت الحرارة وسرعة الرياح أهم العوامل المؤثرة على تعداد كل من أبو العيد ١١ نقطة وأسد المن والأوريس والأسكيمنس كذلك كان للحرارة والرطوبة تأثير فعال على العناكب الحقيقية . أيضا لعبت الحرارة دور رئيسى وفعال على كل من الرواغة ومجموع المفترسات تحت الدراسة.