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Population Fluctuations of Aphid and Leafhopper Insects Infesting Barely Plants and some Predators, Egypt

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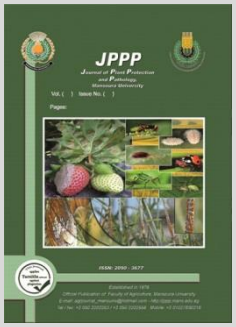

ABSTRACT

The present work was carried out at Diarb-Nigm district, Sharkia Governorate, during the two successive growing barley plants seasons 2016/2017 and 2017/2018, to study the population fluctuations of aphids, leafhoppers and their associated natural enemies. The obtained results showed that the aphid species were *Rhopalosiphum padi* (Linnaeus)., *R. maidis* (Fitch) *and Schisaphis graminum* (R.), leafhoppers *Empoasca decipiens* (Paoli) *and Empoasca decedens* (Paoli), and predators *Coccinella undecimpunctata* (L.), *Paederus alfierii* (Koch.), *Chrysoperla carnea* (Stephens) and true spiders. The aforementioned insect pest were collected by two different methods from barley plants using plant sample and sweep net. The seasonal fluctuations of the aphid species on barley plants showed one peak at the 4th week of February, the 3rd week of February and the 1st week March of for *R. padi*, *R. maidis* and *S. graminum* for the two seasons, respectively. One peak occurred at the 1st week and 3rd week of February for both *E. decipiens* and *E. decedens* for the two seasons, respectively. This research aims to utilize the obtained results in developing the IPM programs against these pests on barley plants through activation the effect of both temperature and relative humidity on insect numbers.

Keywords: Barley plants, seasonal fluctuations, aphids, leafhoppers, whitefly, predators.

INTRODUCTION

The homopterous insects (aphids and leafhoppers) are economic insect pests of many agricultural crops in Egypt. Barley plants are infested by these insect pests which affect the quantity of yield as results of their direct feeding on plant, in addition, these insects are responsible for natural spread of several virus diseases El Gindy (2002); Youssef (2006) and Al-Habashy, Aml (2018). The faunae of these insects on most field and vegetables were studied in Egypt Herakly (1970); El Nahal *et al.*, (1977); Hegab *et al.*, (1987); Al- Moaalem *et al.*, (2005); Malik *et al.*, (2010); Mahmoud *et al.*, (2011); Amer (2016) and Abd-Elsamed and Eisa (2017) reported considerable data on the aphid, leafhopper and predator insects infesting barley plants. The aim of the present work was to determine the population fluctuations of aphid, leafhopper and predator insects on barley, effect of certain climatic factors on the abundance of insects.

MATERIALS AND METHODS

An area about 2100 m^2 was chosen and divided into three replications to carried out this study at Diarb-Nigm district, Sharkia Governorate. The sowing date of barley plants was during the mid week of November in 2016/2017 and 2017/2018 seasons. Sampling started when the age of barley plants reached about 21-28 days after sowing and continued at weekly intervals throughout the growing seasons of barley plants during 2016/2017 and 2017/2018. The normal agricultural practices were followed in due time and all replications were kept free of any insecticide treatments. The following two procedures of sampling were used:

1) Plant samples

Twenty five tillers per replicate representing different were picked out randomly. These leaves were examined in the laboratory at the same day using a binocular microscope and the total number of aphid and predator individuals on both surfaces of the leaves were recorded.

2) Sweep net

The dimensions of the used sweep net were 30 cm diameter and 60 cm deep. Each sample consisted of 100 double strokes that were taken from both diagonal directions of the experimental area. Each sample was kept in a tight closed paper bag and transferred to the laboratory for inspection by a binocular microscope at the same day and the collected leafhoppers were killed by using cyanide killing jar sorted into species and identified according to the work of (Ribaut (1952) ; Neilson (1968) and El-Nahal, *et al.*, (2008) . Counts of the captured leafhoppers were recorded for each sample.

Statistical Analysis

The population dynamics of certain sucking pests and their associated natural enemies were statistically analyzed Costat (2005) to calculate the simple correlation coefficient Snedecor and Cochran (1981).

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RESULTS AND DISCUSSION

1. Survey of some homopterous and predator insects on barley plants

Survey was conducted during 2016/2017 and 2017/2018 seasons on barley plants.

a) Aphids insects:

The obtained results revealed that presence of the following aphid species *Rhopalosiphum padi* (Linnaeus), *Rhopalosiphum maidis* (Fitch) and *Schisaphis graminum* (R.). *R. padi* recorded total number of 2299 and 2110 individuals / plant sample and *R. maidis* recorded total number of 1318 and 1790 insects / plant sample while *S. graminum* recorded total number of 433 and 321 individuals / plant sample for the two seasons, respectively and the results were showed in Table (1).

b) Leafhopper insects:

The obtained results revealed that two leafhopper species belonging to family Cicadellidae were found on barley plants, (Table 1). The collected leafhopper species were according to their abundance as follows: *Empoasca decipiens* (Paoli) recorded total number of 232 and 171 insects / sweep net and *Empoasca decedens* (Paoli) recorded total number of 168 and 137 insects/ sweeping net for the two seasons, respectively.

Table 1. Total number of some piercing sucking insects and predator collected from barley plants by using plant samples and sweep net during 2016/2017 and 2017/2018 seasons.

Insect species	2016/2017		2017/2018	
	Plant samples	Sweep net	Plant samples	Sweep net
R. padi	2299	63	2110	35
R. maidis	1318	42	1790	24
S. graminum	433	16	321	15
E. decipiens	-	232	-	171
E.decedens	-	168	-	137
C. undecimpunctata	60	-	90	-
P. alfierii	30	-	40	-
C. carnea	42	-	43	-
true spiders	77	-	62	-

c) Predator insects

The data presented in Table (1) cleared that, three were predators *Coccinella undecimpunctata* , *Paederus alfierii* (Koch.), *Chrysoperla carnea* (Stephens) and true spiders were found on barley plants. C. undecimpunctata recorded total number of 60 and 90 insects / plant sample and *P. alfierii* recorded total number of 30 and 40 insects / plant sample for the two seasons, respectively. While *C. carnea* recorded total number of 42 and 43 insects / plant sample and true spiders recorded total number of 77 and 62 insects / plant sample for the two seasons, respectively.

2. Seasonal population fluctuations of the dominant homopterous and predator insects.

a) Aphid insects:

Samples (25 tillers) were taken weekly from barley plants during 2016/2017 and 2017/2018 seasons. The seasonal fluctuations of *R. padi*, *R. maidis* and *S. graminum* on barley plants are shown in Fig. (1and 2).

1) The Bird Cherry- Oat Aphid, *Rhopalosiphum padi* (F)

The total number of *R. padi* counted on barely plants by plant samples was represented graphically in Figs. (1 and 2). According to Fig. (1 and 2) it can be pointed out that *R. padi* was appeared under the field conditions on the barely plants during the period from 3rd week of December to 2nd week of April. The total number of initial occurrence were 1 and 4 insects /sample in 2016/2017 and 2017/2018 seasons, respectively. The total numbers of *R. padi* on barely plants tended to increase until it reached the peak 4th week of February with a total number of 380 and 440 insects/sample for the two seasons, respectively. After the this peak the number of *R. padi* decreased with a minimal number at 2nd week of April with a total number of 6 and 3 insects /sample in both seasons, respectively.

2) The Corn Leaf Aphid, *Rhopalosiphum maidis* (F)

The numbers of *R. maidis* collected from barely plants using plant samples are recorded in Figs. (1 and 2). Specimens of *R. maidis* appeared during the 3rd week of December. The total number of initial occurrence was 2 and 0 insects /sample. One peak on barely plants occurred in 3rd week of February with a total number of 320 and 490 insects/sample for the two seasons, respectively. After this the aphids number tended to decline until reached its minim number at 4th week of March with a total number 0 and 5 insects /sample for the two seasons, respectively.

3) The Green Bug, *Schizaphis graminum* (R.)

The weekly numbers of *S. graminum* collected from barely plants using plant samples are recorded in Figs. (1 and 2). The individuals of *S. graminum* were collected from barely plants starting 3rd week of January for both experimental years. The total number of initial occurrence were 1 and 4 insects /samples. The number of individuals fluctuated on barely plants with general tendency to increase reaching its peak Fig. (1 and 2) show one peak representing high population density of individuals during for the two seasons. This peak occurred at 1st week of March with a total number of 97 and 73 insects / sample for the two seasons, respectively. The total number of *S. graminum* on barely plants tended to decline until it reached its minimal number at the 4th week of March with a total number of 9 and 0 insects /sample for the two seasons, respectively.

Hassan (1957) recorded the corn leaf aphids *A. maidis* on barley plants. Abou El-Hagag and Abdel-Hafez, (1998) found that the cereal aphid species, *R. padi* , *R. maidis* , *S. graminum* , and *S. avenae* infested wheat fields in southern Egypt. .Marzouk and El-Bawab (1999) showed that field experiments were conducted at El-Giza Research Station, Egypt, during two successive seasons (1995-97) of barley on infestation aphid *R. maidis* and yield components. Wangal *et al.*, (2000) in Kenya, recorded that the *R. padi* and *M. dirhodum* were common aphid species, but other cereal aphids present were *R. maids, S. avenae, S. geraminum* and *H. setaria*. Juan *et al.*, (2001) in China, conducted experiments at Zhengzhou, Henan, China. They found that the population of wheat aphids, (*R. padi and S. avenae*) was dependent on the resistance of different wheat cultivars. Akhtar and Parveen (2002) in Lahore, Pakistan, recorded that the aphid population on wheat fields, as affected by temperature and humidity was surveyed from 9 January to 14 April of 1998. Two species of aphids, *S. graminum* and *R. padi* were recorded infesting wheat plants in the experimental field. Aphid density peaked on

26 February. During this time, pests started moving from the leaves to the ears. Muhammad *et al.,* (2004) studied the population of aphid, *S. graminum* on wheat. Sharma and Bhatnagar, (2004) in India, mentioned that yield losses caused by the maize aphid, *R. maidis*, on eight barley cultivars. Abdul *et al.,* (2006) found the population fluctuations of *S. avenae* was on wheat and barley at AZRC farm and Agricultural College, Quetta, was significantly higher on wheat as compared with barley during 1st week of April and 1st week of May. The overall mean population of aphid was 1.78/tiller on wheat and 1.25/tiller on barley.Hadi *et al.,* (2011) found that the aphids were surveyed in the beginning of each planting season in several wheat plots. From 2005 to 2008, *R. padi* and *S. graminum* were found consistently between October and December. Al-Habashy, Aml (2008) obtained that aphids (*R maidis, R padi* and *S. graminum*) showed one peak on wheat El-Wakeil and Volkmar (2013) found that the aphids infested wheat plants and they are using sticky traps through large-scale field in Saxony, Germany before and after insecticide applications. Gao and Liu, (2013) found that cultural control measures should play an important role in cereal aphid management on wheat and barley. Planting barley in fields adjacent to those of wheat and intercropping wheat with barley are cultural practices that might suppress the cosmopolitan cereal pest, *S. avenae* (F.). The potential effects of these cultural measures on aphid outbreak risks were evaluated. Amer (2016) aphids recorded one peak on barley plants. *R. maidis, R. padi* and *S. graminum* recorded one peak at the 3rd week of February for the two seasons. Abd-Elsamed and Eisa (2017) susceptibility of three varieties of barely plants (Giza-123, Giza-2000 and Giza-132) were evaluated toward infestation by aphids and leafhoppers. Also, the effect of potassium fertilization on the chemical content and anatomical compositions in relation to homopterous insect population.

b) Leafhopper insects:

1) The Green Leafhopper, *Empoasca decipiens* (Paoli)

The total number of *E. decipiens* individuals per sample (100 duble strokes) on barely plants during 2016/2017 and 2017/2018 seasons were illustrated graphically in Figs. (1 and 2). The first collection of *E. decipiens* individuals was counted at 2nd week of December for the two seasons, respectively. The total initials numbers were 1 insects / sample in the two seasons. According to the abundance of *E. decipiens* on barely plants only one peak was recorded at 1st week of February with a total number of 38 and 34 insects /sample for the two seasons, respectively. The total number of *E. decipiens* tended to decline until reached its minimal at 1st week of April with a total number of 1 and 0 insects /sample for the two seasons, respectively.

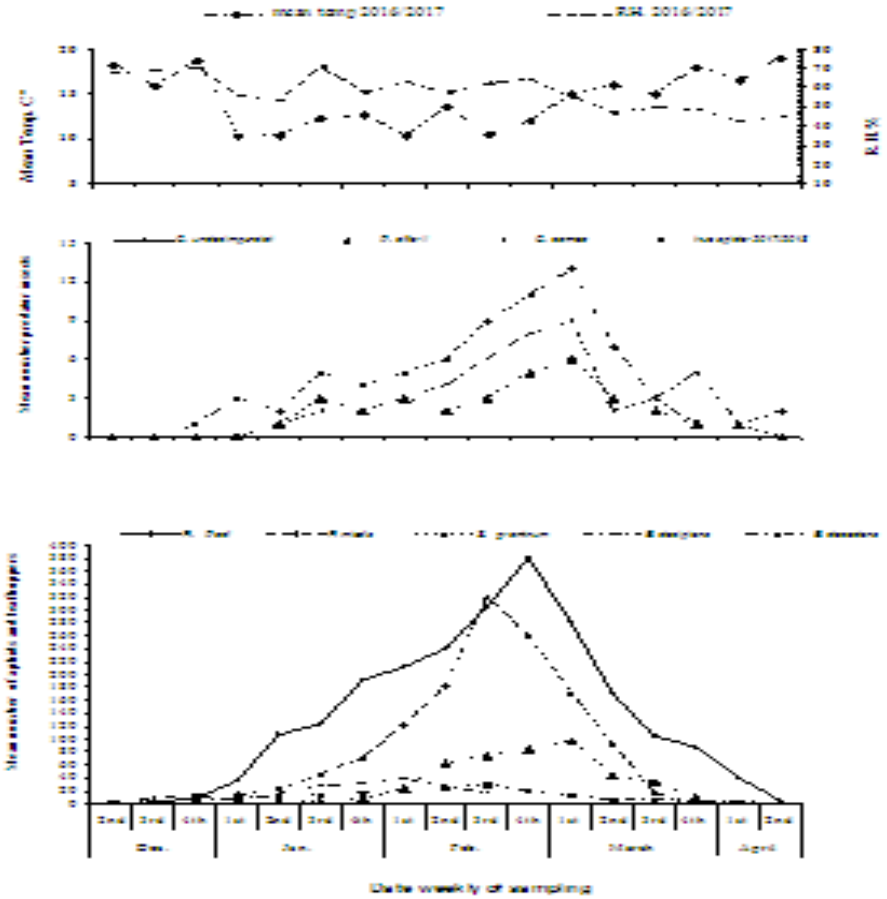

Figure 1. Seasonal fluctuations of aphid , leafhopper and predator insects infesting barley plants at Diarb-Nigm district, Sharkia Governorate during 2016/2017 seasons.

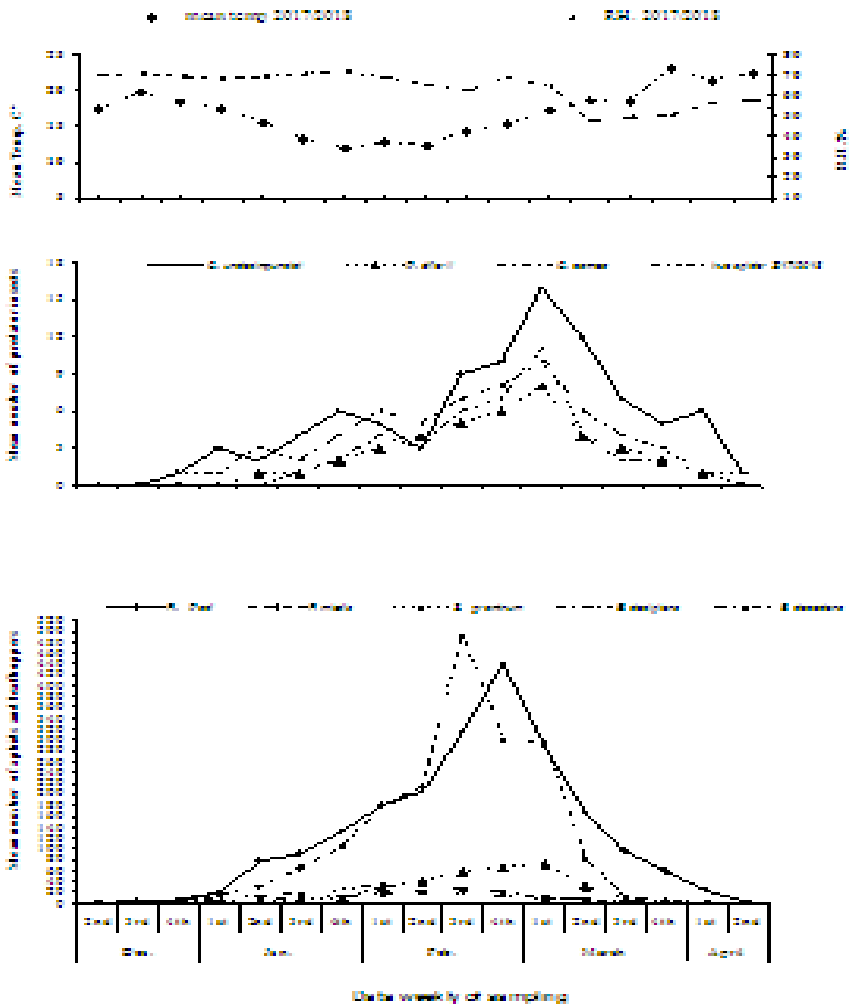

Figure 2. Seasonal fluctuation of aphid , leafhopper and predator insects infesting barley plants at Diarb-Nigm district, Sharkia Governorate during 2017/2018 seasons.

2) The Green Leafhopper, *Empoasca decedens* (Paoli)

The total number of *E. decedens* individuals infesting barely plants was represented graphically in Fig. (1 and 2). The total number of *E. decedens* which firstly collected from barely plants during 2016/2017 and 2017/2018 seasons were 1 and 2 insects /sample at 3rd week of December for the two seasons, respectively. One peak was recorded for *E. decedens* on barely plants at 3rd week of February with a total numbers of 30 and 28 insects /sample for the two seasons, respectively. The number of *E. decedens* decreased to until reached its minimal at 1st week of April with a total number of 0 and 1 insects /sample for the two seasons, respectively.

Ammar *et al.*, (1989) recorded that the leafhopper *C.chinai*. Was infested maize, wheat and barley in February. Al-Habashy, Aml (2008) recorded that *E decipiens* and *E decedens* recorded one peaks on wheat. Amer (2016) according to the abundance of *E. decipiens* and *E. decedens* on barley plants only one peak was recorded at 3rd week of February.

c) Predator insects

Three species predators were recorded during the two seasons of this study. These predates were: *C. undecimpunctata, P. alfierii* and *C. carnea* The total numbers of *C. undecimpunctata, P. alfierii* and *C. carnea* counted on barely plants during the two seasons by plant samples was represented graphically in Figs. (1 and 2).

1) *Coccinella undecimpunctata* (L)

According to Figs. (1 and 2) it can be pointed out that *C. undecimpunctata* was appeared under the field conditions on the barely plants during the period from the 4th week of December to the 2nd week of April. The total numbers of initial occurrence were 0 and 1 for the two seasons. The total numbers of *C. undecimpunctata* on barely plants tended to increase until it reached the peak at 1st week of March with a total numbers of 15 and 16 predator/sample for the two seasons. After the this peak the numbers of *C. undecimpunctata* decreased with a minimal number at 2nd week of April with a total number of two and one predator/sample in both seasons, respectively.

2) *Paederus alfierii* (Koch.)

Data illustrated in Figs. (1 and 2) revealed *P. alfierii* was present under the field conditions on the barely plants during the period from the 2nd week of January to the 1st week of April. The total numbers of initial occurrence were 1 for the two seasons. The total numbers of *P. alfierii* on barely plants tended to increase until it reached the one peak at 1st week of March with a total numbers 6 and 8 predator/ sample for the two seasons, respectively. After peak the numbers of *P. alfierii*

decreased with a minimal number at 1st week of April with a total numbers of 1 predator/sample in both seasons

3) *Chrysoperla carnea* (Steph.),

According to Figs. (1 and 2) it can be seen that *C. carnea* was present under the field conditions on the barely plants during the period from the 2nd week of January to the 1st week of April. The total numbers of initial occurrence were 1 and 0 for the two seasons, respectively. The total numbers of *C. carnea* on barely plants tended to increase until it reached the one peak at 1st week of March with a total numbers 9 and 11 predator/ sample for the two seasons, respectively. After peak the numbers of *C. carnea* decreased with a minimal number at 1st week of April with a total numbers of 1 predator/sample in both seasons.

4)True spiders

According to Fig. (1 and 2) it can be pointed out that true spiders was present under the field conditions on the barely plants during the period from the 4th week of December to the 2nd week of April. The total numbers of initial occurrence were 1 for the two seasons, respectively. The total numbers of true spiders on barely plants tended to increase until it reached the one peak at 1st week of March with a total numbers 13 and 10 predator/ sample for the two seasons, respectively. After peak the numbers of true spiders decreased with a minimal number at 2nd week of April with a total number of 1 predator/sample in both seasons.

Mannaa, (2000) in Egypt, found that aphid species, *S. graminum* (Rond.), *R. padi L.* and *R. maidis* were associated by 15 insect predator species belonging to 9 families and 5 orders, in addition to certain unidentified species of true spiders on wheat plants. Juan *et al.,* (2001) in China, found that the populations of natural enemies were not affected by the resistant cultivars. The results suggested that the resistance of wheat cultivars and the presence of natural enemies could play an important role in the control of wheat aphids. Hesler *et al.,* (2005) found that rich fauna of coccinellids occurs. In this study, coccinellids were sampled within field-crop and grass habitats to survey for various coccinellid species and to determine any effects of habitat management on abundance. Field crops, (maize, wheat-alfalfa intercrop) was subjected to high, inter-mediate, or low Crop-Management Intensity (CMI). Amer (2016) six species of predators were recorded during the two investigation seasons. These predators were: *C. undecimpunctata, C. carnea, P. alfierii, Syrphus sp., Orius sp.* and *Scymnus sp.* showed that of *C. undecimpunctata C. carnea* on barley plants one peak in the 1 st week of March for the two seasons.

3. Effect of temperature and relative humidity.

1) *R. padi*

The results obtained in Table (2) cleared that the correlation coefficient between *R. padi* and maximum temperature was negative and significant (r_1=- 0. 554* and - 0. 505*) in 2016/2017 and 2017/2018 seasons, respectively. The number of *R. padi* was negatively insignificant and negatively significant with minimum temperature (r_2 = - 0.459 and - 0.501*) in the two seasons, respectively. While, relative humidity was positively insignificant (r_3 = 0.069 and 0.048) in the two seasons, respectively.

Table 2. Simple correlation (r), partial regression (b) and explained variance (E.V.) for the numbers of certain insects infesting barley plants under weekly maximum, minimum temperature and relative humidity during 2016/2017 and 2017/2018 seasons.

Insect species	Simple correlation coefficients						Partial regression						Explained variance %	
	2016/2017			2017/2018			2016/2017			2017/2018			2016/	2017/
	r1	r2	r3	r1	r2	r3	b1	b2	b3	b1	b2	b3	2017	2018
R. padi	-0.554*	-0.459	0.069	-0.505*	-0.501*	0.048	0.021	0.063	0.789	0.039	0.407	0.855	32.59	39.03
R. maidis	-0.526*	-0.377	0.187	-0.543*	-0.528*	0.138	0.029	0.136	0.472	0.024	0.029	0.597	28.98	37.39
S. graminum	-0.324	-0.135	-0.013	-0.422	-0.365	0.003	0.205	0.604	0.962	0.091	0.149	0.991	11.71	33.89
E. decipiens	-0.658**	-0.666**	0.399	-0.842**	-0.886**	0.438	0.004	0.004	0.112	0.000	0.000	0.079	60.26	79.74
E. decedens	-0.711**	-0.636**	0.300	-0.717**	-0.711**	0.249	0.001	0.006	0.242	0.001	0.001	0.334	58.66	59.48
C.undecimpunnctat	-0.298	-0.0312	-0.078	-0.110	-0.155	-0.358	0.245	0.223	0.767	0.673	0.554	0.158	13.44	34.17
P. alfierii	-0.346	-0.383	0.034	-0.321	-0.333	-0.177	0.174	0.129	0.897	0.208	0.192	0.494	14.62	37.17
C.camea	-0.374	-0.301	0.055	-0.283	-0.265	-0.089	0.139	0.238	0.835	0.271	0.305	0.733	14.53	22.44
True spiders	-0.358	-0.299	-0.029	0.158	0.245	0.911	-0.403	-0.431	-0.126	0.109	0.084	0.630	14.53	42.07

r_1 and b_1 = Coefficients of simple correlation and partial regression between maxm.temperature and the numbers of insects, respectively.
r_2 and b_2 = Coefficients of simple correlation and partial regression between minm.temperature and the numbers of insects, respectively.
r_3 and b_3 =Coefficients of simple correlation and partial regression between relative humidity and the numbers of insects, respectively.

2) *R. maidis*

The results in Table (2) revealed that the correlation coefficient between *R. maidis* and maximum temperature was negative and significant (r_1 = - 0.526* and - 0.543*) in the two seasons, respectively. The correlation coefficient between *R. maidis* and minimum temperature was negatively insignificant and negatively significant (r_2 =- 0.377 and - 0.528*) in the two seasons, respectively. While, relative humidity was positively insignificant (r_3 = 0.187 and 0.138) in the two seasons, respectively.

3) *S. graminum*

The results in Table (2) obtained that the correlation coefficient between *S. graminum* and maximum temperature was negative and insignificant (r_1 = - 0.324 and - 0.422) in the two seasons, respectively. The correlation coefficient between *S. graminum* and minimum temperature was negative and insignificant (r_2 = - 0.135 and - 0.365) in the two seasons, respectively. While, relative humidity was negatively insignificant and positively insignificant (r_3 = - 0.013 and 0.003) in the two seasons, respectively).

4) *E. decipiens*

The results in Table (2) showed that the correlation coefficient between *E. decipiens* and (maximum and minimum) temperature was negatively high significant (r_1 = - 0.658** and - 0.842**) and (r_2 = - 0.666** and - 0.886**) in the two seasons. While, relative humidity was positively insignificant (r_3= 0.399 and 0.438) during the two seasons, respectively.

5) E. decedens

Data in Table (2) revealed that the correlation coefficient between *E. decedens* and (maximum and minimum) temperature was negatively high significant (r_1 = - 0.711** and - 0.717**) and (r_2 = - 0.636** and - 0.711**)in the two seasons. While, relative humidity was positively insignificant (r_3= 0.300 and 0.249) during the two seasons, respectively.

6) Predators

The results in Table (2) obtained that the correlation coefficient between predator insects (*C. undecimpunctata*, *P. alfierii* and *C.carne a* and true spiders) and three weather factors were negatively insignificant during the two seasons, respectively, except the correlation coefficient between (*P. alfierii* and *C.carnea*) and relative humidity was positively insignificant during the second season.

4. Combined effects of some weather factors on the numbers of aphid, leafhopper and predator insects.

The effect of temperatures and mean relative humidity on aphid, leafhopper and predator insects numbers were estimated by calculating the partial regression analysis. E.V. % values Table (2) demonstrate that the population of aphid, leafhopper and predator insects in the two seasons more sensitive to changes in the considered weather factors (maximum and minimum) temperatures and mean relative humidity showed the highest values of *E. decipiens* E.V. 60.26 % and 79.74 %, for the two seasons respectively. On the other hand, the least combined effects were detected of *C.carnea* showing the least values of 14.62 % and 22.44 for the two seasons, respectively. Similar results were obtained by Parh (1986); Hegab *et al.,* (1987) and Raupach *et al.,* (2002) which greatly correspond with the present results.

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التذبذبات العددية لحشرات المن ونطاطات الأوراق التي تصيب نباتات الشعير وبعض المفترسات - مصر.

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أجريت هذه الدراسة فى منطقة ديرب نجم بمحافظة الشرقية على نباتات الشعير خلال موسمين متتاليين ٢٠١٦/٢٠١٧ و٢٠١٧/ ٢٠١٨ بهدف دراسة التذبذبات العددية لبعض انواع المن ونطاطات الاوراق وبعض اللأعداء الحيوية المصاحبة وقد أوضحت النتائج أن انواع حشرات المن التى تصيب نباتات الشعير هى من الشوفان *R. maidis* و من الذرة *R. padi* ومن النجيليات *S. graminum* وبينما نطاطات الأوراق هي *E. decipiens* و *E. decedens* والمفترسات هى *C. undecimpunctata*, *P. alfierii*, *C. carnea* and true spiders وذلك باستخدام طريقتين لاخذ العينات وهى العينة النباتية والشبكة الكانسة. وجد أن لانواع حشرات المن قمة نشاط واحدة فى الاسبوع الرابع من شهر فبراير و فى الاسبوع الثالث من شهر فبراير و فى الاسبوع الاول من شهر مارس لمن الشوفان *R. maidis* ومن الذرة *R. padi* ومن النجيليات *S. graminum* فى خلال موسمى الدراسة على التوالى. وسجل لنوعى حشرات نطاطات الأوراق *E. decipiens* و *E. decedens* قمة نشاط واحدة على الشعير خلال موسمي الدراسة فى الأسبوع الاول والثالث من شهر فبراير. المفترسات وجد لهما قمة نشاط واحدة فى الاسبوع الاول من مارس لابو العيد و الرواغة ولا سد المن وللعنكبوت الحقيقى خلال الموسمين على التوالى. لذا يهدف هذا البحث الى استخدام النتائج المتحصل عليها و الاستفادة منها عند وضع برامج المكافحة المتكاملة لهذه الافات على محصول الشعير من خلال تفعيل تأثير بعض العوامل البيئية الرئيسية (الحرارة و الرطوبة) المتحصل على تعداد الحشرات.