ECOLOGICAL STUDIES ON SOME PIERCING-SUCKING INSECTS INFESTING COWPEA AT EL-SHARKIA GOVERNORATE, EGYPT

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Abstract

The present work was conducted during 2012 and 2013 seasons to survey the Hemipterous insects, aphids, leafhoppers and whiteflies infesting cowpea crop at Abo-Hammad district, El-Sharkia governorate, Egypt. The seasonal abundance of the aforementioned dominant species and the effects of maximum & minimum temperatures and relative humidity on the pest population were also studied. Plant samples collecting proved to be the most efficient method for collecting aphids and whiteflies, while the sweeping net is more efficient for collecting leafhoppers. *A. craccivora*, *A. gossypii*, *E. decipiens*, *E. decedens*, *C. chinai* and *B. tabaci* were surveyed. *A. craccivora* recorded one peak at the 4th week of July in the two study seasons. *A. gossypii* recorded one peak at the 2nd week of August in 2012 season. In the second season, 2013, two peaks were recorded in the 4th week of July and the 2nd week of August, respectively. *E. decipiens* recorded two peaks, the first one was recorded at the 3rd and 4th week of July for 2012 and 2013 seasons, respectively, while the second one occurred at the 3rd week of August for the two seasons, respectively. *E. decedens* recorded two peaks at the 4th week of July and August for the two seasons, respectively. Two peaks for immature *B. tabaci* were recorded. The first peak was obtained at the end of July for the two seasons of the study. The second one was noticed at the 3rd week of August for the two seasons. Adults of *B. tabaci* recorded the first peak at the 3rd week of July for 2012 and 2013 seasons. Their second peak occurred in the 2nd week of August for the two seasons. The results clearly indicated the presence of significant and insignificant correlation coefficient and partial regression between numbers of different insect species and maximum & minimum temperature and relative humidity during the two successive seasons.

Keywords: *Ecological Studies, Aphids, Leafhoppers, Whitefly, Cowpea*

INTRODUCTION

Cowpea crop constitute the cheapest source of dietary protein and energy. Large number of insect pests attacks cowpea plants throughout the growing season. Insects are a major factor in the low yield figures of African cowpea crop, and they affect each tissue component and developmental stage of the plant. In severe infestations insect pressure is responsible for over 90% loss in yield (Jackal and Daoust, 1986, Hashem, 2005 and Patel *et al.*, 2010). The most economic important

Hemipterous pests are aphids, leafhoppers and whitefly which cause serious damage either directly or indirectly. They feed by piercing plant tissue and penetrating the phloem with needlelike mouthparts. Infested plants become yellowish, stunted, and nonproductive because of direct feeding and the insects' toxic salivary secretions. Also, these insects are efficient vectors of several important virus diseases. The large quantities of honeydew disrupt photosynthesis, which further reduce the yield, Abd–Elsamed, (2006), Patel *et al*., (2012) and Cruz *et al*., (2014).

The present work aimed to survey and investigate the seasonal abundance of the most important common Hemipterous insect pests, aphids, leafhoppers and whitefly at Abo-Hammad district, Sharkia Governorate and study the effect of some climatic factors on the population density of these pests and the efficiency of the different sampling techniques.

MATERIALS AND METHODS

Ecological studies on the common Hemipterous, aphids, leafhoppers and whiteflies were conducted at Abo-Hammad district, Sharkia Governorate. The area of experiments (510 m^2) planted with cowpea during the two successive seasons, 2012 and 2013.

I- Survey and seasonal abundance of aphid, leafhopper and whitefly on cowpea plants

In the experimental fields, the cowpea was sowed in mid of May for the summer plantation of 2012 and 2013 seasons. The sampling procedures started in the mid of June (21 day cowpea plants) and continued till the end of September at weekly intervals. In order to survey the piercing-sucking insects, aphids, leafhoppers and whitefly on cowpea plants, the sweeping nets, plant samples and yellow sticky board trap were used:

1) The yellow sticky board trap

The yellow sticky board traps were used to survey aphids (Hemiptera: Aphididae), leafhoppers (Hemiptera: Cicadellidae) and whitefly (Hemiptera: Aleyrodidae). The trap of 20 × 20 cm yellow paper boards coated with sticky material and hung on wooden rods varied according to the height of cowpea plants through the period of sampling. The trap level was always kept over plant surface with 20 - 30 cm. Three yellow sticky board traps were used in this investigation. Specimens of aphids, leafhoppers and whiteflies were sorted, identified and recorded according to the work of Neilson, (1968), Herakly, (1970) and Hashem, (2005). The counts of captured individuals (aphid, leafhopper and whitefly) were recorded for each trap.

2) Plant sample

Plant sample method was used to survey the aphid and whitefly infesting cowpea plants. Concerning the survey of aphids, weekly samples of 25 leaves from the three levels of the plants (lower, middle and upper levels) were taken randomly; the infested leaves were kept in paper bags and investigated in the laboratory. A simple apparatus was used for this purpose, which was consisted of a wooden desk, a white card board paper divided into 4 cm. a part column put in the bottom on which a glass plate was placed and the upper surface of the glass plate was allowed to be wet with fine droplets of water to reduce the movement of counted aphids, (Hegab *et al.*, 1987). The plant leaves were carefully shaken on the plate and the aphids were counted using a small brush in each column. With regard to whitefly, the total number of adults was directly counted on the plant samples in the early morning. In the laboratory by using the stereoscopic-microscope, the immature stages (nymphs and pupae) on both leaf surfaces were examined, counted and recorded.

3) The sweeping net

The sweeping net was used to survey the leafhoppers infesting cowpea plants. The sweeping net dimensions are 35 cm diameter and 60 cm deep. Each sample consisted of 100 double strokes were taken at random. The specimens collected by the sweeping nets were recorded per each sample.

II- Effect of certain climatic factors (maximum temperature, minimum temperature and relative humidity) on the population density of the dominant piercing-sucking insects infesting cowpea plants

The daily records of both maximum and minimum temperature degrees along with relative humidity during 2012 and 2013 seasons were obtained from the Agrometeorological station at Zagazig city.

The relationship between the weekly mean numbers of collected Hemipterous insects and the corresponding weekly means of maximum, minimum temperatures and relative humidity were estimated. Partial regression was applied to show the effect of each factor on the population density of aphid, leafhopper and whitefly. The results obtained were statistically analyzed; correlation coefficient explained variances and partial regression values were estimated according to Svab, (1973).

RESULTS AND DISCUSSION

1-Survey of aphid, leafhopper and whitefly on cowpea plants

Survey of aphid, leafhopper and whitefly on cowpea plants was studied at Abo-Hammad district, Sharkia Governorate. The data of this study during two successive seasons 2012 and 2013 could be displayed as follow:

i) Aphids (Hemiptera: Aphididae)

The cowpea aphid, *Aphis craccivora* Koch and the cotton aphid, *A. gossypii* (Glov.) were collected by two methods. Data in Table, (1) revealed that the plant samples proved to be the most efficient method for collecting aphid species than yellow sticky board trap. The most extensive infestations by *A. craccivora* (7627 and 6709 individuals) were recorded on cowpea plants during the experimental seasons of 2012 and 2013, respectivily. Also, the total numbers recorded of *A. gossypii* were 2431 and 2168 individuals through 2012 and 2013 seasons, respectivily. The present results agreed with those obtained El-Gindy, (2002), Abd-Elsamed, (2006), Ali *et al.*, (2013) and El-Khayat *et al.*, (2014) who found that the aphids *A. craccivora* and *A. gossypii* infesting cowpea plants.

ii) Leafhoppers (Hemiptera: Cicadellidae)

The data presented in Table, (1) showed the total numbers of three leafhoppers species collected by two different methods, i.e. sweeping net and yellow sticky board trap. These leafhopper species were:

(1) The green leafhopper, *Empoasca decipiens* (Paoli)

(2) The green leafhopper, *E. decedens* .

(3) *Cicadulina chinai* (Ghauri)

The results revealed that sweeping net proved to be more efficient for collecting leafhoppers than sticky board trap during the two successive seasons. The methods of collections appeared the most extensive infestation by *E. decipiens* and *E. decedens* on cowpea during the two successive seasons, respectively, compared by *C. chinai*.

The present results agree with those obtained by El- Gindy, (2002) and Abd-Elsamed, (2006) who surveyed the aforementioned hemipterous insects on leguminous plants.

iii) Whitefly (Hemiptera: Aleyrodidae)

Data presented in Table, (1) showed the total numbers of whitefly, *B. tabaci* collected by two different methods, plant sample and yellow sticky board trap in the investigated areas. Data in Table, (1) revealed that the plant sample was more convenient to whitefly than the other method during the two successive seasons. It

was clear that the higher infestation by the whitefly, *B. tabaci* was recorded on cowpea during the first season, 2012. The present result agreed with those obtained Abd-Elsamed, (2006) and El-khayat *et al*., (2014).

Table 1. Total numbers of aphid, leafhopper and whitefly infesting cowpea plants at Abo-Hammad, Sharkia Governorate collected by using plant sample and yellow sticky board trap and Sweeping net during 2012 and 2013 seasons

Insects	P. S.		Y. S. B. T		S. N.	
	2012	2013	2012	2013	2012	2013
Aphis craccivora	7627	6709	899	764	-	-
A. gossypii	2431	2168	408	394	-	-
Empoasca decipiens	-	-	161	131	901	805
E. decedens	-	-	74	81	497	521
Cicadulina chinai	-	-	42	35	160	120
Bemisia tabaci (adult)	1415	1244	440	398	-	-
B. tabaci (immature)	2898	2065	-	-	-	-

P.S. = Plant sample Y.S.B.T. = yellow sticky board trap S.N. = Sweeping net

2. Seasonal abundance of aphid, leafhopper and whitefly infesting cowpea plants

1) Aphid

i) The cowpea aphid, *Aphis craccivora* Koch

The numbers of aphid fluctuated on cowpea plants with general increase showing one peak Fig., (1). The peak occurred at the end of July with a mean numbers 865 and 663 individuals/sample in 2012 and 2013 seasons, respectively at mean temperature of 28.45˚C with 57.25 % R.H. and 28.50˚C with 50.35 % R.H. for the two seasons, respectively.

Regarding the weekly counts of aphid on cowpea plants, its clear that this species was more abundant during 2012 than 2013 (Fig., 1). Similar results were found by Hashem, (1997), El-Gindy, (2002), Ali *et al.,* (2013) and El-Khayat *et al*., (2014).

ii)The cotton aphid, *Aphis gossypii* (Glover)

Fig., (1) showed that this aphid species has one peak recorded

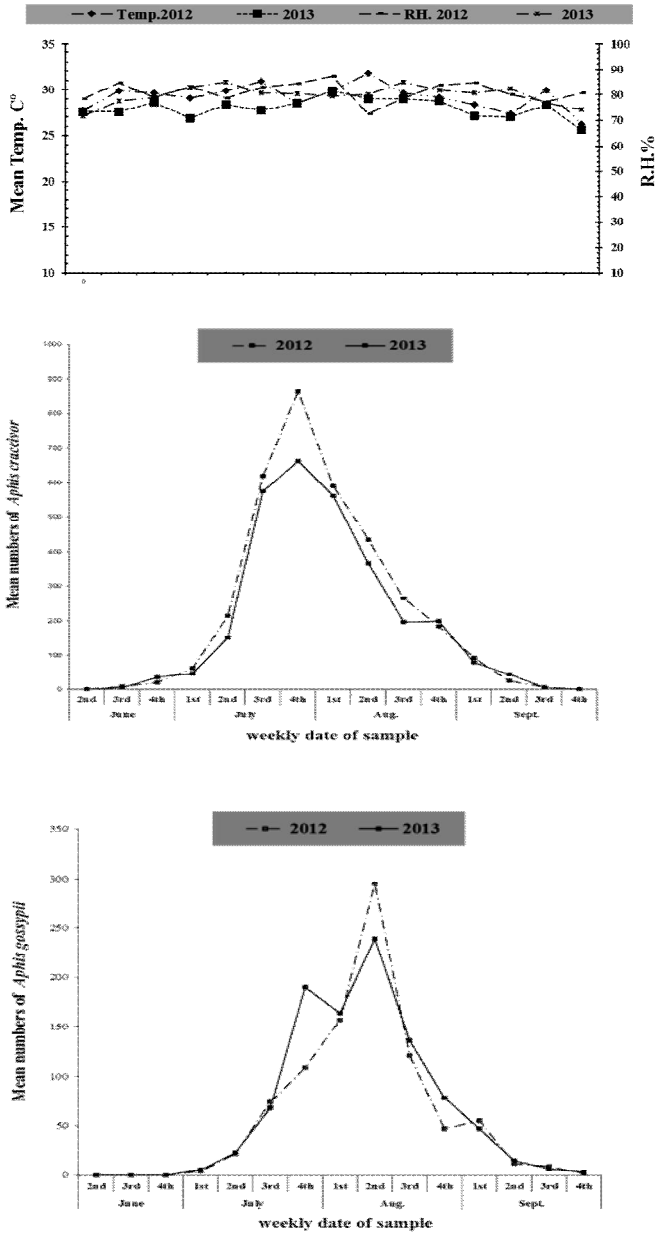

Fig. 1. Population density of *Aphis craccivora* and *A. gossypii* infesting cowpea plants collected by using plant sample at Abo - Hammad, Sharkia Governorate during 2012 and 2013 seasons

in the 2nd week of August with a mean numbers of 295 individuals/sample at mean temperature of 31.79°C with 44.79% R.H. for 2012 season. In the second season, 2013, two peaks were recorded in the 4th week of July and the 2nd week of August of 190 and 239 individuals/sample at mean temperature 28.50°C with 50.35% and 29.00°C with 50.36% R.H., respectively. The population of *A. gossypii* was slightly higher in the first season (approximately 1.12 folds) than in the second season

(Table, 1). The population of *A. craccivora* was greater than *A. gossypii* (approximately 3.1 folds) in the both seasons (Table, 1).

2) leafhopper

Regarding the population abundance of leafhopper species on the cowpea plants during, the two study seasons, the numbers of *Cicadulina chinai* were very few. The study of seasonal abundance was conducted on *Empoasca decipiens* and *E. decedens* only.

i) The green leafhopper, *Empoasca decipiens* (Paoli)

According to the abundance of *E. decipiens* individuals on cowpea plants, two peaks were recorded (Fig., 2). The first peak was recorded at the 3rd and 4th week of July with a mean numbers of 61 and 51 individuals/sample were recorded at mean temperature of 30.93 and 28.50°C with 52.00 and 50.35% R.H. for 2012 and 2013 seasons, respectively. The second one occurred at the 3rd week of August with a mean number of 55 and 47 individuals/sample at mean temperature of 29.64, 29.00°C with 50.71, 56.08% R.H. for the two seasons of the study, respectively. Regarding the weekly counts of *E. decipiens*, on cowpea plants, it is clear that this species was more abundant during 2012 than 2013 (Table, 1).

ii) The green leafhopper, *Empoasca decedens* (Paoli)

Data in Fig., (2) showed that two peaks of *E. decedens* were detected during 2012 and 2013 seasons. The first peak occurred at the end of July with a mean number of 27 and 26 individuals /sample at mean temperature of 28.45 and 28.50°C with 57.25 and 50.35% R.H. for the two seasons, respectively. The second one was presented at the end of August with mean numbers of 29 and 28 individuals/sample at mean temperature of 29.15 and 28.80 °C with 53.40 and 54.00% R.H. for the two seasons, respectively. Regarding the weekly counts of *E. decedens*, on cowpea plants, it is clear that this species was more abundant during 2013 than 2012 (Table, 1). Similar results were found by Hashem, (1997), El-Gindy, (2002). The results indicated that *E. decipiens* had two peaks, (at the 3rd , 4th week of July and at the 3rd week of August), while *E. decedens* had two peaks, (at the end of July and at the end of August) on cowpea plants during 2012 and 2013 seasons, respectively.

These results agreed with the findings of El-Gindy, (2002), Hashem, (2005) and Abd-Elsamed, (2006), who mentioned that *E. decipiens* had two peaks on leguminous and solanaceous plants in summer plantation.

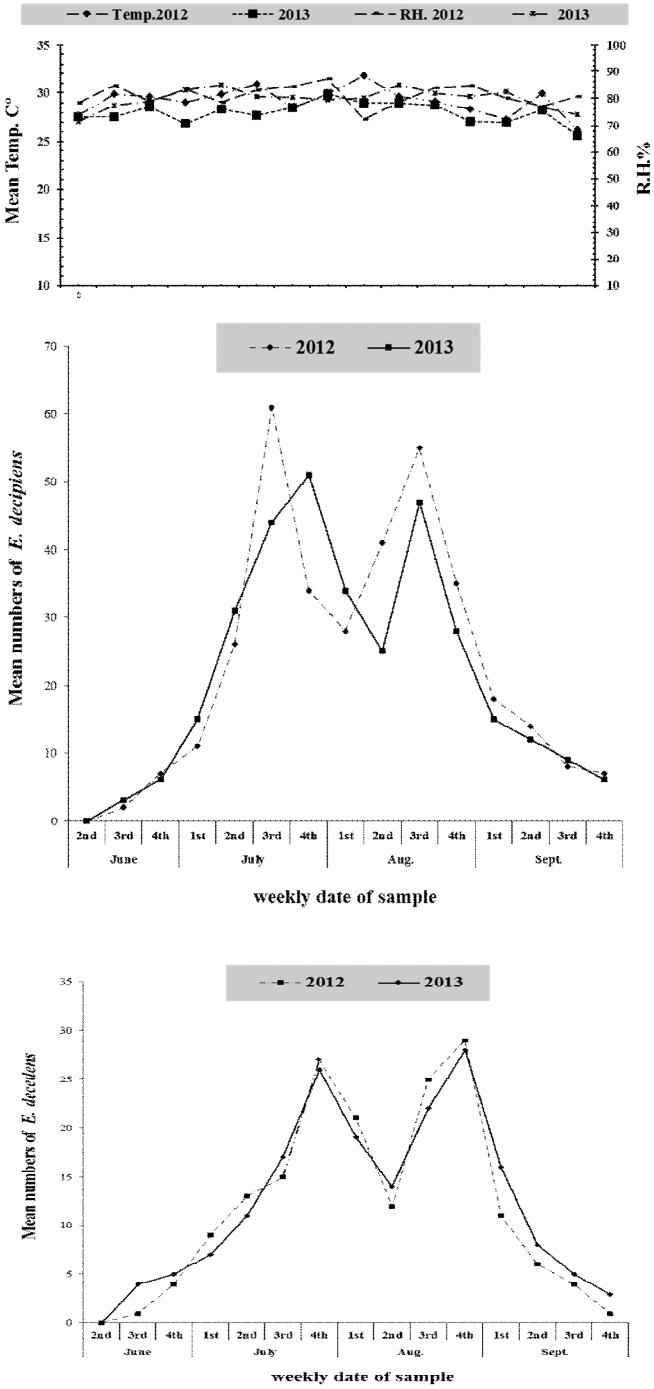

Fig. 2. Population density of leafhopper, *Empoasca decipiens* and *E. decedens* infesting cowpea plants collected by using sweeping net at Abo - Hammad, Sharkia Governorate during 2012 and 2013 seasons

3) The whitefly, *Bemisia tabaci* (Genn.)

i) Immature stage

Regarding the abundance of *B. tabaci* immature stages in 2012 and 2013 seasons Fig., (3) showed that two peaks of population density on cowpea plants were occurred. The first peak was obtained at the end of July with a mean numbers of 133 and 210 individuals/sample in 2012 and 2013 seasons, respectively at mean temperature of 28.45˚C with 57.25% R.H. and 28.50˚C with 50.35% R.H. for the two seasons, respectively. The second one was noticed at the 3rd week of August with a mean numbers of 157 and 199 individuals/sample at mean temperature of 29.64˚C with 50.71% R.H. and 29.00˚C with 56.08 % R.H. for the two seasons, respectively. Generally the numbers of immature individuals were little higher in the second peak, 1.6 and 1.3 folds than in the first one in both seasons, respectively.

ii) Adult stage

Fig., (3) indicated that mean numbers of adults/sample increased until reached its peak at the 3rd week of July with a mean number of 58 and 46 individuals/sample at mean temperature of 30.93˚C with 52.00% R.H. and 27.71˚C with 54.57% R.H. for 2012 and 2013 seasons, respectively. The second peak of the population density occurred in the 2nd week of August with a mean number of 68 and 54 individuals/sample at mean temperature of 31.79˚C with 44.79% R.H. and 29.00˚C with 50.36% R.H. for the two seasons, respectively. Regarding the weekly counts, it is clear that this species was more abundant during 2012 than 2013 (Table, 1).

3. Effect of certain climatic factors, (maximum temperature, minimum temperature and mean relative humidity) on the population density of the dominant piercing-sucking insects infesting cowpea plants

1) Aphid

i) The cowpea aphid, *Aphis craccivora* Koch

In Table, (2) the mean numbers of *A. craccivora* population was positive and insignificant correlation with maximum temperature, r_1 = 0.3158 and 0.3696 in 2012 and 2013 seasons, respectively. The relationship between the numbers of *A. craccivora* population and minimum temperature was positive and significant (r_2 =0.5912*) in 2012 but it was positive and insignificant (r_2 = 0.3695) in 2013 season. There was positive and insignificant correlation coefficient between the population density of *A. craccivora* and relative humidity, r_3 = 0.3120 and 0.4003 in 2012 and 2013 seasons, respectively. The partial regression between *A. craccivora* population and maximum temperature was positive and insignificant (b_1 = 0.0018 and 0.0016 in 2012 and 2013 seasons, respectively). Also, the partial regression between the numbers of *A. craccivora* population and minimum temperature was positive but it

was insignificant (b_2 = 0.0026 and 0.0011 in 2012 and 2013 seasons, respectively). There was positive and insignificant partial regression between the numbers of *A. craccivora* population and relative humidity (b_3 = 0.0045 and 0.0610 in 2012 and 2013 seasons, respectively).

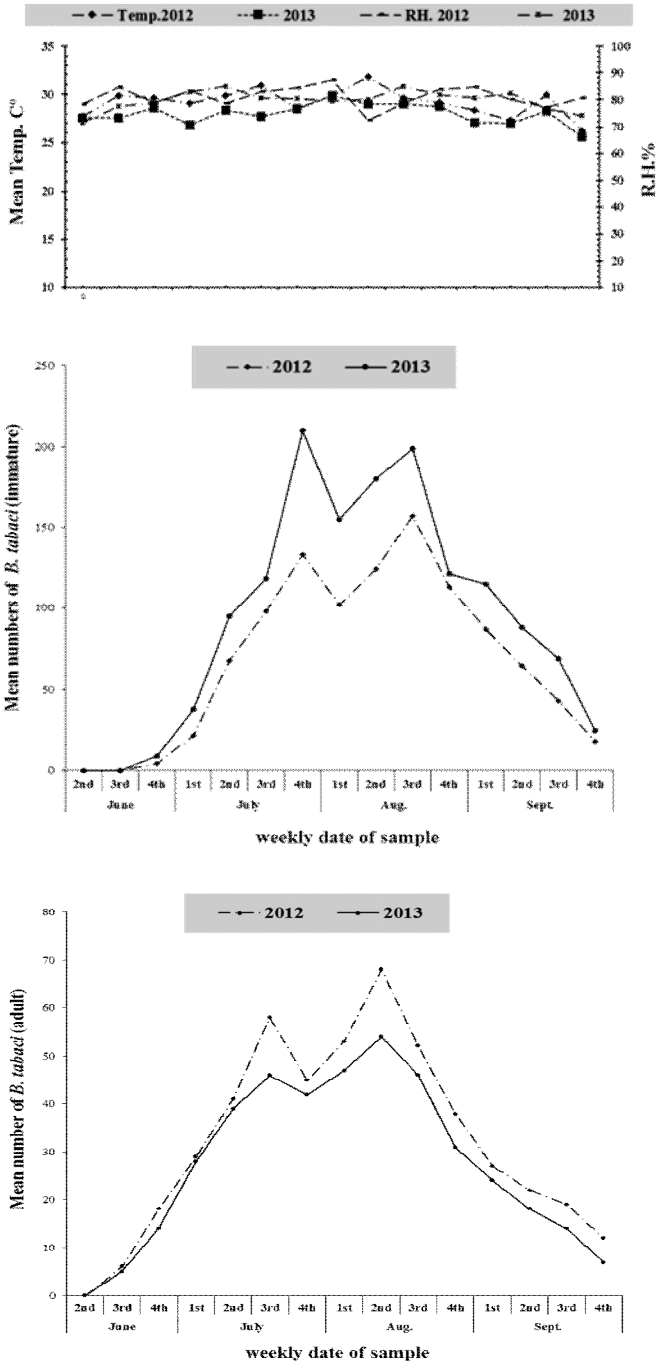

Fig. 3. Population density of the whitefly, *Beimsia tabaci* (immature and adult) infesting cowpea plants collected by using plant sample at Abo - Hammad, Sharkia Governorate during 2012 and 2013 seasons

Table 2. Partial regression and simple correlation coefficient between maximum & minimum temperature and relative humidity and total numbers of Hemipterous insects infesting cowpea plants at Abo-Hammad, El-Sharkia governorate during 2012 and 2013 seasons.

Insects	Simple correlation						Partial regression					
	2012			2013			2012			2013		
	r_1	r_2	r_3	r_1	r_2	r_3	b_1	b_2	b_3	b_1	b_2	b_3
Aphis craccivora	0.3158	0.5912*	0.3120	0.3696	0.3695	0.4003	0.0018	0.0026	0.0045	0.0016	0.0011	0.0610
A. gossypii	0.3914	0.7728***	0.3347	0.5163*	0.5712*	0.0217	19.0039*	44.4862**	-8.3570	28.2784	45.6184	0.5407
Empoasca decipiens	0.3691	0.7366**	-0.1285	0.3868	0.5603*	0.9794	4.135	9.758**	-0.7408	4.4629	9.4261	2.6087
E. decedens	0.0653	0.6024*	0.2311	0.4590	0.5688*	0.4299	0.3764	4.1136**	0.6843	2.7635	4.9925	1.1766
Bemisia tabaci (immature)	0.3031	0.8077**	0.2947	0.3042	0.558*	0.4801	0.0119	0.0241	0.0288	0.0059	0.0078	0.0318
B. tabaci (adult)	0.3067	0.8029**	0.2996	0.3095	0.5664*	0.3138	0.0276	0.0551	0.0672	0.0250	0.3270	0.0861

r_1, b_1 = correlation coefficients and partial regression between maximum temperature and number of insects

r_2, b_2 = correlation coefficients and partial regression between minimum temperature and number of insects

r_3, b_3 = correlation coefficients and partial regression between relative humidity and number of insects

ii) The cotton aphid, *Aphis gossypii* (Glov.)

The mean numbers of *A. gossypii* population was positive and insignificant correlation with maximum temperature (r_1 = 0.3914) in 2012 season, while it was positive and significant (r_1 = 0.5163*) in 2013 season. The relationship between the mean numbers of *A. gossypii* and minimum temperature was positive and highly significant in 2012 season (r_2 = 0.7728***) and it was positive and significant (r_2 = 0.5712*) in 2013 season. There was positive and insignificant correlation coefficient between the population density of *A. gossypii* and relative humidity (r_3 = 0.3347 and 0.0217) in 2012 and 2013 seasons, respectively. The partial regression between *A. gossypii* population and maximum temperature was positive and significant (b_1 = 19.0039*) in 2012 but positive and insignificant (b_1 = 28.2784) in 2013 season. The partial regression between the mean numbers of *A. gossypii* and minimum temperature was positive and highly significant (b_2 = 44.4862**) in 2012 season, but positive and insignificant (b_2 = 45.6184) in 2013 season. There was negative and insignificant partial regression between the mean numbers of *A. gossypii* and relative humidity (b_3 = -8.3570) in 2012 season, while it was positive and insignificant (b3 = 0.5407) in 2013 season.

2) Leafhopper

i) The green leafhopper, *Empoasca decipiens* (Paoli)

The correlation coefficient between *E. decipiens* population and maximum temperature was positive and insignificant (r_1 = 0.3691and 0.3868) in 2012 and 2013 seasons, respectively. Concerning the relationship between *E. decipiens* population and minimum temperature, there was positive and high significant correlation (r_2 = 0.7366**) in 2012 season, but it was positive and significant (r_2 = 0.5603*) in 2013 season. The correlation coefficient between the population of *E. decipiens* and relative humidity was negative and insignificant (r_3 = -0.1285) in 2012 but it was positive and insignificant (r_3 = 0.9794) in 2013 season. The partial regression between the population of *E. decipiens* and maximum temperature was positive and insignificant (b_1 = 4.135 and 4.4629) in 2012 and 2013 seasons, respectively. There was positive and highly significant partial regression between *E. decipiens* population and minimum temperature (b_2 = 9.758**) in 2012 season, while it was positive and insignificant (b_2 = 9.4261) in 2013 season. The partial regression between *E. decipiens* population and relative humidity was negative and insignificant (b_3 = - 0.7408) in 2012 season, but it was positive and insignificant (b_3 = 2.6087) in 2013 season.

ii) The green leafhopper, *Empoasca decedens* (Paoli)

The correlation coefficient between *E. decedens* population and maximum temperature was positive and insignificant, (r_1 = 0.0653 and 0.4590) in 2012 and

2013 seasons, respectively. Concerning the relationship between *E. decedens* population and minimum temperature, there was positive and significant correlation (r_2 = 0.6024* and 0.5688*) in 2012 and 2013 seasons, respectively. The correlation coefficient between the population of *E. decedens* and relative humidity was positive and insignificant (r_3 = 0.2311 and 0.4299) in 2012 and 2013 seasons, respectively. The partial regression between population of *E. decedens* population and maximum temperature was positive and insignificant (b_1 = 0.3764 and 2.7635) in 2012 and 2013 seasons, respecyively. There was positive and highly significant partial regression between *E. decedens* population and minimum temperature (b_2 = 4.1136**) in 2012 season, whereas it was positive and insignificant (b_2 = 4.9925) in 2013 seasonre. The partial regression between *E. decedens* population and relative humidity was positive and insignificant (b_3 = 0.6843 and 1.1766) in 2012 and 2103 seasons, respectively.

3) The whitefly, *Bemisia tabaci* (Genn.)

i) Immature stage

Positive and insignificant correlation coefficient was found between immature stages of *B. tabaci* population and maximum temperature (r_1 = 0.3031 and 0.3042) in 2012 and 2013 seasons, respectively. The correlation coefficient between *B. tabaci* population and minimum temperature was positive and highly significant (r_2 = 0.8077**) in 2012 season, but it was positive and significant (r_2 = 0.5580*) in 2013 season. The correlation coefficient between *B. tabaci* population and relative humidity was positive and insignificant (r_3 = 0.2947 and 0.4801) in 2012 and 2013 seasons, respectively. The partial regression between the mean numbers of *B. tabaci* and maximum temperature were positive and insignificant (b_1 = 0.0119 and 0.0059) in 2012 and 2013 seasons, respectively. Positive and insignificant partial regression was found between mean numbers of *B. tabaci* and minimum temperature (b_2 = 0.0241 and 0.0078) in 2012 and 2013 seasons, respectively. The partial regression between the mean numbers of *B. tabaci* and relative humidity was positive and insignificant (b3 = 0.0288 and 0.0318) in 2012 and 2013 seasons, respectively.

ii) Adult stage

The correlation coefficient between the adult stage of *B. tabaci* population and maximum temperature was positive and insignificant (r_1 = 0.3067 and 0.3095) in 2012 and 2013 seasons, respectively. While it was positive and highly significant between the population of *B. tabaci* adults and minimum temperature (r_2 = 0.8029**) in 2012 season, but it was positive and significant (r_2 = 0.5664*) in 2013 season. The correlation coefficient between *B. tabaci* population and relative humidity were positive and insignificant (r_3 = 0.2996 and 0.3138) in 2012 and 2013 seasons, respectivly. The partial regression between the mean numbers of *B. tabaci* population and maximum temperature was positive and

insignificant (b_1 = 0.0276 and 0.0250) for the two seasons, respectively. Also it was positive and insignificant between *B. tabaci* population and minimum temperature (b_2 = 0.0551 and 0.3270) for the both seasons, respectively. The partial regression recorded between mean numbers of *B. tabaci* population and relative humidity was positive and insignificant (b_3 = 0.0672 and 0.0861) in 2012 and 2013 seasons, respectively. The results agreed with Khalifa and Elkhidir, (1965), Lal, (1981) and Aldyhim and Khalil, (1993) who found that the change in the enviromental factors from year to year (such as maximum and minimum daily temperature, relative humidity, direction and speed of wind, rain fall, ….etc.) effects the population density and dynamics of insect pests and the occurrence of the natural enemies. Mondal and Gill, (2010) mentioned that whitefly population was severely influenced by weather parameters i.e., temperature, rainfall and relative humidity. The rainfall adversely effected population, followed by temperature and relative humidity. Ali *et al*., (2013) showed that temperature and relative humidity had different effects on insects under investigation, significant with some insects and insignificant with the other.

Combined effects of meteorological factors and path analysis

The effect of maximum, minimum temperatures and mean relative humidity on aphids, leafhoppers and whitefly population was estimated by calculating the partial regression analysis (Least Square Regression equation). Values of explained variance by the three aforementioned meteorological factors (Table, 3) showed that the considered factors have played a conspicuous role in detecting the activity of these pests during the study seasons. These results indicated that the tested meteorological factors play a great role in regulating the population density and seasonal abundance of such insect pests. Similar findings were reported by Hegab, (1997 and 2001), El-Gindy, (1997 and 2002), Hashem, (1997 and 2005), Abd-Elsamed, (1999 and 2006), which greatly correspond with the present results.

The method of path coefficient included the independent variable i.e. maximum temperature, minimum temperature and mean relative humidity. Path analysis was practiced in order to find out the relative importance of these variable in contributing numbers of insects. Table, (3) presented the relative importance in contributing numbers of insects as recorded in percentage of variation of maximum temperature, minimum temperature and mean relative humidity in 2012 and 2013 seasons.

Table 3. Explained and unexplained variance and the effects of maximum , minimum temperature and mean relative humidity on the total numbers of hemipterous insects infesting cowpea plants at Abo-Hammad, Sharkia, Governorate during 2012 and 2013 seasons.

Insects	Explained variance		Unexplained variance	
	2012	2013	2012	2013
Aphis craccivora	0.4459	0.2985	0.5541	0.7015
A. gossypii	0.7315	0.34402	0.2685	0.65598
Empoasca decipiens	0.5690	0.4935	0.4310	0.5065
E. decedens	0.5560	0.4887	0.4440	0.5113
Bemisia tabaci (immature)	0.7533	0.3390	0.2467	0.6610
B. tabaci (adult)	0.7924	0.4564	0.2076	0.5436

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دراسات إيكولوجية على بعض الحشرات الثاقبة الماصة التي تصيب اللوبيا في محافظة الشرقية بمصر

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أجريت الدراسة فى مركز أبو حماد، محافظة الشرقية خلال موسمي ٢٠١٢ و ٢٠١٣ على حشرات المن، نطاطات الأوراق والذبابة البيضاء التى تصيب اللوبيا. أثبتت دراسات الحصر تواجد حشرات منْ اللوبيا (*Aphis craccivora*) ومنْ القطن (*A. gossypii*) ونطاطات الأوراق (*Empoasca decipiens, E. decedens* and *Cicadulina chinai*) و الذبابة البيضاء (*Bemisia tabaci*).

أوضحت نتائج دراسة الوفرة الموسمية للأنواع السائدة ما يلى:

أ- المنْ: سجل منْ اللوبيا قمة نشاطه في الأسبوع الرابع من يوليو في كلا موسمي الدراسة ، أما منْ القطن فسجل قمة نشاط واحدة في الأسبوع الثاني من أغسطس في الموسم الأول (٢٠١٢) ولكنه في الموسم الثاني سجل قمتي نشاط، كانت قمة نشاطه الأولى فى الأسبوع الرابع من يوليو أما القمة الثانية فسجلت في الأسبوع الثاني من أغسطس .

ب – نطاطات الأوراق: سجل (*E. decipiens*) قمتي نشاط في كلا موسمي الدراسة، كانت القمة الأولى فى الأسبوع الثالث والرابع من شهر يوليو لكلا الموسمين على التوالي. أما القمة الثانية فسجلت في الأسبوع الثالث من شهر أغسطس خلال موسمي الدراسة. كما سجل قمتي نشاط لحشرة (*E. decedens*) في الأسبوع الرابع لكلٍ من شهري يوليو وأغسطس على التوالي خلال موسمي الدراسة.

جـــ – الذبابة البيضاء: سجلت كلٍ من الأطوار الغير كاملة و الأطوار الكاملة قمتي نشاط على نباتات اللوبيا. فكانت قمة النشاط الأولى للأطوار الغير كاملة فى نهاية شهر يوليو لكلا الموسمين، أما القمة الثانية فكانت فى الأسبوع الثالث من شهر أغسطس في كلا الموسمين. أما الحشرات الكاملة سجلت قمتها الأولى في الأسبوع الثالث من شهر يوليو لكلا الموسمين، وسجلت القمة الثانية في الأسبوع الثاني من شهر أغسطس في كلا الموسمين.

تم دراسة تأثير كلٍ من الحرارة العظمى والحرارة الصغرى والرطوبة النسبية على الكثافة العددية للأنواع السائدة من حشرات المنْ، نطاطات الأوراق والذبابة البيضاء التى تصيب اللوبيا، وقد أوضحت النتائج أن متوسط كل من الحرارة العظمى والحرارة الصغرى والرطوبة النسبية لها تأثير معنوى على تعداد الحشرات تحت الدراسة.