APPLICATION OF SEROLOGY TO EVALUATE THE RELATIONSHIP BETWEEN SOME SUGAR BEET INSECT PESTS AND THEIR PREDATORS

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Abstract

Prey predator relationships had been studied by three methods; using serology by double diffusion test, analyzing statistically the correlation between population fluctuations of both groups in sugar beet fields and evaluating the feeding efficiency of the predators in the laboratory. This work was conducted from 2001-2003 at the experimental farm and Economic Entomology Department, Kafr El-Sheikh, Faculty of Agriculture. Serological studies by double diffusion test revealed sharp reactions (positive) between antigens of aphids, the tortoise beetle, the beet fly, the stink bug, the beet moth, and *Chrysoperla carnea* (Steph.) antiserum (the precipitin lines were 5, 6, 4, 2 and 2 lines, respectively). Sharp reactions were found also between the antiserum of the ladybird and all of the aphids, the tortoise beetle, the beet fly, the stink bug and the beet moth antigens (the precipitin lines were 6, 4, 5, 0 and 3 lines, respectively). The two antisera of the two tested predators when tested with the antigens of the other predators, no reactions were detected. The lacewing, *Ch. carnea* appeared from Nov. to Apr. Larvae had one peak (41 and 25 individ). in the first and second seasons, respectively, during Apr. That peak followed by peaks of *Cassida vittata* Vill., *Pegomyia mixta* Vill., *Scrobipalpa ocellatella* Boyd., *Aphis* spp. and *Nezara viridula* L. in the same month. *Coccinella undecimpunctata* L. had two peaks of abundance. In the first season, the first peak was recorded in Nov. (45 individual), associated with the aphid. The second peak (30 individi.) was found at the same time of the peaks of *C. vittata, P. mixta, S. ocellatella, Aphis* spp. and *N. viridula*, in Apr. In the second season those peaks were found in Nov. and Mar. (48 and 24 individ.), respectively.

When *Ch. carnea* was reared on the tortoise beet beetle, the beet fly and the beet moth, it consumed 175.35 beet beetle eggs, 79.75 of the tortoise beet beetle larvae, 179.75 beet fly larvae and 67.5 beet moth larvae during 9.75, 10.05, 9.50 and 10.25 days, respectively. *C. undecimpunctata* consumed 428.51 beet beetle eggs, 168.25 beet beetle larvae, 270.25 beet fly larvae, 127.25 beet moth larvae during 9.25, 9.75, 11.80, 13.75 days, respectively. These results suggest that serological techniques might be used in detecting the relationship between the predators and the insect pests, the precise and quick method which now widely used in insect researches and rarely used in Egypt.

INTRODUCTION

Sugar beet, (*Beta vulgaris* L.) is one of the most important crops in Egypt and all over the world. Sugar beet has great importance in sugar production all over the world. On the other hand, sugar beet fields are good reservoir for natural enemies and pests. The relationships between insect pests and their predators are very important for integrated pest management (Youssef, 1994 and Shalaby, 2001). Many chrysopids and coccinellids can play an important role in regulating populations of injurious insects, in particularly, *C. vittata, P. mixta* and *S. ocellatella* eggs and larvae (Boraei *et al.,* 1993, Youssef, 1994, El-Agamy *et al.,* 1996 and El-Khouly, 2002).

Predation efficiency of *Ch. carnea* and *C. undecimpunctata* on the immature stages of the main insect pests of sugar beet were evaluated by many authors (Ahmed, 2000, Youssef and Abou-Attia, 2001, Talha, 2001 and Kassem, 2002).

Serological studies carried out to evaluate the relationship between the antiserum of predators against insect pest antigens (the degree of reaction shown in the agar of the double diffusion test) (Bora[illegible]984 and Peterson, 1972).

Serology defined by Leone in 1953 as the branch of biology concerning with the nature and significance of proteins as revealed by their reactions with antisera produced against them.

The present work was carried out in the laboratory and the experimental farm of the Faculty of Agriculture, Kafr El-Sheikh, Tanta University from 2001-2003 to study the prey-predator relationship in sugar beet fields by the following methods.

1. Serological studies on the relationship between some insect pests and their predators.
2. Studying the population fluctuations of certain common predators associated with insect pests on sugar beet.
3. Evaluating feeding efficiency of the chrysopid, *Ch. carnea* and the coccinellid, *C. undecimpunctata* in the laboratory.

MATERIALS AND METHODS

1. Serological studies

Samples of the insect pests and associated predators which were used in the serological tests were collected from sugar beet fields. Insects of each sample were anesthetized while in the net, using a piece of cotton saturated with ether and transferred to paper bag (about 20 g of fresh insects), well tied by rubber band.

Samples were labeled, stored and preserved shortly after collection in -20°C freezing unit.

To produce the antigens, each sample was crushed in motor pestle, and grounded to obtain fine powder, which suspended in saline solution 1% NaCl and transferred to a beaker with a few drops of Sodium azide. That solution was refrigerated for at least 24 hr at 6°C to dissolve soluble proteins, and then the homogenate was centrifuged for 15 min at 2500 rpm and the supernatants poured through a millipore-sterilizing filter. The obtained supernatants were used for serological tests or injections after mixing them with the adjuvant.

The antigens of insects which were prepared are antigen 1- *C. vittata* larvae, collected in Mar. and Apr., antigen 2- *P. mixta* larvae, collected in Mar. and Apr., antigen 4- *N. viridula* nymphs and adults, collected in Apr.; antigen 5- *S. ocellatella* larvae, collected in Apr. antigen 10- *M. corollae* adults and larvae catched from Apr. and May. antigen 16- *P. alfierii* adults and nymphs, collected from Nov. to Apr. antigen 20- *S. interruptus* adults and larvae, collected from Nov. to May. antigen 21- *C. vicina isis* adults and larvae, collected from Mar. to May. antigen 22- *C. vicina nilotica* adults and larvae, collected from Mar. to May and antigen C-*Aphis* spp.

Mature male New Zealand white rabbits were used for injection program and antisera preparation. Each rabbit received 10 injections, first one subcutaneous followed by a second interamuscular and so on, as follows: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0 and 6.0 ml, respectively. In the first injection, a mixture of complete adjuvant and insect extract (antigens A, B and C) in the ratio of 1: 1 was thoroughly emulsified in a vortex stirrer before injection into rabbits.

The rabbits were bled one week after the last injection, blood samples were incubated at 37°C for two hr, then transferred to a refrigerator at 4°C for 24 hr, to allow clot to separate from the serum. Obtained antiserum was centrifuged for 15 minutes at 2500 rpm in order to separate blood cells. Obtained clear antiserum was mixed with Sodium azide. 0.2% and kept at -20°C until use. Three different antisera were antiserum A- *Ch. carnea*, antiserum B- *C. undecimpunctata* and antiserum C- *Aphis* spp.

Gel double diffusion test difico agar 1% was introduced on blaze for 30 min and poured in Petri-dishes (5.5 cm). Sodium azide (0.02%) was added to the gel before pouring. After solidification, four peripheral wells and one central were made in the gel. The distances between the peripheral and the central one and between each

other were equally the same. The central well was filled with the antiserum, whereas the others filled with the tested antigens. Each well was filled with 0.2 ml of the sample. Petri dishes were kept carefully at 4°C for one week, then the reactions were examined for detecting and counting the resulting precipitin lines (Pettersson, 1972 and Boraei, 1984).

2. Population fluctuations of the main pests and associated predators

The experimental area was about half feddan, planted on Oct. and divided into six parts. Sampling was initiated in this plantation three weeks, sampling took place weekly all the season round, from Nov. till Apr. Every sample was represented by 30 randomized plants. The plants were confined into the bags and tied. Catch of each sample transferred to the laboratory for identification and counting.

3. Predation efficiency of *Ch. carnea* and *C. undicempunctata*:

The following experiments were conducted in the Economic Entomology Department, Faculty of Agriculture at Kafr El-Sheikh. The two predators, the green lacewing, *Ch. carnea* and the ladybird, *C. undecimpunctata* were reared under laboratory conditions (26-31°C and 65-75% R.H.), to study their feeding efficiency on three insect pests from sugar beet fields (*C. vittata* eggs and larvae, *P. mixta*, larvae and *S. ocellatella* larvae).

Adults of predators were collected from sugar beet fields, transferred to the laboratory. Each couple was confined in glass jar, covered with black muslin sheet as site for oviposition, and furnished with filter paper to provide enough humidity. Eggs were collected and incubated until hatching. A piece of cotton soaked in sugar solution (10%) in small plastic container was placed inside the jar for feeding.

Newly hatched larvae (48) were divided into 12 replicates and moved individually to Petri-dishes (10 cm) with filter paper at their bottoms. Each replicate was provided daily with the tested insect pest. Every morning, dishes were inspected to remove remains of the devoured prey as well as individuals alive that exceeded the needs of the predators. Complete new groups were then introduced into dishes. As the predatory instars progressed, number of each group of introduced hosts were also increased, until reached their maximum. Number of devoured prey, by each larval instar of the predator, was calculated daily until pupation occurred.

Throughout the period of this study, chemical control was not applied. Data obtained were statistically analyzed using Duncan's Multiple test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Serological studies

Data of the present work were used to detect prey-predator relationships. It was quite enough to determine the proportion of known predator fed on particular pest species. The reaction was examined and resulting precipitin lines were counted. Data indicate strong reactions when antisera were reacted with their homologous antigens, however, when it was tested with the heterologous antigen, the reaction was faint indicating lower positive reaction. In the present study, it was found that produced antisera were strongly enough for detectable precipitin reactions.

Relationship between the predator *Ch. carnea* and associated insects

As shown in the Table (1) and Figs. (1, 2) antiserum of *Ch. carnea* (A) when tested with the insect pests antigens; the aphids, the tortoise beetle, the beet fly, the stink bug and the beet moth, gave sharp precipitin lines (positive reactions), represented by 5, 6, 4, 2 and 2 precipitin lines, respectively. However, it gave a negative reactions when tested with the heterologous antigens of the other predators; *C. undecimpunctata, P. alfierii* and *I. senegalensis*).

Relationship between the predator *C. undecimpunctata* and associated insects

Data presented in Table (1) and illustrated in Figs. (3, 4) obviously indicate that the same trend was also observed with *C. undecimpunctata* antiserum and the main insect pests collected from sugar beet fields, since sharp reaction was found with the tortoise beetle, the beet fly, the green stink bug and the bee moth antigens (4, 5, 0 and 3 precipitin lines, respectively). Also, positive precipitin reactions was found between the aphid antigen and the ladybird (*C. undecimpunctata*, antiserum) represented by 6 precipitin lines. On the other hand, it gave negative reaction with the other heterologous antigens of *C. undecimpunctata, I. senegalensis, M. corollae and Ch. carnea.*

Relationship between aphids and associated predators

Results of Table (2) reveal that the coccinellid beetles (*C. undicempunctata, C. vicina isis,* and *C. vicina nilotica*) show the highest reactions among all the tested predators when tested with aphids, (Fig. 5 , 6), that positive precipitin reactions, between the aphid and those (efficient) predators were clearly detected as not less

than 5 precipitin lines seen. Faint reaction represented by 3 lines for *M. corollae* and *S. interruptus* were recorded. On the other hand, no reaction happened at all between the aphid antiserum and the antigens of *Calosoma chlorostictum* Dej. or *I. senegalensis* which are known to live in habitats and environment completely different from that of aphids. These results agree with the findings of Pickavance (1970) who showed that the arthropod predators were feeding on aphids in the field gave positive precipitin reaction when tested against aphids. It was also recorded by Leathwick and Winterbourne (1984), who found that the aphid antigen when tested with the antiserum *C. undecimpunctata* gave positive reactions.

2. Population fluctuations of the two predators and associated insect pests

As shown in Table (3), the lacewing, *Ch. carnea* was found from Nov. to Apr., then the population increased gradually until reaching its peak during Apr., (41 individuals). This peak followed the peaks of *C. vittata* (578 individ.), *P. mixta* (343 individ)., *S. ocellatella* (145 individ.) in the first season. In the second season, population fluctuation showed nearly the same trend. One peak was recorded on Apr. and was represented by 25 individ. and associated with the peaks of the three main pests; *C. vittata* (535 individ.) in Mar., *P. mixta* (318 individ.), and *S. ocellatella* (99 larvae), in the same month. Shalaby (2001) stated that one peak of the *Ch. carnea* occurred in Apr.

Highly significant positive correlations were detected between the lacewing and the tortoise beetle, the beet fly and the beet moth, it was just positive between that predator and the green stink bug (Table, 4). Similar results, between the predator and the tortoise beetle, the beet fly, the beet moth and the green stink bug, were obtained by Talha (2001). In the present work, however, negative correlation was found betweee *Ch. carnea* and aphids.

Data presented in Table (3) clearly show that the ladybird occurred in sugar beet fields during early season in high numbers, as 45 and 48 individ. were recorded in Nov. in the first and the second season, respectively, then decreased from Dec. till Feb. That peak was associated with aphids in the two seasons. The second peak was found in Apr., represented by 30 individ. that peak was associated with the peaks of the main pests, *C. vittata, P. mixta, S. ocellatella, Aphis* spp. and *N. viridula* in the same month in the first season. In the second season, that peak was found in Mar., represented by 24 individ., in association with nearly all the other insect pests,

synchronizing with the tortoise beetle (535 individ.) and aphids (54 individ) or followed by the peaks of the two other insect pests which occurred one month later, in Apr., *P. mixta* (318 individ.) and *S. ocellatella* (99 individ.). The obtained results agree with that obtained by Youssef (1994).

Highly significant correlation was found between the ladybird and aphids in both seasons and it was also positive for the tortoise beetle, the beet fly and the beet moth, but not significant. On the other hand, negative correlations were recorded here between the ladybird and the green stink bug in both seasons (Table 4). Samy ***et al.*** (1992) found also positive correlations between *C. undecimpunctata* and *P. mixta* and *C. vittata.*

3.Predation efficiency of *Ch. carnea* and *C. undecimpunctata*

Data presented in Table (5) indicate that, when the predator, *Ch. carnea* larvae feed on eggs of the beet beetle, the duration of three larval instars were; 2.25, 2.75 and 4.75 days, respectively. The first larval instar consumed 19.00 eggs (10.84% out of total consumed eggs), the second consumed 47.75 eggs (27.23% and the third consumed 108.6 eggs (61.93%). Daily consumed of eggs per larvae in the three larval instars were 8.44, 17.36 and 22.86 eggs, respectively.

Feeding capacity of *C. undecimpunctata* larvae fed on *C. vittata* eggs is presented in Table (5), the larval stage was completed in four instars, all lasted for 9.75 days. The predator consumed 39.75, 85.50, 105.76 and 197.50 eggs, by the first, second, third and fourth larval instars, respectively. Nearly half (46.09%) of them were consumed by the fourth instar alone. The estimated average daily consumption of eggs was 19.88, 38.00, 60.43 and 52.67 eggs of the 1^{st}, 2^{nd}, 3^{rd} and 4^{th} larval instars of *C. vittata,* respectively.

When *Ch. carnea* larvae which lasted for 10.05 days were fed on newly hatched beet beetle, the chrysopid predator consumed 79.75 individ. (Table 6). Daily consumed larvae were 7.23 and 11.84 individ., in the second and third instars, respectively. The predator did not feed on *C. vittata* larvae while the predator was in the first instar and start to feed on them in the second instar which consumed 23.50 larvae, (29.47%) and third instars which fed on 56.25 larvae (70.53%). In this respect Talha (2001) found that *Ch. carnea* in the first instar did not feed on the larvae of *C. vittata* and start to feed on them when it reaches the second instar.

When the ladybird were fed on newly hatched larvae of *C. vittata* the duration of the four larval instars averaged 13.75 days. The predator consumed 168.25 beetle larvae. The average consumption of the predator larvae on the four larval instars were 7.45, 10.92, 13.73 and 15.19 larvae per day, respectively (Table 6).

As far as the larvae of the *Ch. carnea* were fed on newly hatched larvae of *P. mixta*, the duration of the three larval instars was 9.50 days. The first larval instar of the predator did not feed on *P. mixta* larvae till the predator molted to the 2nd instar, the average consumption of the predator larvae was 33 larvae (18.36% of the total number of the consumed larvae) and 146.75 larvae (81.64%) during second and third instars, respectively (Table 7). Youssef and Abou-Attia (2001) reported that the daily number of *P. mixta* larvae consumed by one *Ch. carnea* larva was 16.75 and 89.26 larvae for the second and third instars, respectively. Also, they found that the predator in the first instar did not feed on the larvae of *P. mixta*.

The data presented in Table (7) showed durations of *C. undecimpunctata* larval instars and number of consumed beet fly 1st instar larvae by each of those instars, 1st larval instar lasted for 2.25 days during which it consumed 18.25 larvae of the prey, 2nd larval instar lasted 2.50 days and consumed 43.50 larvae, 3rd larval instar has a duration of 1.75 days and consumed 64.0 larvae, while 4th consumed throughout 2.75 days 124.50 larvae. The percentages of feeding capacity for each of the four larval instars of this predator were; 7.29, 17.38, 25.58 and 49.75%, respectively.

Data shown in Table (8) indicate that, when the predator *Ch. carnea* larvae fed on larva of the beet moth, the duration of the three larval instars was 2.75, 3.50 and 4.00 days, respectively. The average of total consumed larvae per the predator larvae were 12.75, 21.00 and 33.75 larvae, for the first, second and third instars, respectively. The third instar was the most efficient as it consumed 50% of the total number of larvae. Daily consumed larvae were 4.64, 6.00 and 8.44 larvae in the first, second and third instars, respectively. In this respect, Youssef and Abou-Attia (2001) counted 5.20, 7.20 and 9.20 larvae/day for the three larval instars of the beet moth, respectively.

Data in Table (8) indicate that the duration of the predator *C. undecimpunctata* was 11.80 days for the four larval instars. The first larval instar consumed 11.25 larvae of the beet moth (8.84% out of total consumed), second instar larvae consumed 19.5 larvae (15.32%), third consumed 39.25 larve, (30.85%) and the fourth larval instar consumed the largest number of beet moth larvae, 57.25

(44.99%). Daily consumed larvae were; 5.63, 7.80, 11.21 and 15.07 per day in the first, second, third and fourth instars, respectively.

In conclusion, prey-predator relationships had been studied by three methods; analyzing statistically the correlation between population fluctuations of both groups; in sugar beet fields, evaluating the feeding efficiency of the predators in the laboratory and studying the possibility of using serology in this respect. The statistical analysis revealed insignificant or rather highly significant positive correlations between the predator populations and each of *C. vittata, P. mixta* and *S. ocellatella*. The longest duration was recorded when that predators reared on the beet beetle. Strong reactions were found between that predators and aphid followed by the beet beetle and the beet fly and finally by the beet moth, it shows the relative importance of the most dominant insect pests and associated predators. It was interesting to observe that no serological reactions (zero bands) were detected between any antiserum of the two tested predators and any of the antigens of the other tested predators, in other words no one of them feed on other indicating that they haven't negative effect on the activity of each other in the field.

Finally, these results suggest that serological techniques might be used in detecting the relationship between the predators and the insect pests, the precise and quick method which now widely used in insect researches and rarely used in Egypt.

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Table 1. Precipitin lines detected with double diffusion test between *Ch. carnea, C. undecimpunctata* antiserum and antigens of some sugar beet insects.

Insect antigens	No. of precipitin lines	
	Ch. carnea	*C. undecimpunctata*
Ch. carnea (A)*	8	0
C. undecimpunctata (B)	0	7
Aphis spp. (C)	5	6
I. senegalensis (D)	0	0
C. vittata (1)	6	4
P. mixta (2)	4	5
N. viridula (4)	2	0
S. ocellatella (5)	2	3
M. corollae (10)	0	0
P. alfierii (16)	0	0

Refer to materials and methods to know the characters of a special antigen or antiserum expressed here or in the following figures, by a letter or number.

Table 2. Precipitin lines detected with double diffusion test between anti-aphid-serum and antigens of associated predators.

Insect antigens	No. of precipitin lines
Ch. carnea (A)*	5
C. undecimpunctata (B)	6
Aphis spp. (C)	7
I. senegalensis (D)	0
M. corollae (10)	3
Calosoma chlorostictum (11)	0
P. alferii (16)	2
Sc. interruptus (20)	3
C. vicina isis (21)	5
C. vicina nilotica (22)	5

* Refer to materials and methods to know the characters of a special antigen or antiserum expressed here or in the following figures, by a letter or a number.

Table 3. Population fluctuations of insect pests and associated predators in sugar beet field during the seasons, 2001-2002 and 2002-2003.

Date	Predators		Pests				
	Ch. carnea L + A	*C. undecimpunctata* L + A	*C. vittata* L + A + P	*P. mixta* L + P	*S. ocellatella* L	*Aphis* spp. A + N	*N. viridula* A + N
	2001/2002						
Nov.	5	45	0	13	0	255	9
Dec.	7	19	2	31	2	31	19
Jan.	6	0	2	48	8	22	21
Feb.	14	4	35	43	18	0	32
Mar.	37	12	394	206	109	33	11
Apr.	41	30	578	343	145	50	26
Total	110	110	1011	684	282	391	118
	2002/2003						
Nov.	4	48	0	9	0	82	0
Dec.	4	12	0	15	4	13	2
Jan.	5	0	5	122	12	0	27
Feb.	13	3	259	163	22	35	30
Mar.	23	24	535	138	45	54	29
Apr.	25	23	533	318	99	4	19
Total	74	110	1332	765	182	188	107

N. Nymphs L. Larvae pupae A. Adults

Table 4. Simple correlation coefficients between the main pests in sugar beet field and their predators during two successive seasons.

Pests / Predator	*C. vittata*	*P. mixta*	*S. ocellatella*	*Aphis* spp.	*N. viridula*
2001-2002					
Ch. carnea	+0.905**	+0.873**	+0.908**	-0.164	+0.366
C. undecimpunctata	+0.256	+0.212	+0.215	+0.754**	-0.236
2002-2003					
Ch. carnea	+0.793**	+0.539**	0.757**	-0.051	+0.376
C. undecimpunctata	+0.067	+0.282	+0.024	+0.686**	-0.398*

* Significant (P = 0.05) ** Highly significant (P = 0.01)

Table 5. Larval duration and predation efficiency of *Ch. carnea* and *C. undecimpunctata* reared on *C. vittata* eggs under laboratory conditions.

Larval instar	Duration (days ± SD)	Consumed eggs		Daily no. consumed
		No ± SD	%	
Ch. carnea				
1st	2.25 ± 0.50	19.00 ± 0.82	10.84	8.44
2nd	2.75 ± 0.50	47.75 ± 2.75	27.23	17.36
3rd	4.75 ± 0.50	108.60 ± 9.97	61.93	22.86
Total	9.75	175.35		
C. undecimpunctata				
1st	2.00 ± 0.82	39.75 ± 4.57	9.28	19.88
2nd	2.25 ± 0.96	85.50 ± 5.07	19.95	38.00
3rd	1.75 ± 0.50	105.76 ± 4.97	24.68	60.43
4th	3.75 ± 0.96	197.50 ± 23.57	46.09	52.67
Total	9.75	428.51		

Table 6. Larval duration and predation efficiency of *Ch. carnea* and *C. undecimpunctata* reared on the beet beetle 1st larval instar, under laboratory conditions.

Larval instar	Duration (days ± SD)	Consumed larvae		Daily no. consumed	
		No ± SD	%		
Ch. carnea					
1st	2.05 ± 0.58	0.00	0.00	0.00	
2nd	3.25 ± 0.50	23.50 ± 1.29	29.47	7.23	
3rd	4.75 ± 0.50	56.25 ± 4.27	70.53	11.84	
Total	10.05	79.75			
C. undecimpunctata					
1st	2.75 ± 0.50	20.50 ± 1.29		12.18	7.45
2nd	3.25 ± 0.50	35.50 ± 1.29		21.09	10.92
3rd	3.75 ± 0.50	51.50 ± 1.29		30.6	13.73
4th	4.00 ± 0.62	60.75 ± 1.71		36.12	15.19
Total	13.75	168.25			

Table 7. Larval duration and predation efficiency of *Ch. carnea* and *C. undecimpunctata* reared on the beet fly 1st larval instar, under laboratory conditions.

Larval instar	Duration	Consumed eggs		Daily no.
	(days ± SD)	No ± SD	%	consumed
Ch. carnea				
1st	2.50 + 0.58	0.00	0.00	0.00
2nd	2.75 + 0.50	33.00 + 2.16	18.36	12.00
3rd	4.25 + 0.50	146.75 + 10.78	81.64	34.53
Total	9.50	179.75		
C. undecimpunctata				
1st	2.25 + 0.50	18.25 + 0.96	7.29	8.10
2nd	2.50 + 0.58	43.50 + 4.43	17.38	17.40
3rd	1.75 + 0.50	64.00 + 2.92	25.58	36.57
4th	2.75 + 0.50	124.50 + 8.81	49.75	45.27
Total	9.25	250.25		

Table 8. Larval duration and predation efficiency of *Ch. carnea* and *C. undecimpunctata* reared on the beet moth 1st instar larvae under laboratory conditions.

Larval instar	Duration	Consumed eggs		Daily no.
	(days ± SD)	No ± SD	%	consumed
Ch. carnea				
1st	2.75 + 0.50	12.75 + 0.96	18.89	4.64
2nd	3.50 + 0.58	21.00 + 1.83	31.11	6.00
3rd	4.00 + 0.82	33.75 + 2.06	50.00	8.44
Total	10.25	67.50		
C. undecimpunctata				
1st	2.00 + 0.50	11.25 + 1.41	8.84	5.63
2nd	2.50 + 0.58	19.50 + 1.29	15.32	7.80
3rd	3.50 + 0.58	39.25 + 6.13	30.85	11.21
4th	3.80 + 0.96	57.25 + 3.81	44.99	15.07
Total	11.80	127.25		

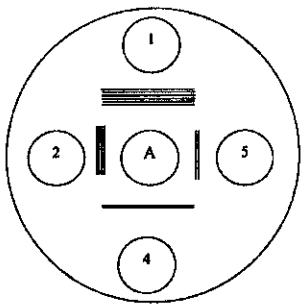

Fig. 1. Antiserum of *Ch. carnea* (A) was diffused against the antigens, *C. vittata* (1), *P. mixta* (2), *N. viridula* (4) and *S. ocellatella* (5)

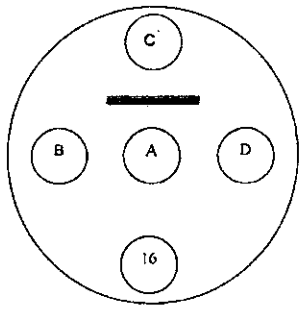

Fig. 2. Antiserum of *Ch. carnea* (A) was diffused against the antigens; *Aphis spp.* (C), *C. undecimpunctata* (B), *P. alfierii* (16), and *I. senegalensis* (D)

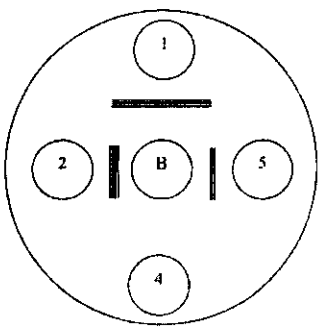

Fig. 4. Antiserum of *C. undecimpunctata* (B) was diffused against the antigens; *C. vittata,* (1), *P. mixta* (2), *N. viridula* (4), and *S. ocellatella* (5)

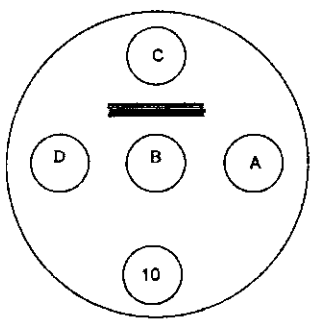

Fig. 3. Antiserum of *C. undecimpunctata* (B) was diffused against the antigens; *Aphis* spp. (C), *I. senegalensis* (D), *M. corollae* (10), and *Ch. carnea* (A)

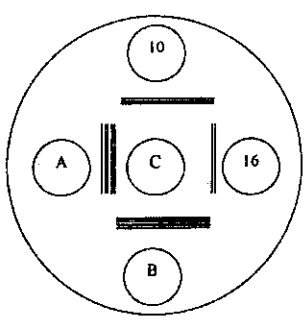

Fig. 5. Antiserum of the aphid (C) was diffused against the antigens; *M. corollae* (10), *P. alfierii* (16), *C. undecimpunctata* (B), and *Ch. carnea* (A)

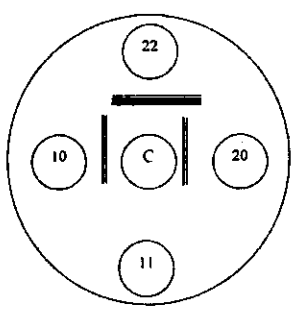

Fig. 6. Antiserum of the aphid (C) was diffused against the antigens; *C. vicina nilotica* (22), *M. corollae* (10), *C. chlorostictum* (11), and *S. interruptus* (20).

تطبيق السيرولوجى فى تقييم العلاقة بين بعض آفات بنجر السكر الحشرية ومفترساتها

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١. قسم الحشرات الاقتصادية ، كلية الزراعة بكفرالشيخ ، جامعة طنطا

٢. قسم النبات الزراعى ، كلية الزراعة بكفرالشيخ ، جامعة طنطا

٣. معهد بحوث وقاية النبات ، مركز البحوث الزراعية ، محطة سخا

تم إجراء هذا البحث فى كل من المزرعة البحثية وقسم الحشرات الاقتصادية بكلية الزراعة بكفرالشيخ ــ جامعة طنطا فى الفترة من ٢٠٠١-٢٠٠٣م على بنجر السكر ونظرا لما يتمتع به من مجموع خضرى كثيف يكون عرضة لمهاجمة العديد من الآفات الحشرية التى تسبب له أضرارا شديدة ، كذلك يكون مخزن للأعداء الحيوية التى تلعب دورا مهما فى تقليل أعداد الآفات الحشرية الهامة لذا كان الهدف من البحث دراسة علاقة المفترسات بالآفات الحشرية فى حقول بنجر السكر **وقد درست هذه العلاقة بعدة طرق:**

١-دراسة العلاقة السيرولوجية بين بعض المفترسات وآفات بنجر السكر الحشرية المصاحبة لها.

٢-دراسة التغيرات العددية لبعض المفترسات الحشرية وأهم الآفات المصاحبة لها ، ودراسة العلاقة بينها.

٣-دراسة الكفاءة الأفتراسية لنوعين من المفترسات الحشرية (أسد المن و أبوالعيد ١١ نقطة) على بعض الآفات الحشرية لبنجر السكر. وقد تم الحصول على النتائج التالية:

العلاقة السيرولوجية بين بعض المفترسات والافات الحشرية المصاحبة لها:

عند اختبار أنتسيرم أسد المن مع أنتيجينات آفات بنجر السكر (المن ، خنفساء البنجر السلحفائية، ذبابة البنجر ، البقة الخضراء فراشة البنجر) باستخدام اختبار الانتشار فى الآجار أظهرت النتائج وجود تفاعل موجب بين هذا المفترس والآفات الحشرية وكون عدد من الخطوط الترسيبية الواضحة جدا (٥ ، ٦ ، ٤ ، ٢ ، ٢) خط ترسيبى على التوالى ، دليل على أن هذا المفترس يتغذى فى الطبيعة على تلك الآفات.

وعند اختبار أنتسريم (B) أبوالعيد ١١ نقطة مع آفات بنجر السكر السابقة ظهر عدد من الخطوط الترسيبية الواضحة جدا (٦ ، ٤ ، ٥ ، . ، ٣) خط ترسيبى على التوالى دليل على وجود علاقة قوية بين هذا المفترس والآفات ماعدا أنتجين البقة الخضراء (٤) أعطى تفاعل ضعيف. عند اختبار أنتسيرم المن مع أنتجينات أسد المن ، أبوالعيد ١١ نقطة ، ذبابة السرفس ، الرواغة ، الاسكمنس ، أبوالعيد الأسود ، أبوالعيد السمنى أعطى عدد من الخطوط الترسيبية الواضحة جدا (٥ ، ٦ ، ٣ ، ٢ ، ٥ ، خط ترسيبى).

التغيرات العددية لبعض المفترسات الحشرية والافات المصاحبة لها:

تم دراسة التغيرات العددية لنوعين من المفترسات الحشرية الموجودة على محصول بنجر السكر *Ch. carnea, C. undecimpunctata* وخمسة من الافات الحشرية الهامة المصاحبة لها منها آفات متخصصة وآفات عامة (*C. vittata, P.mixta, S. ocellatella, Aphis* ssp. and *N. viridula*) ظهر أسد المن فى شهر نوفمبر ووصل أعلى تعداد له فى شهر أبريل (٤١ فردا) عقب أعلى زيادة فى أعداد خنفساء وذبابة وفراشة البنجر والمن والبقة الخضراء فى الموسم الأول أما فى الموسم الثانى فكان له ذروة واحدة بتعداد (٢٥ فردا) خلال شهر أبريل فى نفس وقت ظهور ذبابة وفراشة البنجر ، وجد ارتباط معنوى عالى بين المفترس وخنفساء وذبابة وفراشة البنجر فى الموسم الأول والثانى من الدراسة.

كان لمفترس أبو العيد ذروتان الأولى فى شهر نوفمبر (٤٥ فردا) عقب أعلى زيادة فى أعداد المن ، أما الذورة الثانية فى شهر أبريل بتعداد (٣٠ فردا) فى نفس وقت زيادة أعداد آفات البنجر وذلك فى الموسم الأول ، أما فى الموسم الثانى فكان له ذروتان الأولى فى شهر نوفمبر ٤٨ فرد فى نفس وقت ذروة المن ، والثانية فى شهر مارس (٢٤ فردا). وقد لوحظ أن قمم النشاط لحشرة أبوالعيد دائما ما تكون مرتبطة بوجود أعلى كثافة لخنفساء وفراشة البنجر وكان الارتباط عالى المعنوية جدا مع المن خلال الموسم الأول والثانى من الدراسة.

الكفاءة الافتراسية لمفترسات اسد المن وابى العيد ١١ نقطة على بعض آفات بنجر السكر الحشرية:

عند تغذية يرقات مفترس أسد المن على بيض ويرقات خنفساء البنجر السلحفائية معمليا اكتمل الطور اليرقى المفترس فى خلال ٩,٧٥ و ١٠,٥ أيام استهلك خلالها ١٧٥,٣٥ بيضة و ٧٩,٧٥ يرقة. ووجد أن العمر اليرقى الأول للمفترس لا يتغذى على يرقات خنفساء وذبابة البنجر. عند تربية يرقات أسد المن على يرقات ذبابة البنجر وجد له ثلاث أعمار يرقية استغرقت ٩,٥ يوما استهلك خلالها ١٧٩,٧٥ يرقة. أظهرت النتائج أن متوسط الاستهلاك ليرقة أسد المن على الفقس الحديث ليرقات فراشة البنجر فى الأعمار اليرقية الثلاثة ١٢,٧٥ ، ٢١,٠ ، ٣٣,٧٥ يرقة على التوالى فى مدة تتراوح بين ٢٥ و ١٠ يوما. أما عند تربية مفترس أبوالعيد ١١ نقطة على بيض ويرقات خنفساء البنجر السلحفائية اكتمل العمر اليرقى للمفترس فى ٩,٧٥ ، ١٣,٧٥ يوما استهلك فيها ١٧٥,٣٥ بيضة ، ٤٢٨,٥ يرقة على التوالى. أما عند تغذيته على يرقات ذبابة وفراشة البنجر (فقس حديث) اكتمل الطور اليرقى للمفترس فى ٩,٢٥ ، ١١,٨ يوما استهلك خلالها ٢٠,٢٥ ، ١٢٧,٥ يرقة على التوالى. ومن هذه الدراسة نستنتج أن المفترسات الحشرية هامة جدا فى برامج المكافحة الحيوية دليل على ارتباطها القوى مع بعض آفات بنجر السكر فى الحقل والتغذية عليها بكفاءة فى المعمل. دراسة العلاقة بين الآفات الحشرية ومفترساتها بالاختبارات السيرولوجية تعتبر طريقة سريعة وسهلة لمعرفة علاقة المفترس بالآفة. ولذلك يوصى باستخدامها لدقتها وسرعة انجازها فى هذا المجال للاستفادة بها فى برامج المكافحة المتكاملة للآفات.