

## INTERACTION AMONG VEGETABLE CROPS, PIERCING SUCKING INSECT PESTS AND ASSOCIATED PREDATORS.

Abd El-Kareim, A. I.<sup>1</sup>; L. M. Shanab<sup>1</sup>; L.A. El-Batran<sup>1</sup> and M. G., Ali<sup>2</sup>  
<sup>1</sup>Econom. Entomol. Dept., Fac. of Agric., Mansoura Univ., Mansoura, Egypt.

<sup>2</sup>Agric. Res. Center (ARC,Iraq)

### ABSTRACT

The coccinellid predators (*Coccinella undecimpunctata* and *Coccinella septempunctata*) were more abundant species on the tested host plants than *Chrysoperla carnea* and *Eupeodes corolla* (F). The coccinellid predators greatly preferred white bean over cowpea and squash. However, the chrysopid predator, *Chry. carnea* greatly preferred white bean over squash and cowpea plants. *E. corolla* (F) showed more preferability to cowpea than white bean or squash plants.

In respect to the preference of predators for their prey, *Chrysoperla Carnea* and *E. corolla* (F) greatly preferred aphids and whitefly over leafhopper. On contrary, coccinellid predators showed highest degrees of preference to leafhoppers and aphids than whitefly.

### INTRODUCTION

Legume vegetables are widely cultivated crops in many countries of the world and in Egypt because they contain high protein (about 20%) that is characterized as a complete protein compared with those of other vegetables (Nosser, 1996). The cowpea, *Vigna unguiculata* (L.) is one of the most important vegetable leguminous crops in many parts of the world and in Egypt as a protein rich food. In Egypt, in 2009 (Anony mous.,2010). *Phaseolus Vulgaris b.*, are grown in every continent except Antarctica.. Worldwide, 23 million tones of dry *Phaseolus Vulgaris L.* and 17.1 million tones of green beans were produced in 2010 (USDA, 1986).. In Egypt, *Cucurbita pepo L.* is one of the most popular garden vegetables planted today.

Unfortunately, these crops are attacked by several insect pests throughout their different growth stages. Piercing-sucking insect pests are very injurious and cause serious damage to the yield in both quantity and quality (Jackai, 1995; Ward et al., 2002 and Hassan 2013). Their damage occur either directly by sucking plant juice or indirectly as vectors of virus diseases.

Chemical control of pests result an environmental pollution, serious side effects to human, domestic animals and natural enemies (Schmutterer, 1990).. So, the biological control remains a very essential component in insect pest management. This is especially recommended in vegetable plantations, because vegetable crops are most likely used as fresh foods . In the last few years, the Ministry of Agriculture aims to minimize the use of insecticides in integrated pest management programs. To maintain the natural balance, it is imported to conserve the natural enemies.

The aphidophagous predators ( Helal et al., ,1996 ; Abdel-Kareim et al.,2011; Salman et al., 2014; Khuhro et al., 2012 and Al-Deghair et al.,

2014) proved to be the main mortality factor of piercing-sucking insect pests (i.e. aphids, white fly and leafhopper).

The host plant had an effective role on the piercing-sucking pest populations and their predators, the natural enemies showed differences of their searching characteristics in response to host plant species (Abd El-Kareim ,2002) . So the host plant it must be considered in the IPM programs (Marouf, 2007 and Abdel-kareim et al.,2011).

**Therefore, the present investigation aimed to study the following topics:**

- 1.Studying the seasonal abundance of the main predaceous insect species and their prey (aphids, leafhoppers and the whitefly) in cowpea, white bean and squash fields.
- 2- Evaluating the interaction among host plants, prey and seasonal activity of associated predators.

## **MATERIALS AND METHODS**

### **Field experiments:**

The field experiments were carried out at the Experimental Farm of the Faculty of Agriculture, Mansoura University to determine the relation between insect natural enemies (i.e. predators) and sucking insect pests ( aphids, leafhoppers and whitefly) on different vegetable crops (squash, *Cucurbita pepo* L white bean, *Phaseolus vulgaris* L. and cowpea (*Vigna unguiculata* (L.)).

To estimate the seasonal abundance of the main sucking insect pests and predaceous insects associated with cowpea, white bean and squash plants, an area of about 630 m<sup>2</sup> was prepared, as recommended, and divided into nine plots (each of 70 m<sup>2</sup>) This means three treatments (crops) and three replicated.

All vegetable crops were sown on 20th February (during 2013) and on 6th February (during 2014).All regular agricultural practices were normally conducted except the use of insecticides.

### **Sampling techniques:**

Plant samples were collected weekly at random from each replicate starting one month after sowing date and continued till harvest. Each sample consisted of 15 leaves /replicate. Leaves were introduced into polyethylene bags in the field and then picked up and transferred to the laboratory for examination.

In the laboratory, the collected samples were inspected using a binocular microscope as follows: three inches were determined for every squash leaf (2 lateral and 1 terminal).Individuals of both aphid and whitefly were counted on every square inch. It means that 135 sq. in. (45 leaves x 3 Sq. In.) as well as 45 leaves of both cowpea and white bean were inspected weekly. In case of leafhopper the individuals were counted directly in the field on the leaves.

The numbers of each insect species (tomato whitefly, aphids and leafhoppers) were counted and recorded. The presence of predators on the collected samples was also recorded. The insect predators which observed on each sample were collected using an aspirator and counted.

**Statistical analyses:**

correlation and regression analysis were done between prey densities (i.e., the weekly average of each prey density) and the seasonal abundance of insect predators.

**RESULTS**

**1. The relation between predaceous insects and the tested host plants:**

**1.1 Total number and relative abundance of predaceous insects:**

As shown in Table (1), the coccinellid predators (*C. undecimpunctata* and *C. stemptpunctata*) were more occurring on the tested host plants than were *Chy. carnea* and *E. corolla*. However, the coccinellid predators represented by 40.1, 36.5 and 35.3% (in the first season) and 41.8, 61.8 and 41.6% (in the second season) of the total number of predaceous insects in white bean, cowpea and squash fields, respectively.

The coccinellid predators preferred white bean (40.1&41.8) and cowpea (36.5 &61.8) over squash (35.3 &41.6) in the first and second seasons, respectively (Table,1). On the other hand, the chrysopid predator, *Chy. carnea* greatly preferred white bean and squash to cowpea plants. The occurrence percentages of *Chy. Carnea* population on white bean, squash and cowpea plants were 31.2, 34.6 and 23.3 in the first and 23.6, 17.7 and 14.3% in the second season , respectively. *E. corollae* showed more preferability to cowpea (36.5 and 43.8) to white bean (25.7 and 31.5)or squash plants (26.3 and 37.2%) in the first and second seasons, respectively.

**1.2. Seasonal abundance of predaceous insects:**

**1.2.1. The coccinellid predators :**

As shown in Figure (1), the coccinellid predators started to visit white bean and cowpea plants early on 13<sup>th</sup> of March (in the first season) and exhibited a distinct peak on white bean (13 individual) and cowpea (19 individuals/sample), recorded on the 1<sup>st</sup> of May and 24<sup>th</sup> of April, respectively. While on squash plants, it appears later on the 3<sup>rd</sup> of April with one peak of abundance on 22<sup>th</sup> of May represented by 14 individuals. In the second year (2014), coccinellid populations exhibited approximately similar trend of changes on all host plants. It started to visit all host plants at the first week of March and showed one peak of abundance; recorded on the 29<sup>th</sup> of April. So, it could be concluded that coccinellid predators preferred cowpea over squash and white bean.

**1.2.2. The chrysopid, *Chry. carnea* :**

*Chy. carnea* population started to appear on white bean and cowpea fields on the 4<sup>th</sup> of March and showed the highest occurrence on the 15<sup>th</sup> of May 2013, represented by 14 and 9 individuals/sample. While, *Chy. carnea* population started to visit squash plants at the last week of March and exhibited the highest peak on the 17<sup>th</sup> April (9 individuals/sample). In the second season, it exhibited similar trend of changes on white bean, cowpea and squash plants. However, it showed one peak of abundance on the 6<sup>th</sup> of May, represented by 12, 6 and 6 individuals/sample, respectively.

So, it could be concluded that *Chry. carnea* preferred white bean plants in comparsion with cowpea or squash.

### 1.2.3. The hoverfly, *E. corollae*:

Data illustrated in Fig.(1) indicated that *E. corollae* showed more preferability to cowpea than to white bean or squash plants. In the first year, it exhibited the highest abundance on 15<sup>th</sup> May, 15<sup>th</sup> May and 27<sup>th</sup> May on cowpea, white bean and squash, represented by 16, 13 and 8 individuals /45 leaves, respectively. In the second year, *E. corollae* showed no preferrability to all host plants. However, it starts to appear on all host plants on 25<sup>th</sup> of March 2014 and showed no preference among host plants.

## 2. The relation between predaceous insects and their prey.

### 2.1. Seasonal abundance of predators in response to prey density:

The changes of each predator's population in response to their prey densities on each host plant were illustrated in Fig (2, 3 and 4).

### 2.2. The interaction among host plants, preys and seasonal activity of associated predators.

To evaluate the interaction among the different prey densities and seasonal activities of associated predators on tested host plants, multi-regression analysis was done. The calculated values of multi-regressions representing the common effect of mean preys densities (i.e. aphids, leafhoppers and whitefly) on the population of each predator in white bean, cowpea and squash fields, are shown in Tables (2, 3 and 4) which indicated to the following :

#### In whitebean field:

With respect to coccinellid predators: Multi-regression analysis revealed that the common effect of the prey population size (aphids, whitefly, *B..tabaci* and leafhopper) exhibited strong effect on the coccinellid populations (Table,2). However, 85.0 and 95.6% of the total population changes were due to the compound effect of the tested prey in 2013 and 2014. In 2013, the highest effective prey was that of the mean aphid densities followed by means of whitefly and leafhopper densities, where the determination coefficient values ( $R^2$ ) were 67.1, 59.6 and 40.9%, respectively. In 2014 season, the highest effective prey was that of mean whitefly followed by leafhopper and aphid densities , where  $R^2$  were 84.8, 82.2 and 69.5%, respectively.

Multi-regration analysis illustratrd that the relation between number of coccinellids ( $N_{co}$ ) and all of mean aphids (A) , whitefly (W) and leafhopper

#### (L) could be represented by the following sub models:

$$N_{co} = - 0.97 + 0.31 A - 0.25 W + 0.36 L \text{ (in 2013)}$$

$$N_{co} = - 1.90 + 0.09 A + 0.22W + 0.27 L \text{ (in 2014)}$$

As shown in Table (2), *Chry. carnea* population exhibited insignificant correlation with leafhopper population in 2013 and 2014 seasons. The highest effective prey density was that of aphid followed by mean whitefly and leafhopper densities, where the ( $R^2$ ) were (76.5, 60.4 and 23.4%) and (39.8, 72.2 and 22.8%, respectively) in the first and secondseasons.

The relation between number of *Chy. carnea* population ( $N_{ch}$ ) and all of mean aphids (A), whitefly (W) and leafhopper (L) could be represented by the following sub models:

$$N_{ch} = - 1.07 + 0.30 A - 0.14 W + 0.18 L \text{ (in 2013)}$$

$$N_{ch} = 1.08 - 0.01 A + 0.61 W - 0.22 L \text{ (in 2014)}$$

*E. corolla* population showed variable responses to the changes of leafhopper population, it exhibited an insignificant and significant response in the first and second seasons (Table,2). On the other hand, the highest effective prey density in 2013 season was that of aphid followed by whitefly and leafhopper, where ( $R^2$ ) were 92.9, 76.5 and 24.0%. In 2014 season, the highest effective prey density was that of whitefly followed by leafhopper and aphids. ( $R^2$  values were 72.3, 60.0 and 50.5%, respectively). All prey population contributed 93.0 and 75.0% of the total population changes of *E. corolla*. The relation between numbers of *E. corolla* population ( $N_s$ ) and all of mean aphids (A), whitefly (W) and leafhopper (L) could be represented by the following sub models:

$$N_s = - 1.16 + 0.21 A + 0.03 W - 0.01 L \text{ (in 2013)}$$

$$N_s = 0.91 + 0.02 A + 0.23 W + 0.09 L \text{ (in 2014)}$$

#### **In cowpea field:**

Statistical analysis indicated that the common effect of the prey population size (aphids, whitefly, *B. tabaci* and leafhopper) exhibited strong effect on the coccinellid populations, especially in 2014 season (Table,3). However, 72.5 and 90.5% of the total population changes were due to the compound effect of the tested prey in 2013 and 2014. In 2013, the highest effective prey was that of the mean leafhoppers followed by whitefly and aphid densities, where  $R^2$  values were 49.5, 44.5 and 35.2%, respectively. While, in 2014 season, the highest effective prey was that of mean whitefly followed by aphids and leafhopper,  $R^2$  were 84.4, 79.8 and 43.9%, respectively. The relation between number of coccinellids ( $N_{co}$ ) and all of mean aphids (A), whitefly (W) and leafhopper (L) could be represented by the following sub models:

$$N_{co} = - 1.43 + 0.16 A - 0.30 W + 0.89 L \text{ (in 2013)}$$

$$N_{co} = - 2.40 + 0.22 A + 0.29 W + 0.10 L \text{ (in 2014)}$$

*Chy. carnea* population exhibited no response to the changes of leafhopper population on cowpea plants in both seasons (Table,3), however, there was insignificant correlation between *Chy. carnea* population and leafhopper density. While, aphids and whitefly appeared to be the key preys, its contributed 73.2 & 78.6% (in 2013) and 78.8 & 72.6% (in 2014) of the total population changes of *Chy. carnea* population. On the contrary, leafhopper contributed only 35.1 and 29.5% in 2013 and 2014. The compound effect of all preys in 2013 and 2014, represented by 92.5 and 82.4% of the total population changes of *Chy. carnea*. The relation between number of *Chy. carnea* population ( $N_{ch}$ ) and all prey densities could be represented by the following sub models:

$$N_{ch} = - 0.89 + 0.06 A + 0.23 W - 0.10 L \text{ (in 2013)}$$

$$N_{ch} = - 1.39 + 0.12 A + 0.08 W + 0.01 L \text{ (in 2014)}$$

Correlation and regression analysis showed that *S. corolla* population was significantly affected by their prey (aphids and whitefly population) and insignificantly affected by leafhoppers, where the ( $R^2$ ) was 85.0, 55.2 and 20.9% in 2013 season. While, in 2014 the  $R^2$  was 88.5, 86.6 and 42.6%. So, it could be noticed that *E. corolla* population showed different response to the changes of leafhopper population, it exhibited an insignificant and significant response in the first and second seasons (Table,2). The relation between numbers of *E. corolla* population ( $N_s$ ) and its preys represented by the following sub models:

$$N_s = 2.78 + 0.21 A + 0.21 W - 0.02 L \text{ (in 2013)}$$

$$N_s = -2.40 + 0.23 A + 0.19 W + 0.07 L \text{ (in 2014)}$$

#### In squash field:

As shown in Table (4) coccinellid populations were significantly affected by all preys on squash plants during 2013 and 2014 season, the common effect of the preys populations represented by 93.5 and 80.0% of the total population changes in 2013 and 2014. In 2013, the highest effective prey was leafhoppers density followed by whitefly and aphids, where the  $R^2$  values were 93.3, 80.8 and 47.5%, respectively. While, in 2014 season, the highest effective prey was whitefly followed by aphids and leafhopper,  $R^2$  was 64.1, 42.5 and 38.6%, respectively.

The relation between number of coccinellids ( $N_{co}$ ) and their preys represented by the following sub models:

$$N_{co} = -1.43 + 0.03 A - 0.12 W + 0.49 L \text{ (in 2013)}$$

$$N_{co} = -2.95 - 0.87 A + 0.96 W + 0.65 L \text{ (in 2014)}$$

Values of the compound effect of all preys on *C. carnea* population was lower in 2013 than those in 2014, represented by 58.7 and 98.3% in 2013 and 2014 seasons. *C. carnea* population exhibited a seight response in the first season to the changes of leafhopper population on squash plants. However, aphids, whitefly and leafhopper population contributed 52.9, 45.5 and 29.9% (in 2013) and 94.6, 89.6 and 40.6% (in 2014) of the total population changes of *C. carnea* population. The relation between number of *C. carnea* population ( $N_{ch}$ ) and all prey densities could be represented by the following sub models:

$$N_{ch} = -0.42 + 0.16 A + 0.28 W - 0.18 L \text{ (in 2013)}$$

$$N_{ch} = -0.53 + 0.21 A + 0.07 W - 0.05 L \text{ (in 2014)}$$

Correlation and regression analysis showed that the highest effective prey on *E. corolla* population in 2013 season was that of the mean leafhopper, followed by whitefly and aphid, where the values of ( $R^2$ ) were 78.9, 68.9 and 53.1%, respectively. While, in 2014 season, the highest effective prey was that of mean aphids followed by whitefly and leafhopper, where  $R^2$  value were 93.1, 78.9 and 37.3%, respectively (Table,4). The relation between numbers of *E. corolla* population ( $N_s$ ) and its preys represented by the following sub models:

$$N_s = 0.29 + 0.05 A + 0.18 W + 0.01 L \text{ (in 2013)}$$

$$N_s = -0.39 + 0.59 A - 0.003 W - 0.17 L \text{ (in 2014)}$$

## DISCUSSION

### 4.1 Attractiveness of tested host plants to insect predators

Surveying the insect predators associated with summer plantations of white bean, cowpea and squash assured that the most dominant predators were the coccinellid *C. undecimpunctata* and *C. septempunctata*, *E. corolla* and *C. Carnea*. As mentioned by other authors, these predators were recorded as important natural enemies associated with white bean, cowpea and squash plants in Egypt (Abdel-Gawaad *et al.*, (1990) ; Amro (2004); Ali *et al.*, (2013) and Gameel (2013)

The present investigation indicated that seasonal abundance of predaceous insects showed differences in their response to host plant species. However, the collected predators , coccinellids and *C. carnea* greatly preferred white bean over cowpea and squash. On the contrary, *E. corollae* greatly preferred cowpea over white bean and squash.. Also, the predators of *Rodolia cardinalis*, *Chilocorus bipustulatus* and *C. motrouzari* exhibited different response to different host plants Cardoso, 1990; Heidari *et al.*, 1999 and Abdel-Mageed, (2005). Plant volatiles are derived from a complex of biochemical processes and some of these compounds appear to be common in different plant species (Arab and Bento, 2006).

According to El-Baradey (2012), differences in predators response to different host plant species may be attributed to chemical stimulants (kairomone) produced by the plant species and may explain variation of predator abundance on different host plants. Similar conclusion was obtained by Abd El-Kareim (2002) ; Abdel-Kareim *et.al*, (2011) and Marouf (2011) that emission of auditory stimuli from the host plant is the main factor in insect attraction. Luna and Jepson (2001) indicated that differences of predators (hoverflies and coccinellid beetles ) in response to the tested host plants may be attributed to physical or chemical stimulants For some predatory species, a blend of compounds, including volatiles from the plants in the habitat as well as prey volatiles are involved (Hagen, 1986).

### 4.2 Interaction among host plants, preys and predators activity.

Predator-prey interactions play a substantial role in shaping spatial distributions of organisms in biological communities (Williams and Flaxman, 2012). Jalali (2012) demonstrated that significant host plant-prey interactions were evident for every component of development (juvenile survival, developmental time, adult mass at emergence) and reproduction of associated predators .

In the present study, tested predators (coccinellids, *C.carnea* and *E. corolla*) showed variable responses to prey population on the tested host plants, especially with leafhopper populations. *C. undecimpunctata* exhibited higher searching rates when fed on *A. gossypii* than when fed on *Aphis punicae* (Shinji) (Al-Deghair *et al.*, 2014). Also, the total developmental time from egg hatching to adult eclosion of chrysopid, *Chrysoperla carnea* differed significantly when reared on the four aphid species (*Aphis gossypii*, *Sitobion avenae*(F), *Rhopalosiphum maidis* (Fitch), and *Aphis nerii*) (El-Serafi *et al.*, 2000). According to Giles *et al.* (2002), *Aphis pisum* reared on *Medicago*

*sativa* L was suitable prey for *C. septempunctata* survival, development, and adult size than *A. pisum* reared on *Vicia faba* L. A significant faster rate of development when the predator *C. septempunctata* was reared on *Acyrtosiphon pisum* Harris than observed on *R. maidis* (Obrycki and Orr, 1990)

**Table (1): Total number and relative abundance of predaceous insect species (*Chrysoperla carnea*, *Eupeodes corolla* (F.) and the coccinellids, *Coccinella undecimpunctata*, *Coccinella stemtpunctata*) in white bean, cowpea and squash summer plantations collected through 2013 and 2014 seasons.**

2014 season						2013 season						Predator
<i>Cucurbita pepo</i> L.		<i>Vigna unguiculata</i>		<i>Phaseolus vulgaris</i> L.		<i>Cucurbita pepo</i> L.		<i>Vigna unguiculata</i>		<i>Phaseolus vulgaris</i> L.		
%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	
17.7	20	14.3	16	23.6	39	34.6	54	23.3	44	31.2	63	<i>Chrysoperla carnea</i> Steph.
37.2	42	43.8	41	31.5	52	26.3	41	36.5	69	25.7	52	<i>Eupeodes corolla</i> Fabr
41.6	47 (57) (34)	61.8	49 (70) (48)	41.8	69 (75) (48)	35.3	55 (31) (24)	36.5	69 (41) (28)	40.1	81 (54) (27)	Coccinellid: <i>C.undecimpunctata</i> & <i>C. stemtpunctata</i>
3.5	4	5.4	6	3.0	5	3.8	6	3.7	7	3.0	6	Other: <i>Peaderes alferii</i> , <i>Orius</i> sp.
100	113	100	112	100	165	100	156	100	189	100	202	Total

**Table (2): The correlation and regression coefficient between the mean number of collected predators and each of aphids, whitefly and leafhoppers population densities in white bean field during 2013 and 2014 seasons.**

Multi regression				Simple Correlations and regression				Season	Prey	Predators	
E.V.%		P	b	R <sup>2</sup> %	p	b	r				
2014	2013										
95.6	85.0	0.011	0.31	67.1	0.002	0.50	0.82	2013	Aphids	<i>Coccinellids</i>	
		0.041	0.09	69.5	0.001	0.24	0.83	2014			
		0.066	-0.25	59.7	0.005	0.13	0.77	2013			White fly
		0.114	0.22	84.8	0.000	0.66	0.92	2014			
87.6	78.9	0.026	0.36	40.9	0.034	0.23	0.64	2013	Leaf hoppers		
		0.012	0.27	82.2	0.000	0.53	0.91	2014			
		0.063	0.30	76.5	0.000	0.21	0.88	2013	Aphids		
		0.795	-0.01	39.8	0.037	0.11	0.63	2014			
		0.451	-0.14	60.4	0.005	0.17	0.78	2013			
		0.001	0.61	72.2	0.001	0.36	0.85	2014			
75.0	93.0	0.401	0.18	23.4	0.131	0.23	0.48	2013	Leaf hoppers	<i>Chrysoperla carania</i>	
		0.022	-0.24	22.6	0.140	0.16	0.47	2014			
		0.034	0.21	92.9	0.000	0.23	0.96	2013	Aphids		
		0.653	0.02	50.5	0.014	0.19	0.71	2014			
		0.803	0.23	76.5	0.000	0.19	0.87	2013	White fly		
0.218	0.23	72.3	0.001	0.36	0.85	2014					
0.803	-0.01	24.0	0.126	0.23	0.49	2013	Leaf hoppers	<i>Eupeodes corolla</i>			
0.479	0.08	60.4	0.005	0.27	0.78	2014					



**Table (3): The correlation and regression coefficient between the mean number of collected predators and each of aphids, whitefly and leafhoppers population densities in cowpea field during 2013 and 2014 seasons.**

Multi regression			Simple Correlations and regression				Season	Prey	Preadators		
E.V.%		P	b	R <sup>2</sup> %	p	b				r	
2014	2013										
90.5	72.5	0.050	0.16	35.2	0.050	0.15	0.59	2013	Aphids	Coccinellids	
		0.091	0.22	79.8	0.000	0.46	0.89	2014			
		0.304	-0.30	44.9	0.024	0.35	0.67	2013	White fly		
		0.108	0.29	84.4	0.000	0.58	0.91	2014			
82.4	97.5	0.050	0.89	49.5	0.016	0.61	0.70	2013	Leaf hoppers		
		0.346	0.09	43.9	0.026	0.42	0.66	2014			
		0.001	0.06	73.2	0.001	0.12	0.86	2013	Aphids		Chrysoperla carania
		0.089	0.12	78.8	0.000	0.81	0.89	2014			
0.001	0.23	78.6	0.000	0.25	0.88	2013	White fly				
0.363	-0.08	72.6	0.001	0.21	0.85	2014					
95.9	91.8	0.162	-0.98	35.1	0.055	0.28	0.59	2013	Leaf hoppers		
		0.868	0.009	29.5	0.084	0.13	0.54	2014			
		0.002	0.21	85.0	0.000	0.26	0.92	2013	Aphids	Eupeodes coralla	
		0.006	0.23	88.5	0.000	0.39	0.94	2014			
		0.263	0.21	55.2	0.009	0.44	0.74	2013	White fly		
		0.057	0.19	86.6	0.000	0.48	0.93	2014			
0.92	-0.02	20.9	0.158	0.46	0.45	2013	Leaf hoppers				
0.225	0.06	42.6	0.029	0.33	0.65	2014					

**Table (4): The correlation and regression coefficient between the mean number of collected predators and each of aphids, whitefly and leafhoppers population densities in squash field during 2013 and 2014 seasons.**

Multi regression			Squash Correlations and simple regression				Season	Prey	Preadators		
E.V.%		P	b	R <sup>2</sup> %	p	b				r	
2014	2013										
80.0	93.5	0.847	0.03	47.5	0.019	0.49	0.69	2013	Aphids	Coccinellids	
		0.077	-0.89	42.5	0.030	0.56	0.65	2014			
		0.542	-0.12	80.8	0.000	0.39	0.89	2013	White fly		
		0.011	0.95	64.1	0.003	0.55	0.80	2014			
98.3	58.7	0.010	0.49	93.1	0.000	0.40	0.97	2013	Leaf hoppers		
		0.066	0.65	38.6	0.041	0.69	0.62	2014			
		0.466	0.16	52.9	0.011	0.31	0.73	2013	Aphids		Chrysoperla carania
		0.001	0.21	94.6	0.000	0.26	0.97	2014			
0.355	0.28	45.5	0.023	0.18	0.67	2013	White fly				
0.035	0.06	89.6	0.000	0.20	0.95	2014					
96.1	69.2	0.411	-0.18	29.9	0.082	0.13	0.55	2013	Leaf hoppers		
		0.100	-0.05	40.6	0.035	0.22	0.64	2014			
		0.792	0.05	53.1	0.011	0.31	0.73	2013	Aphids	Eupeodes corolla	
		0.001	0.59	93.1	0.000	0.49	0.96	2014			
		0.490	0.18	68.9	0.002	0.22	0.83	2013	White fly		
		0.972	-0.003	78.9	0.000	0.36	0.89	2014			
0.951	0.012	62.0	0.004	0.19	0.79	2013	Leaf hoppers				
0.063	-0.17	37.3	0.046	0.40	0.61	2014					

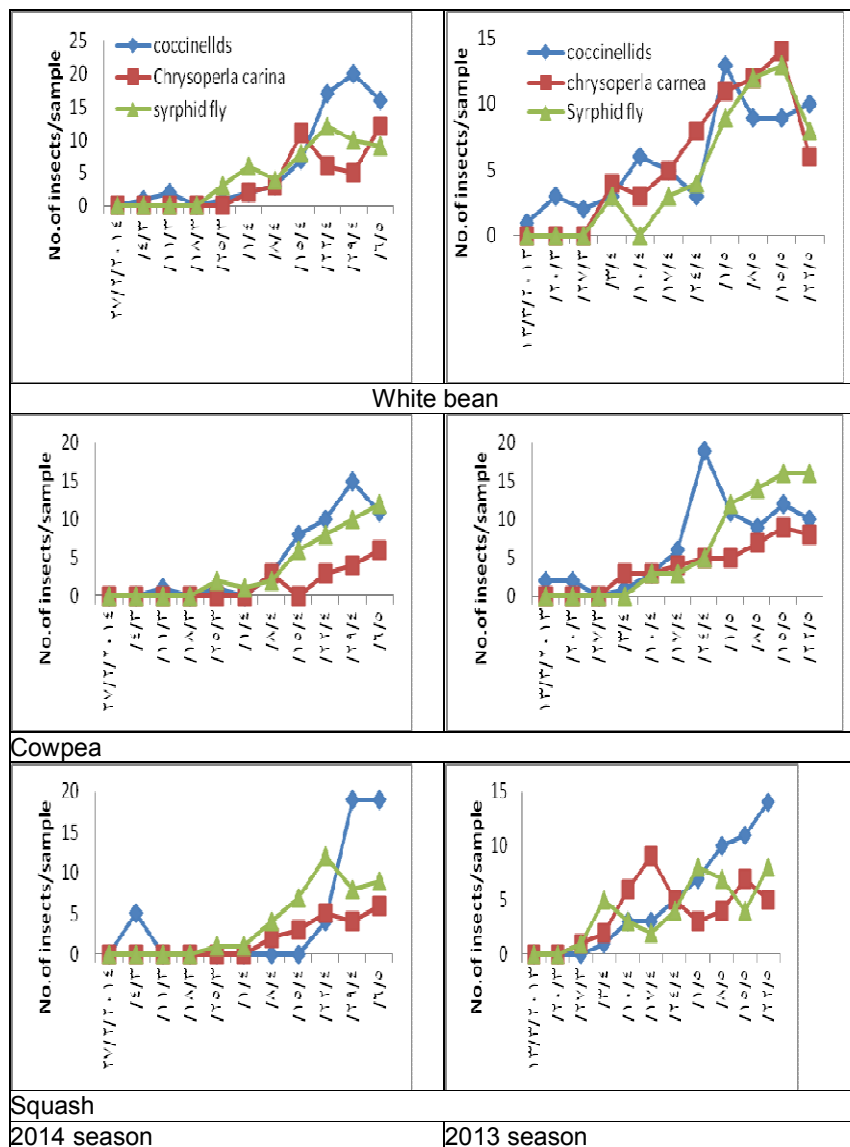


Figure (1): Seasonal abundance of Coccinellid predators (*Coccinella undecimpunctata* and *Coccinella septempunctata*) ; the chrysopid, *C. carnea* and the hoverfly, *Eupeodes corolla* in response to host plant species (white bean, cowpea and squash) at Mansoura district during 2013 and 2014.

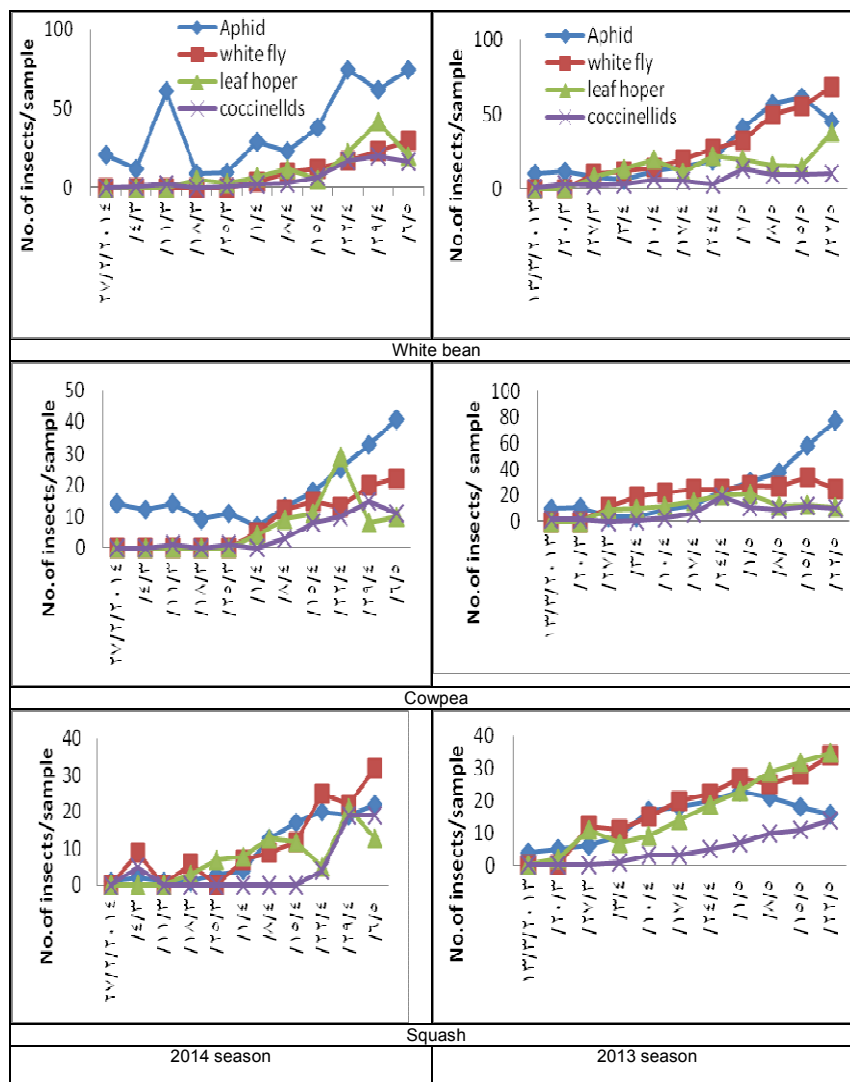


Fig.2: Seasonal abundance of the coccinellid predators (*Coccinella undecimpunctata* and *Coccinella septempunctata*) in response to prey densities (aphids, whitefly and leafhoppers) on white bean, cowpea and squash plants during 2013 and 2014 seasons.

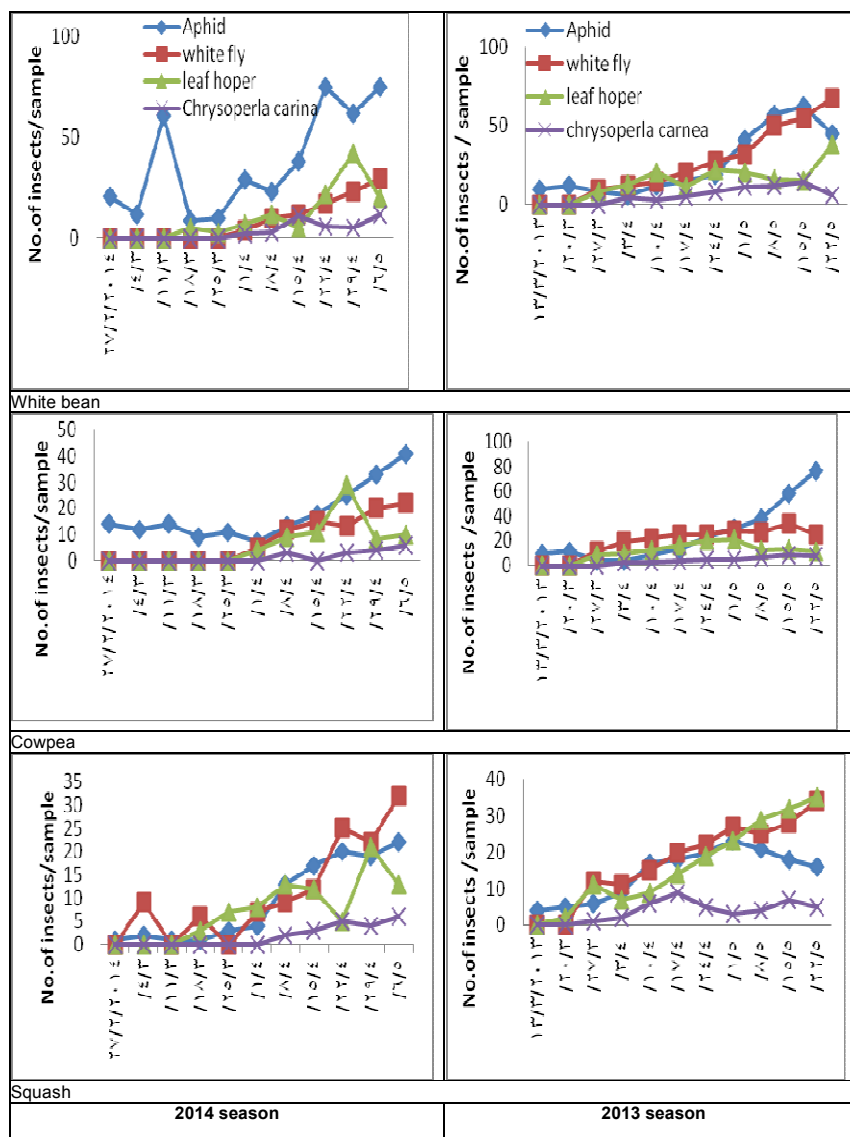


Fig.3: Seasonal abundance of the chrysopid predator (*Chrysoperla carnea*) in response to prey densities (aphids, whitefly and leafhoppers) on white bean, cowpea and squash plants during 2013 and 2014 seasons.

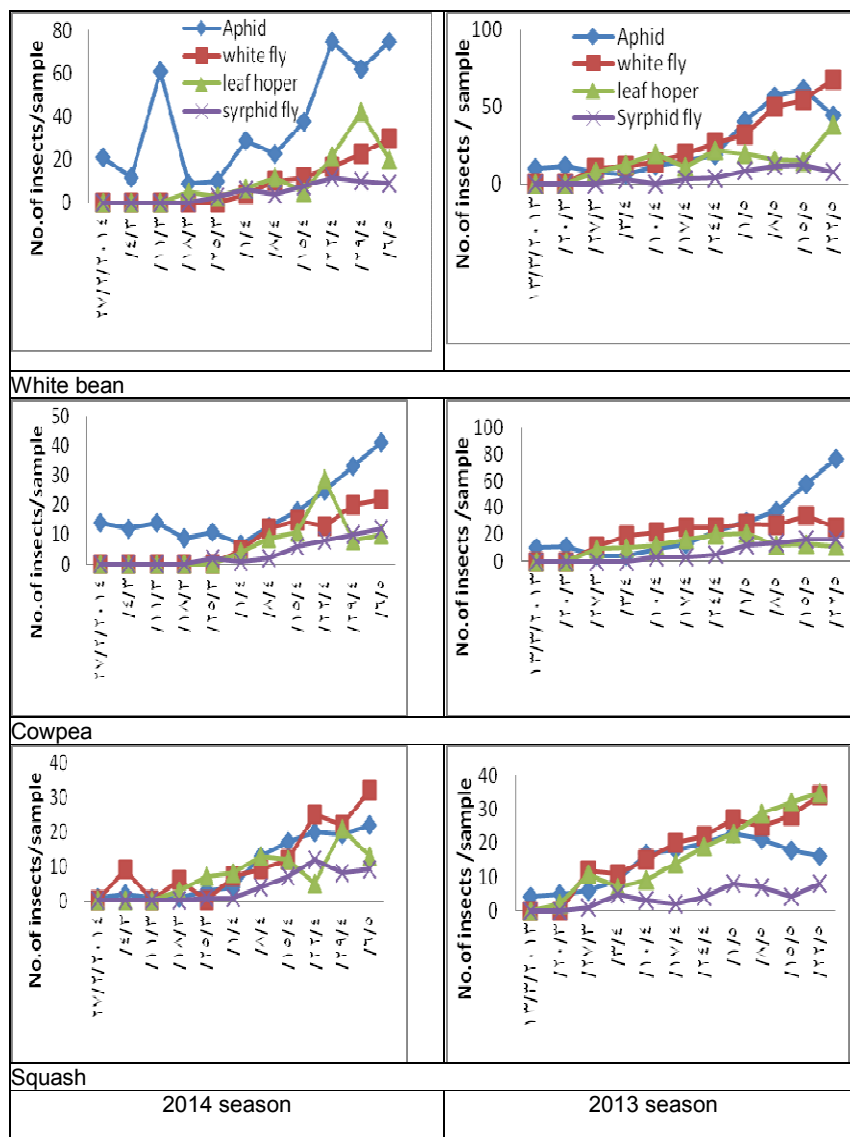


Fig.4: Seasonal abundance of the syrphid predator (*Eupeodes corollae*) in response to prey densities (aphids, whitefly and leafhoppers) on white bean, cowpea and squash plants during 2013 and 2014 seasons.

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التفاعل بين كلا من محاصيل الخضر والحشرات الماصة والمفترسات المرتبطة بها.  
عبد الستار إبراهيم عبد الكريم<sup>١</sup> , لييب محمود شنب<sup>١</sup> , ليلى عبدالستار البطران<sup>١</sup> و  
محمد جمال علي<sup>٢</sup>  
قسم الحشرات الاقتصادية - كلية الزراعة جامعة المنصورة - مصر<sup>١</sup>  
مركز البحوث الزراعية - العراق<sup>٢</sup>

أثبتت الدراسة الحالية أن كلاً من مفترسات أبو العيد (أحد عشرة نقطة وأبو العيد سبع نقط) كانت أكثر الأنواع تواجداً على النباتات تحت الدراسة مقارنة بأسد المن الأخضر وذبابة السيرفس. وقد وجد أن مفترسات أبو العيد كانت تفضل الفاصوليا أكثر من اللوبيا والكوسة بينما فضل مفترس أسد المن الفاصوليا عن كل من نباتات الكوسة واللوبيا . أما ذبابة السيرفس فقد أبدت أعلى تفضيل لها لنباتات اللوبيا مقارنة بكل من الفاصوليا والكوسة. بالنسبة لتفضيل المفترسات لفرائسها فقد أوضحت النتائج أن كلاً من أسد المن وذبابة السيرفس تفضل حشرات المن والذبابة البيضاء على نطاقات الأوراق بينما أبدت مفترسات أبو العيد تفضيلاً لكل من نطاقات الأوراق والمن عن الذبابة البيضاء .