

Monitoring and Seasonal Abundances of the Leafhoppers; *Empoasca decipiens* (Paoli), *Empoasca decedens* (Paoli) and their Associated Predators on some Leguminous Vegetable Crops in Egypt

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ABSTRACT

The present study was conducted to survey leafhopper species and their associated predators on some leguminous crops; broad-bean, pea, cowpea and bean plants at Diarb-Nigm district, Sharkia Governorate, Egypt during 2006/07 and 2007/08 seasons. Also, to study the effects of some climatic factors on the population densities of dominant leafhopper and their predatory species. Leafhopper species; *Empoasca decipiens* (Paoli), *E. decedens* (Paoli) and *Cicadulina chinai* (Ghau) were recorded. Sampling was conducted using insect sweeping net. Results indicated that *E. decipiens* had one peak occurred on broad-bean plants in 3rd week of February and 1st of March in the two seasons, respectively. However, two peaks occurred on pea plants in 3rd weeks of January and February 2007/08. Two peaks occurred on bean plants in 1st weeks of July and August, 2007 and in 3rd weeks of July and August, 2008. Two peaks occurred on cowpea plants in 1st weeks of July and August, 2007 and one peak in 3rd week of July, 2008. Population density of *E. decedens* showed two peaks occurred on broad bean and pea plants in 3rd weeks of February and March, 2006/07 and also, two peaks on pea plants in 1st weeks of February and March, 2007/08. Two peaks occurred on bean plants in 1st week of July and 3rd week of August in the two seasons, respectively. Two peaks occurred on cowpea plants in 3rd weeks of July and August 2008. Obtained results indicated that five predatory species, *Coccinella undecimpunctata* L., *Chrysoperla carnea* (Steph), *Paederus alfieri* (Koch.), *Metasyrphus corollae* F. and *Scymnus* sp. were found associated with those leafhoppers. *C. undecimpunctata* and *Ch. Carnea* were the most dominant species. Temperature and relative humidity had significant effects on the population densities of both the leaf hoppers and their predators in the all studied crops.

Key words: Leafhoppers, *Empoasca decipiens*, *Empoasca decedens*, leguminous crops, predators, Egypt.

INTRODUCTION

Leguminous vegetable plants; cowpea, bean, broad-bean and pea plants are considered the most important plants because of their high nutritive values as human food. Cultivated area increased to cover the needs of people and the requirement of local and foreign markets (Ahmed, 2007). Leafhopper insects cause serious damage to leguminous plants, either directly by sucking plant juice or indirectly as vectors of virus diseases; Hegab *et al.*, (1987), El-Gindy (1997), Abdel-Samed (2005) and Ahmed (2007). Predatory species recorded associated with leafhopper species infesting leguminous vegetable plants included, *Paederus fuscipes* (Zhu, 1984); *Orius insidiosus*, *Chilocorus cati* and *Cycloneda sanguinea* (Cotte and Cruz 1989).

The scope of the present study was directed towards the following:

- 1- Survey and seasonal abundances of the leafhopper species and their associated predators on some leguminous vegetable crops; cowpea, bean, broad-bean and pea in Egypt,
- 2- Effect of temperature and relative humidity on population densities of the leafhoppers and their associated predators in the studied leguminous vegetable crops.

MATERIALS AND METHODS

Four leguminous crops; cowpea, bean, broad bean

and pea were planted in an area of about 1/2 feddan (= 2100 m²) at Diarb-Nigm district, Sharkia Governorate, Egypt for two growing seasons 2006/07 and 2007/08. Experimental area was divided into two plots in winter (for broad bean and pea) and in summer (for cowpea and bean). All regular cultural practices were carried out and no chemical control was applied. Sampling took place weekly by using an insect sweeping net (fifty double-net strokes/sample/date) from each plot. Collected insects were placed in plastic bags, anesthetized with diethyl ether and transferred to the laboratory for classification, counting and recording. Daily degrees of temperature and relative humidity were obtained from the Agricultural Meteorological station at Sharkia Governorate and estimated as biweekly means. Correlation coefficients between the number of predaceous insects and the leafhoppers were statistically calculated. Costat Software Program (1990) was applied for statistical analysis of results.

RESULTS AND DISCUSSION

1- Survey of leafhoppers and their associated predators on leguminous vegetable plants

Three leafhopper species; *Empoasca decipiens* (Paoli), *E. decedens* (Paoli) and *Cicadulina chinai* (Ghau) (Homoptera: Cicadellidae) were recorded during the present study, on the four leguminous vegetable crops; broad bean, pea, cowpea and bean. *E. decipiens* and *E. decedens* were the most dominant

species. Present results agree with those obtained by Mowafy (1988), El-Gindy (2002), Abdel-Samed (2005) and Ahmed (2007) who surveyed the aforementioned homopterous insects on leguminous plants in Egypt. Meanwhile, the predaceous species occurred were; *Coccinella undecimpunctata* L. and *Scymnus* sp. (Coleoptera: Cocciniellidae), *Paederus alferii* (Coleoptera: Staphylinidae), *Chrysoperla carnea* (Steph.) (Neuroptera: Chrysopidae) and *Metasyrphus corollae* F. (Diptera: Syrphidae). These results agree with Zhu (1984), Kennedy *et al.* (1990), and Rao *et al.* (2004).

2- Seasonal abundances

2.1. Winter crops

2.1.1. Broad bean

A- *Empoasca decipiens* (Paoli)

E. decipiens occurred on broad-bean plants in 3rd third week of December. Initial counts were 2 and 3 individuals/ sample in 2006/07 and 2007/08 seasons, respectively, at the means of 18.1 & 18.3 °C and 62.7 & 67.7 % R.H. for the two seasons, respectively. One peak (41 and 43 adults/ 50 double-net strokes) occurred in 3rd and 1st of weeks of February and March in the first and second seasons, respectively, at the means of 18.3 and 20.8 °C and 63.5 % and 65.8 % R.H. for the two seasons, respectively (Fig. 1).

B- *Empoasca decedens* (Paoli)

E. decedens was recorded first in 3rd week of December 2006. Initial counts were 2 and 4 individuals/ sample in the two seasons, respectively. In 1st season, two peaks (33 adults/ 50 double-net strokes) occurred in 3rd weeks of February and March, at the means of 18.3 °C and 63.5 and 61.7 % R.H. Meanwhile, one peak (29 adults) occurred in 1st week of March 2008 (at 20.8 °C and 65.8 % R.H.) (Fig.1). These results partially agree with the findings of El Gindy (2002) and Abdel-Samed (2005) who mentioned that *E. decipiens* and *E. decedens* had one peak on winter leguminous vegetable plants.

C- Associated predators

C. undecimpunctata, *Ch. carnea*, *P. alferii* and *M. corollae* were recorded on broad-bean plants during the two seasons of study. *C. undecimpunctata* showed two population peaks (15 and 31 individuals/ 50 strokes) in 1st weeks of February and March, season 2006/07. In season 2007/08, one peak (27 individuals/ 50 strokes) was recorded in 3rd week of February. *Ch. carnea* reached its peak (21 individuals /50strokes) in 1st week of March in the first season. In the second season, two population peaks (12 and 18 individuals /50 storks) were recorded in 1st weeks of February and March. *P. alferii* reached its peaks (11 and 9 individuals/50

strokes) in 1st week of March in both seasons. *M. corollae* was recorded in few numbers in both seasons (Fig. 1). El-Defrawi *et al.* (2000) stated that, *S. interruptus* was the most common predator observed in faba bean fields in Egypt, while, El-Khawas *et al.* (2004) recorded, only, one individual of *Scymnus* sp. in 4th week of February on faba bean plants at Moshtohor region, Qaluobia, Egypt.

2.1.2. Pea

A- *Empoasca decipiens*

Fig. (2) showed that *E. decipiens* had one peak (37 adult /50 strokes) occurred in 3rd week of February 2007, while two peaks (21 and 29 adults) were recorded in 3rd weeks of January and February of the second season, respectively

B- *Empoasca decedens*

Population density of *E. decedens* showed two peaks of abundances in the first season and one peak in the second season. In the first season (18 and 28 adults/ 50 strokes) occurred in 1st weeks of February and March, at the means of 13.7, 18.6 °C and 67.6, 63.4 % R.H. In the second season, a peak of (27 adults/ 50 double strokes) occurred in 3rd week of February at 18.3 °C and 61.7% R.H. (Fig. 2). Similar findings were reported by El-Gindy (2002) and Abdel-Samed (2005).

C- Associated predators

C. undecimpunctata, *Ch. carnea*, *P. alferii* and *M. corollae* were recorded on pea plants during the two seasons of study. *C. undecimpunctata* population peaked (30 individuals /50 strokes) in 3rd of February in season 2006/07, but two population peaks (13 and 22 individuals/50 double-net strokes) occurred in 1st weeks of February and March in the second season. *Ch. carnea* reached its peaks (21 and 15 individuals/50 strokes) in 3rd week of February of the two seasons. *P. alferii*, reached its highest abundances (6 and 9 individuals) in 1st week of March in both seasons. *M. corollae* was recorded in few numbers (3 and 5 individuals) in 3rd week of March in the two seasons, respectively (Fig. 2).

2-2-Summer plantations

2.2.1. Bean

A- *Empoasca decipiens*

Fig. (3) showed that *E. decipiens* had two peaks in each of the two seasons. In the first season, peaks (24 and 33 adults/ 50 double strokes) occurred in 1st weeks of July and August, at the means of 30.9 & 31.9 °C and 65.5 & 67.1 % R.H. Meanwhile in the second season, peaks (64 and 73 adults/50 strokes) occurred in 3rd weeks of July and August, at means of 33.0 & 33.6 °C and 66.1 & 68.7 % R.H., respectively (Fig. 3).

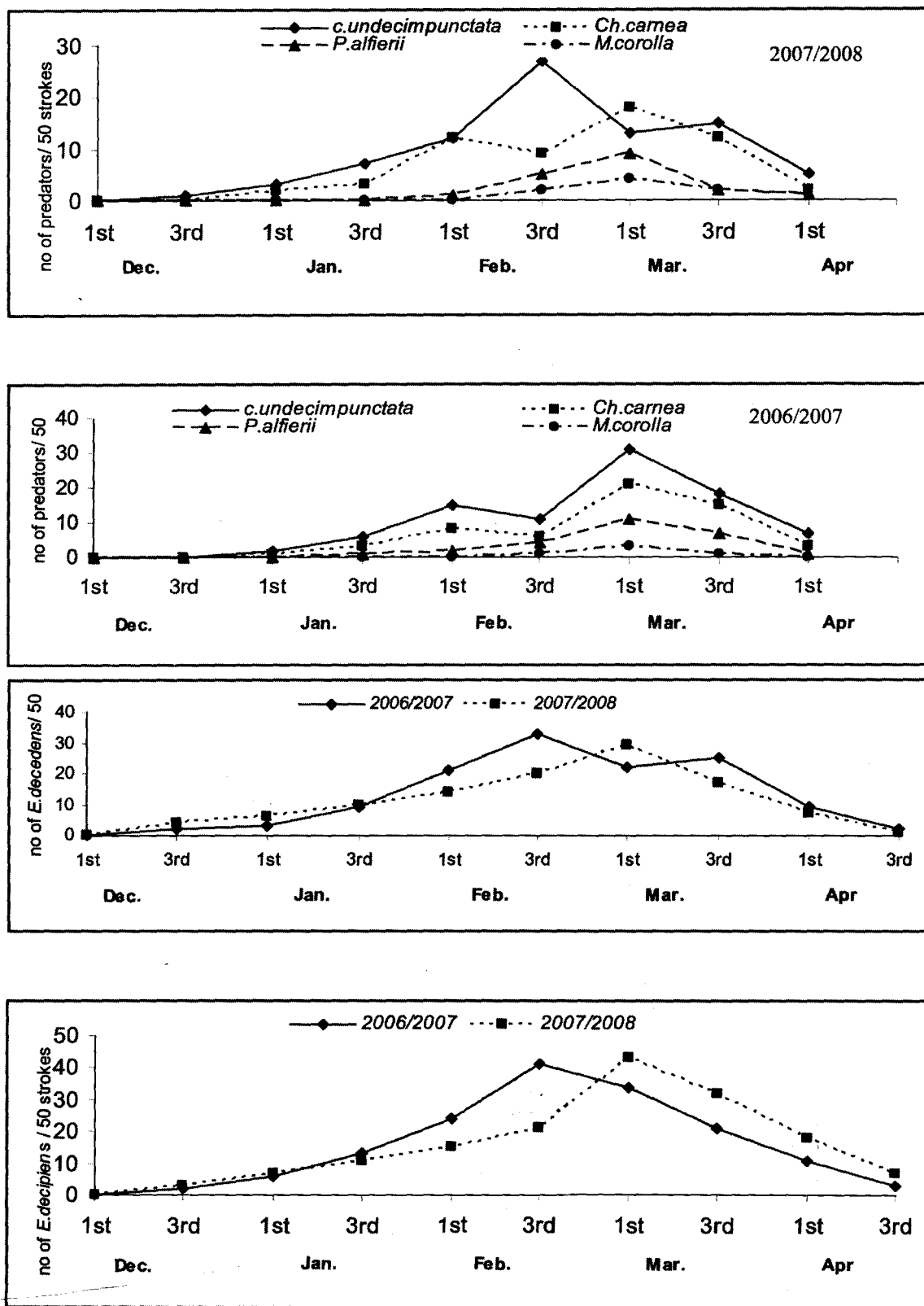


Fig (1): Seasonal abundances of the leafhoppers, *E. decipiens*, *E. decedens* and their associated predators on broad bean plants, at Diarb-Nigm, Sharkia Governorate, Egypt during 2006/07 and 2007/08 growing seasons.

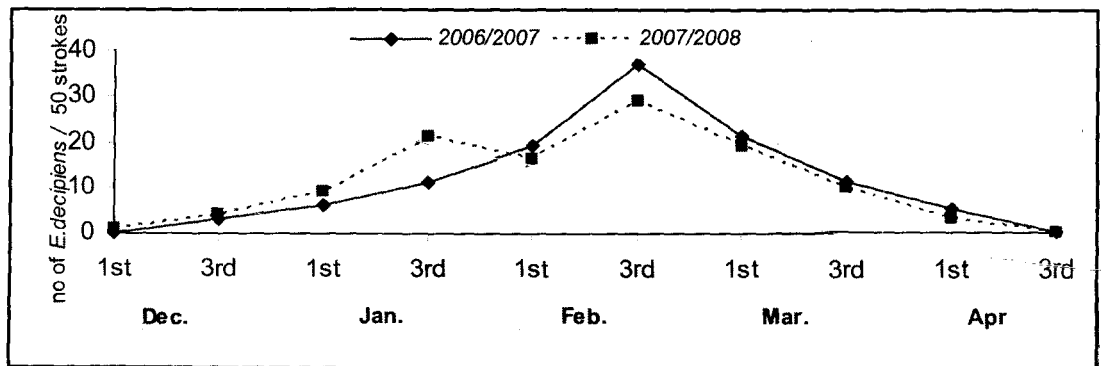
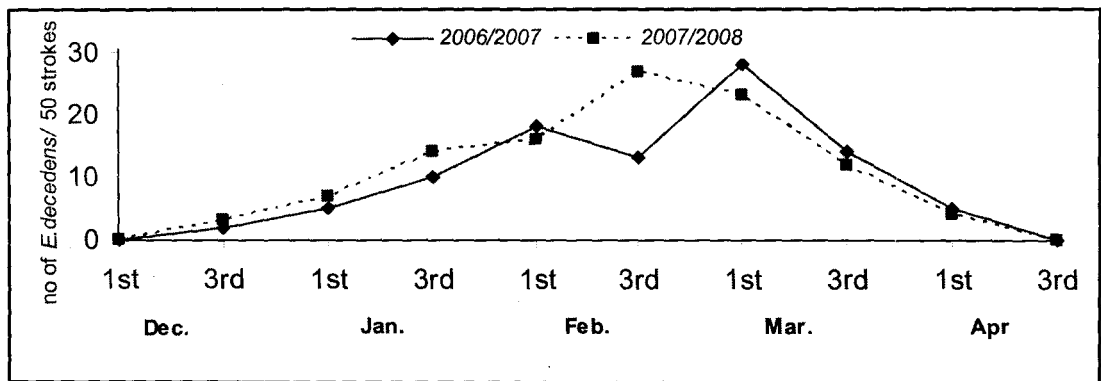
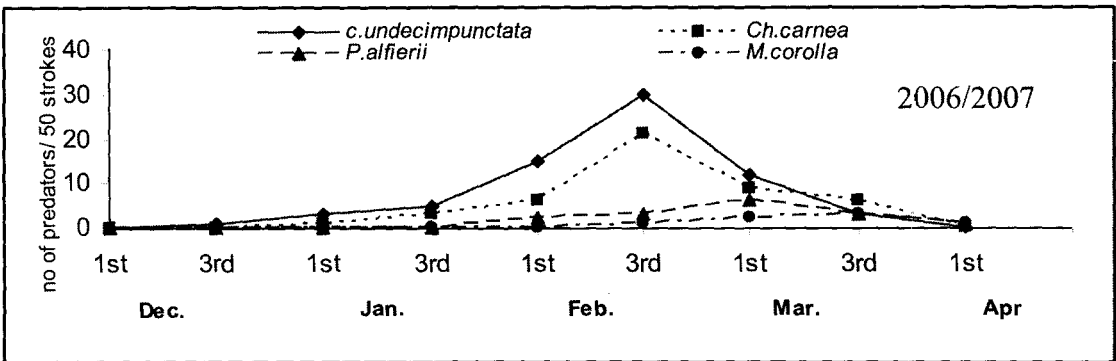
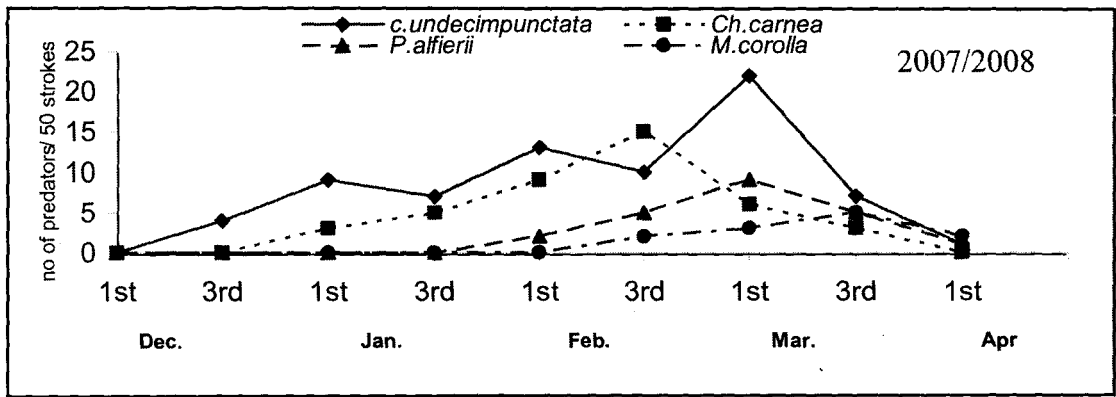


Fig (2): Seasonal abundances of the leafhopper *E. decipiens*, *E. decedens* and their associated predators on pea plants at Diarb-Nigm, Sharkia Governorate, Egypt during 2006/07 and 2007/08 growing seasons.

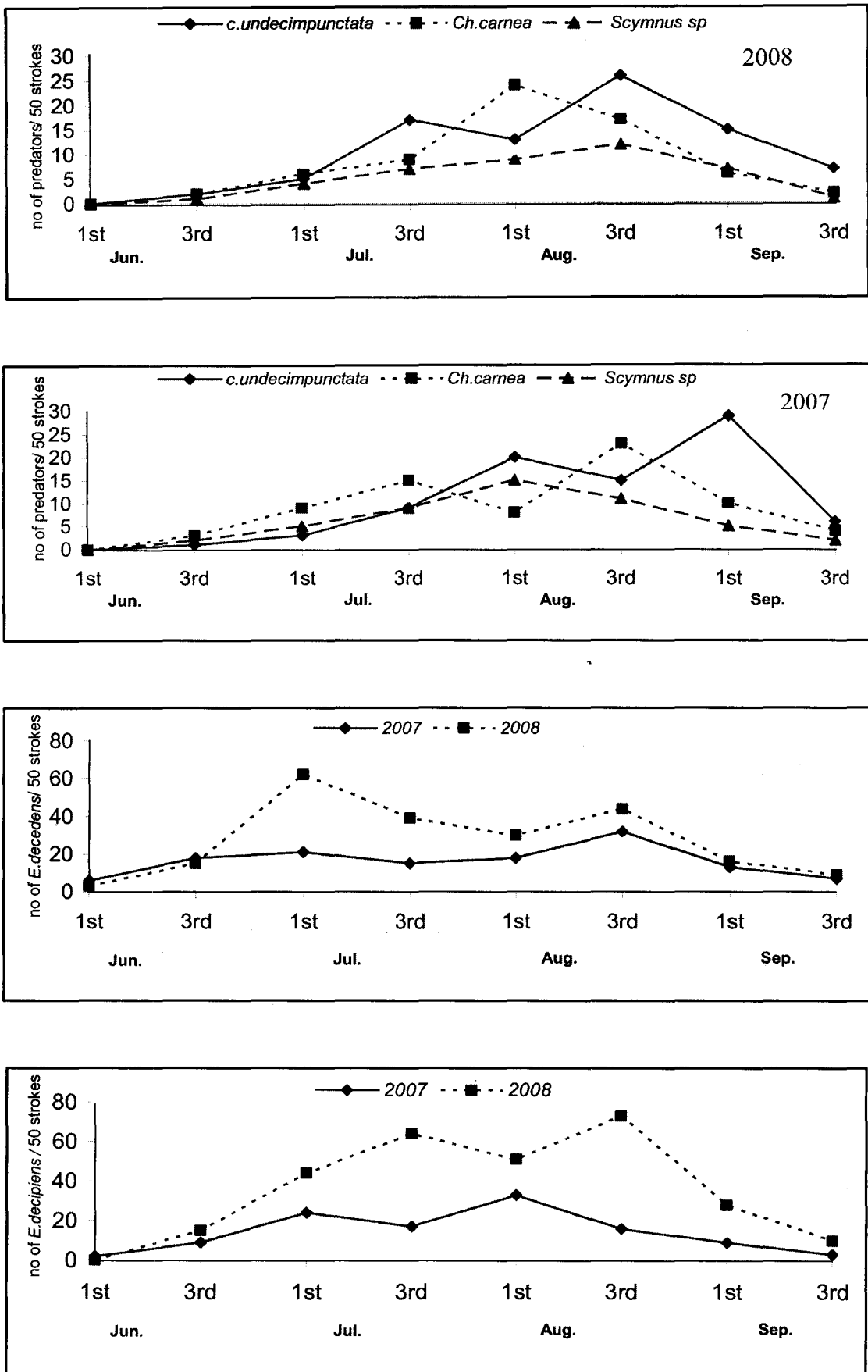


Fig. (3): Seasonal abundances of the leafhopper; *E. decipiens*, *E. decedens* and their associated predators on bean plants, at Diarb Nigm, Sharkia Governorate, Egypt during 2007 and 2008 growing seasons.

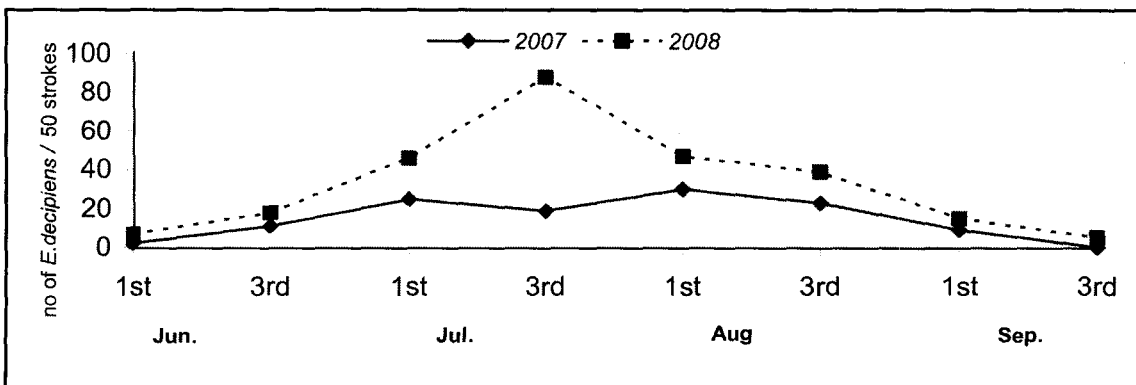
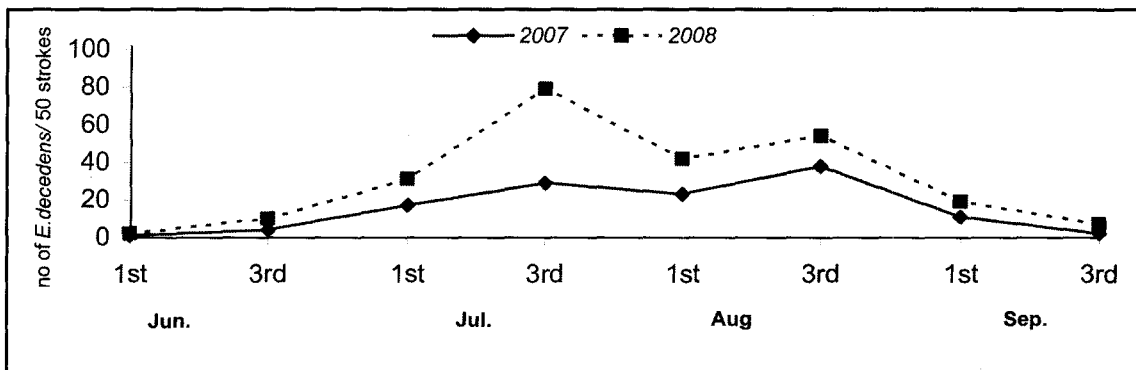
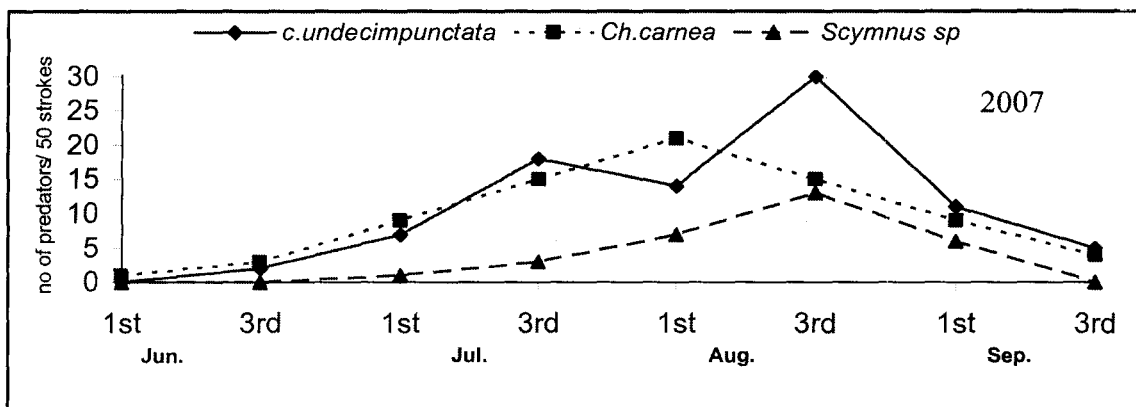
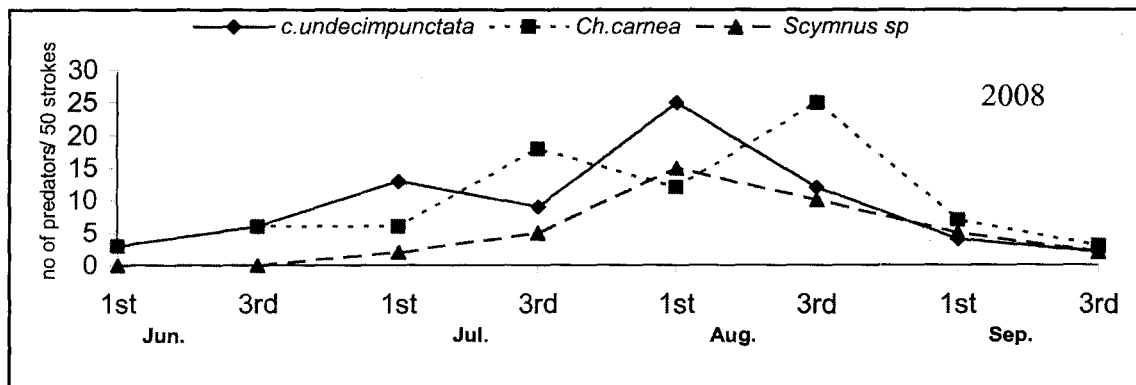


Fig. (4): Seasonal abundances of the leafhopper; *E. decipiens*, *E. decedens* and their associated predators on cowpea plants, at Diarb-Nigm, Sharkia Governorate, Egypt during 2007 and 2008 growing seasons.

Table (1): Simple correlations between temperature and relative humidity in relation to total numbers of certain leafhoppers and associated predators on broad bean and pea plants during 2006/07 and 2007/08 seasons.

Weather variable	Broad bean						Pea					
	Simple correlation Corr. (r)											
	2006/07						2006/07					
	<i>E. decipiens</i>	<i>E. decedens</i>	<i>C. undecimpunctata</i>	<i>Ch. carnea</i>	<i>P. alferii</i>	<i>M. corollae</i>	<i>E. decipiens</i>	<i>E. decedens</i>	<i>C. undecimpunctata</i>	<i>Ch. carnea</i>	<i>P. alferii</i>	<i>M. corollae</i>
Mean T.	-0.307	-0.308	-0.059	-0.222	0.127	0.083	-0.398	-0.451	-0.245	0.033	-0.037	0.188
Mean R.H.%	0.301	0.266	0.082	-0.250	-0.073	0.036	0.405	0.418	0.235	0.085	0.103	0.217
2007/08						2007/08						
Mean T	0.101	0.253	-0.270	-0.457*	0.065	-0.017	-0.686*	-0.518*	-0.052	-0.285	-0.187	-0.150
Mean R.H.%	0.056	0.334	0.197	0.331	0.061	0.173	0.438	0.412	-0.094	0.057	0.128	-0.190

Table (2): Simple correlations between temperature and relative humidity in relation to total number of certain leafhoppers and associated predators on cowpea and bean plants during 2007 and 2008 seasons.

Weather variable	Cowpea					Bean				
	Simple correlation Corr. (r)									
	2007					2007				
	<i>E. decipiens</i>	<i>E. decedens</i>	<i>C. undecimpunctata</i>	<i>Ch. carnea</i>	<i>Scymnus sp.</i>	<i>E. decipiens</i>	<i>E. decedens</i>	<i>C. undecimpunctata</i>	<i>Ch. carnea</i>	<i>Scymnus sp.</i>
Mean T	0.627*	0.646*	0.738**	0.833**	0.789*	0.585*	0.592*	0.708**	0.735**	0.766**
Mean R.H.	0.577*	0.640*	0.769**	0.820**	0.773**	0.594*	0.460	0.610*	0.771**	0.748**
2008					2008					
Mean T	0.683*	0.754*	0.645*	0.745**	0.720*	0.869**	0.735**	0.717**	0.821**	0.536*
Mean R.H.	0.854**	0.728**	0.899**	0.911**	0.759**	0.873**	0.716**	0.760**	0.834**	0.795**

Table (3): Numerical relation among weather factors (Temperature & R.H %) and total numbers of leafhoppers and associated predators on broad bean and pea during 2006/07 and 2007/08 seasons.

Weather variable	Broad bean						Pea					
	Simple Regression											
	2006/07						2006/07					
	<i>E. decipiens</i>	<i>E. decedens</i>	<i>C. undecimpunctata</i>	<i>Ch. carnea</i>	<i>P. alferii</i>	<i>M. corollae</i>	<i>E. decipiens</i>	<i>E. decedens</i>	<i>C. undecimpunctata</i>	<i>Ch. carnea</i>	<i>P. alferii</i>	<i>M. corollae</i>
	R2	R2	R2	R2	R2	R2	R2	R2	R2	R2	R2	
Mean T	0.145	0.142	0.145	0.113	0.233	0.050	0.210	0.229	0.179	0.170	0.126	
Mean R.H. %	0.119	0.104	0.120	0.111	0.193	0.073	0.182	0.188	0.136	0.192	0.101	
Multiple regression	0.762**	0.603*	0.795**	0.643**	0.815**	0.957**	0.635*	0.910**	0.825**	0.564*	0.586*	
2007/08						2007/08						
Mean T	0.097	0.130	0.106	0.209	0.158	0.164	0.499*	0.269	0.030	0.112	0.204	
Mean R.H. %	0.041	0.178	0.286	0.197	0.010	0.069	0.037	0.030	0.085	0.116	0.142	
Multiple regression	0.717**	0.720**	0.758**	0.769**	0.729**	0.638**	0.924**	0.837**	0.884**	0.602*	0.386	

Table (4): Numerical relation among weather factors (Temperature & R.H %) and total number of certain leafhoppers and associated predators on cowpea and bean during 2007 and 2008 seasons.

Weather Variable	Cowpea					bean				
	Simple Regression									
	2007					2007				
	<i>E. decipiens</i>	<i>E. decedens</i>	<i>C. undecimpunctata</i>	<i>Ch. carnea</i>	<i>Scymnus sp</i>	<i>E. decipiens</i>	<i>E. decedens</i>	<i>C. undecimpunctata</i>	<i>Ch. carnea</i>	<i>Scymnus sp</i>
R2	R2	R2	R2	R2	R2	R2	R2	R2	R2	
Mean T	0.404	0.419	0.545*	0.700**	0.702**	0.354	0.379	0.516*	0.628*	0.712**
Mean R.H. %	0.346	0.410*	0.598*	0.672*	0.633*	0.360	0.245	0.384	0.666*	0.727**
Multiple regression	0.973**	0.980**	0.977**	0.998**	0.972**	0.936**	0.974**	0.903**	0.998**	0.983**
	2008					2008				
Mean T	0.647*	0.585*	0.462	0.662*	0.619*	0.504*	0.794**	0.544*	0.658*	0.736**
Mean R.H. %	0.342	0.552*	0.840**	0.939**	0.638*	0.838**	0.526*	0.831*	0.729**	0.849**
Multiple regression	0.995**	0.994**	0.999**	0.986**	0.792**	0.990**	0.998**	0.902**	0.997**	0.908**

Table (5): Correlation coefficient between *E. decipiens*, *E. decedens* and their associated predators on broad bean, pea, cowpea and bean plantations by sweeping-net during 2006-07 and 2007-08 seasons.

Season	Plant	Insects	Simple correlation coef. (r)			
			<i>E. decipiens</i>		<i>E. decedens</i>	
			2006/07	2007/08	2006/07	2007/08
Winter planting	Broad bean	<i>C. undecimpunctata</i>	0.778**	0.732**	0.757**	0.840**
		<i>Ch. carnea</i>	0.981**	0.070	0.930**	0.807**
		<i>P. alfieri</i>	0.650*	0.949**	0.626**	0.923**
		<i>M. corollae</i>	0.798**	0.940**	0.713**	0.950**
	Pea	<i>C. undecimpunctata</i>	0.702**	0.597*	0.926**	0.716**
		<i>Ch. carnea</i>	0.364	0.560*	0.586*	0.756**
		<i>P. alfieri</i>	0.655*	0.412	0.873**	0.616**
		<i>M. corollae</i>	0.038	0.022	0.407	0.209
Summer planting	Cow pea	<i>C. undecimpunctata</i>	0.517*	0.481	0.875**	0.727**
		<i>Ch. carnea</i>	0.821**	0.556*	0.837**	0.754**
		<i>Scymnus sp.</i>	0.598*	0.550*	0.884**	0.658**
	Bean	<i>C. undecimpunctata</i>	0.500*	0.901**	0.544*	0.559*
		<i>Ch. carnea</i>	0.383	0.891**	0.700**	0.577*
		<i>Scymnus sp.</i>	0.538*	0.766**	0.739**	0.389

B- *Empoasca decedens*

Population density of *E. decedens* showed two peaks in the two seasons. In the first season, the peaks (21 and 32 adults/ 50 strokes), at the means of 30.9 & 31.8 °C and 65.5 & 66.8% R.H. and (62 and 44 adults/ 50 double-net strokes), at the means of 32.8 & 33.6 °C and 66.1 & 68.7, % R.H, occurred in 1st week of July and 3rd week of August, in the two seasons, respectively (Fig. 3). These results agree with the findings of El-Gindy (2002) and Abdel-Samed (2005) who mentioned that *E. decipiens* and *E. decedens* had two peaks on leguminous plants in summer plantations.

C- Associated predators

The predators *C. undecimpunctata*, *Ch. carnea* and *Scymnus sp.* were recorded on bean plants during the two seasons of study.

Two population peaks (20 and 29 individuals/50 double-net strokes) of *C. undecimpunctata* were recorded in the first season in 1st weeks of August and September. In the second season, also two peaks (17 and 26 individuals/ 50 strokes) were recorded in 3rd weeks of July and August. *Ch. Carnea* showed also, two population peaks (15 and 23 individuals/50 double strokes) during the first season (3rd weeks of July and August). In season 2008, the peaks (24 and 15 individuals/ 50 double-net strokes) were recorded in 1st week of August. *Scymnus sp.* reached its peak (15 and 12 individuals/ 50 strokes) in 1st and 3rd weeks of August 2007 and 2008, respectively.

2.2.2. Cowpea

A- *Empoasca decipiens*

As shown in Fig. (4), *E. decipiens* had two peaks (25 and 30 adult/ 50 double strokes) in 1st

weeks of July and August, 2007 and one peak (88 adults/ 50 strokes) in the second season occurred in 3rd week of July, at the means of 33.0 °C and 66.1 % R.H, respectively (Fig. 4).

B- *Empoasca decedens*

Population density of *E. decedens* showed two peaks in each season. In the first season, the peaks (29 and 38 adults/ 50 double strokes) occurred in 3rd weeks of July and August. In the second season, the peaks (79 and 54 adults/ 50 double strokes) were recorded in 3rd weeks of July and August (Fig. 4). These results agree with the findings of Ammar and Farrag (1976), Metwally (1989), El-Gindy (2002) and Abdel-Samed (2005) who mentioned that *E. decipiens* has two peaks on leguminous and solanaceous plants in summer plantations.

C- Associated predators

C. undecimpunctata, *Ch. carnea* and *Scymnus* sp. were recorded on cowpea plants during the two seasons of study. *C. undecimpunctata* showed two population peaks (18 and 30 individuals/ 50 strokes) (3rd weeks of July and August, 2007) and one peak (25 individuals/ 50 double strokes) in 1st week of August, in season 2008. *Ch. carnea* reached its peak (21 individuals/ 50 double strokes) in 1st week of August, in the first season. Two population peaks (18 and 25 individuals/ 50 strokes) in 3rd weeks of July and August were recorded during season 2008. *Scymnus* sp. reached its peaks (13 and 15 individuals/ 50 double strokes) in 3rd week of August of both seasons.

3- Effect of temperature and relative humidity on the population densities of certain leafhoppers and their associated predator insects

3.1. Winter Plantations

Broad bean

Data presented in Table (1) indicated that the leafhoppers, *E. decipiens*, *E. decedens* and their associated predators showed insignificant relationships with weather conditions during the first season 2006/07. While in the second season, *E. decipiens*, *E. decedens* and *C. undecimpunctata* cleared significant positive correlations with maximum R.H. %. *Ch. carnea* showed a significant negative correlation with the minimum and mean temperatures, while it showed a significant positive correlation with the maximum temperature and maximum R.H. %. Also, *P. alferii* and *M. corollae* cleared a significant positive correlation with maximum temperature in the second season 2007/08.

Pea

Data summarized in Table (1), referred that *E. decipiens* population abundance correlated

positively and significantly with temperature in 2007/08, while *E. decedens* showed a significantly positive correlation with maximum R.H. %. Also, *Ch. carnea* and *P. alferii* showed significant positive correlations with maximum R.H. %. Simple regression analysis showed insignificant relationships among *E. decipiens*, *E. decedens* and their predators and weather factors during the first season 2006/07. In 2007/08, the minimum, mean temperatures and maximum R.H. % showed significant effects on the population densities of *E. decipiens* and *E. decedens*. Also, maximum R.H. % showed a significant relationship with the numbers of *C. undecimpunctata*, *Ch. carnea* and *P. alferii*.

3.2. Summer Plantations

Cowpea and bean plants

As shown in Table (2), *E. decipiens*, *E. decedens* and their associated predators showed significant and highly positive correlations with the weather conditions during the two seasons. Data in Table (4), the minimum and maximum temperatures significantly affected the population densities of *E. decipiens* in the first season; also mean temperature showed a significant effect on the same insect in the second season. Minimum and mean temperatures and R.H. % showed significant effects on the number of *E. decedens*, in the second season. Minimum and mean temperatures and R.H.%, significantly affected the population densities of *C. undecimpunctata*, *Ch. carnea* and *Scymnus* sp. on cowpea in both seasons. Multiple regression analysis showed highly significant values in the two seasons between *E. decipiens*, *E. decedens* in relation to their predators on cowpea and bean (Table, 4). In Table (5), data indicated highly significant positive correlations among *E. decipiens* and *E. decedens* in relation to *C. undecimpunctata*, *P. alferii* and *M. corollae* in the two seasons, while *Ch. carnea* had a highly positive correlation with the population density of *E. decipiens* in the first season and *E. decedens* in both seasons on broad bean plants.

—On pea plants, *C. undecimpunctata* had a highly significant positive correlation with the numbers of *E. decipiens* and *E. decedens* during the two seasons. *Ch. carnea* had a highly significant positive effects on the population density of *E. decipiens* in the second season and *E. decedens* in both seasons. *P. alferii* had a highly significant positive correlation on *E. decedens* in the second season. On cowpea, a highly significant positive correlation value was found between *E. decedens* and its associated predators during the two seasons.

Also, all the predators had significantly affected the number of *E. decipiens* during 2007 season. On

bean plants, *C. undecimpunctata* and *Scymnus* sp. had a highly significant positive correlation with the number of *E. decipiens* in the second season. Also, *C. undecimpunctata* and *Ch. carnea* had a significantly positive effect on the population density of *E. decedens* in both seasons.

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