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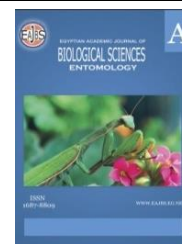
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Population Dynamics on The Main Faba Bean Insect Pests in Relation to Certain Ecological Factors in Kafr El-Sheikh Region, Egypt.

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ABSTRACT

Field experiments were conducted at Kafr El-Sheikh governorate, Egypt, in 2020- 2021 and 2021- 2022 seasons to study the population dynamics of certain insect pests infesting faba bean plants namely *Liriomyza trifolii* (Burgess); *Aphis craccivora* (Koch) and *Empoasca* spp. In addition, the impacts of certain weather and biotic factors on the population density of the previously mentioned pests. *Liriomyza trifolii* population density increased in January and March (7.5 and 8.2 larvae/25 leaflets) in 2021 and 2022, respectively. The highest population of nymphs and adults of *Empoasca* spp in the first season were 6.8 individuals on the 20th of February, while, in the 2022 season the population density was higher at the end of the season during April and recorded 18 individuals/ 5 plants. For results of the simple correlation in 2021 season, *Liriomyza trifolii* insects were insignificant with the weather, and biotic factors, whereas, in the 2022 season the relationship was significant with R.H%, wind velocity and plant age. The percentage of explained variance was 38 and 84 % during the two seasons, respectively. For *Empoasca* spp, in the first season, the population of insect density was significantly correlated for minimum temperature, while, in 2022 season population was significant with RH% and predators. Plant age was a significant effect on the population fluctuations of *A. craccivora* and *Empoasca* spp during the second season. The percentage of Explained variance for the effect of climatic factors, and biotic factors on *Empoasca* spp were 75 and 74 % during the two seasons, respectively. This research aims to utilize the obtained results in developing the IPM programs against the main faba bean insect pests through activation of the effect of temperature, relative humidity and wind velocity on insect numbers.

INTRODUCTION

Faba bean (*Vicia faba* L.) is the most important nutritive popular food crop in Egypt. It contains a high ratio of proteins, carbohydrates and vitamins which are main for human feeding (Jensen *et al.*, 2010). It has the ancillary benefits of nitrogen fixation and thus, reduces fertilizer requirements (Al-Antary *et al.*, 2007).

In the Mediterranean region, faba bean crop is liable to attack by several insect pests in the field. Some of them cause extensive damage and required the development of control methods as the serpentine American leaf miner, *Liriomyza trifolii* (Burgess) (Diptera: Agromizidae); cowpea aphid, *Aphis craccivora* (Koch.) and leafhopper,

Empoasca spp. (Homoptera : Cicadellidae) that affect the quality and quantity of faba bean yield (Abdallah *et al.*, 2000 and Mohamed and Salman, 2001).

Aphids infest faba bean plants and other leguminous species causing direct damage by sucking the plant sap (El-Heneidy *et al.*, 1998, El-Defrawi *et al.*, 2000 and Abdel-Rahman *et al.*, 2005).

The faba bean leafminer; *Liriomyza congesta* is considered one of the most destructive pests in faba bean plantations (Hassanein *et al.*, 1988 and Salem *et al.*, 1998). The adult female of Leafminer puncture plant tissues to lay eggs (Bethke and Parella, 1987), and larvae feed on mesophyll tissue causing mines between the upper and lower leaflets. The damage ratio increased as the mines' numbers increased (Parella *et al.*, 1985). Insect predators play an important role in managing insect pests (Ali *et al.*, 2013 and El-Mashaly 2013). Vanderycken *et al.* in Belgium (2011) recorded the aphid's natural enemies such (Hoverflies, coccinellids and lacewings in several agro-ecosystem, (wheat, corn, potato corn, and broad bean). Thus, a number of biotic and abiotic factors may affect the severity of infestation caused by *Liriomyza* pests and *Empoasca* spp.

The present study aims to determine the population of *Liriomyza trifolii* (Burgess), *Empoasca* spp and *Aphis craccivora*, which attack the Faba bean crop in Kafr EL-Sheikh as well as the population of three predators: *Chrysopela carnea* (Steph.), *Coccinella undecimpunctata* and *Scymnus* spp. Which was found to be associated with the three insect pests and their role in decreasing the population density of studied pests. Also, to find out the correlation and regression coefficient between the population density of this key pest and certain abiotic factors (such as temperature, relative humidity and wind velocity) and biotic factors, plant age and insect predators.

MATERIALS AND METHODS

1. Population Fluctuation of The Main Insect Pests Infesting Faba Bean Plants and Their Associated Predators:

A field study was carried out on the farm of Sakha Agriculture Research Station, Kafr El-Sheikh Governorate, Egypt (31°09'N latitude and 30°94'E longitude at 13m above mean sea level) in two seasons, 2020-2021 and 2021-2022.

The insect pests attacking faba bean and their natural enemies (predators) were examined directly. The experimental area of about one feddan was divided into equal plots. The plot size was 84 m² and four replicates were chosen randomly. An area was sown by faba bean variety; Sakha4 on November 10th during the 2021 and 2022 seasons and the investigation after 30 days from cultivation until the frontier season, the plain agricultural transactions were followed regularly wanting any insecticidal treatments over the growing season. A population study of *Liriomyza trifolii* (Burgess), (Diptera: Agromizidae); was done by counting its numbers on a sample of 100 leaflets chosen randomly (25 leaflets /replicate). A sample of five plants per replicate was examined weekly to the count number of aphids, *Aphis craccivora*. The gassid, *Empoasca* spp was done by counting its numbers on a sample of 20 plants chosen randomly early in the morning. Three insect predators were counted per plant; the number of eggs and larvae of the green lacewing, *Chrysoperla careneae*, (Steph., 1836) (Neuroptera: Chrysopidae) larvae and adults of *Scymnus* spp (Coleoptera- Coccinellidae), and the eleven spotted lady- beetle, *Coccinella undecimpunctata*, (F.1758) (Coleoptera- Coccinellidae). After the direct count of adults, the previous samples were picked and then put in paper bags and examined on the same day in the laboratory with the aid of a stereoscopic microscope for counting the legume aphid, *Aphis craccivora* (Koch) "nymphs and adults" the faba bean leaf miner, *Liriomyza trifolii* (Burgess) "larvae". The weather factors: temperature, relative humidity and wind

velocity were obtained from the Meteorological Station of Sakha, Egypt and statistical analysis with the Statistic Package for social sciences (SPSS), v.20.0 software was used to decide the simple correlation and regression coefficient and partial regression between ecological factors and mean population of certain insect pests.

RESULTS AND DISCUSSION

Population Dynamics of The Main Insect Pests in Faba Bean Variety, Sakha4 During The 2020-2021 And 2021-2022 Seasons:

Leafminer, *Liomyza trifolii* (Burgess):

During the first season, 2020-2021 date (Table 1) showed that, by the beginning of the season, the population was very low then it increased gradually during January and reach the first peak (7.5 larvae/25 leaflets) on 16 Jan 2021 under field conditions at (18.5°C, Max. temp., 73.4% RH. and 42.9 km/hr Wind velocity), respectively. As well, the plant age was (67 days). The population decreased by the end of the season when the plant age of faba bean plants was (144 days).

Result cleared that in the 2022 season, the first apparition of *Liomyza trifolii* (Burgess) was recorded on 11 Dec 2021 (0.6 insects/ 25 leaflets). The highest beak was recorded on 26 March (8.2 insects/25 leaflets) under field conditions at (16.6°C, Max. temp., 68.5% RH. and 82.0 km/24hr Wind velocity), respectively. As well, the plant age was (137 days). Table (2).

El-Mashaly (2013) observed that the maximum number of *L. congesta* 186 larvae /100 leaflets on faba bean cultivar in the first November plantation was recorded on 31 January 2012, while, the maximum in mid of November plantation was 196 larvae/ 100 leaflets recorded on 28th Feb. Shalaby *et al.* (2012) found two peaks for *L. trifolii* in 7 of January (85 individuals / 20 leaves) and on 11 February (291 individuals. / 20 leaves) in the first season while in the second season were on 9 February (123 individuals. / 20 leaves) and in 2 of March (184.67 individuals. / 20 leaves). Shower, *et al.* (2016) stated that larvae of *Liriomyza trifolii* (Burgess) recorded a maximum level during mid-February, then the population gradually decreased and completely lapse by the end of March. Hawila (2016) also found that the maximum number of *Liriomyza congesta* was registered on 28 February 740 larvae / 150 leaflets at (15.1°C., 87.4% RH. and 00 mm/day Ran fall) after that, the population drop by the end of the season.

The Leafhoppers, *Empoasca* spp.:

In the first season, the leafhoppers population began with the number of 1.6 individuals. / 5 plants on 13 December 2020 at (22.9°C, Max. temp., 75.7% RH. 51.2 km/24hr Wind velocity), respectively. Then the population increased gradually to reach its maximum number of 5.0 individuals. / 5 plants at (23.4°C, Max. temp., 61.5% RH. 50.0 km/hr Wind velocity), respectively, and 6.8 individuals./ 5 plants at (16.8°C Max. temp., 74.0% RH. 61.8 km/24hr Wind velocity), respectively. On 6 and 20 of Feb. 2021 after that, the population decreased to 3 individuals/ 5 plants by the end of the season on 3 April (Table 1). As for the second season, results obtained in (Table 2) indicated that the leafhopper population began to appear with the number of 2.2 individuals. on 18 Dec. then increased to reach two peaks, the first peak was recorded on 12 March 12 individuals/ 5 plants at (21.9°C, Max. temp., 72.3% RH. 110.5 km/hr Wind velocity), respectively, the highest peak was registered at the end of the season on 2 April 18 individuals./ 5 plants at (25.5°C, Max. temp., 67.7% RH. 95.2 km/hr. Wind velocity), respectively, after 144 days from cultivation. These results indicated that *Empoasca* spp. preferred the older faba bean plants over the younger ones.

The Cowpea Aphid, *Aphis craccivora* Koch.:

The first season 2021 date (Table 1) indicated that the number of *A. craccivora* began with 3 individual /5 plants on 12 December 2020. The highest number of *A. craccivora* was recorded on the 16th of January at 6 individuals /5 plants at (18.5°C, Max. temp., 73.4% RH. 42.9 km/hr Wind velocity), respectively. As well, the plant age was (67 days). In the second season, results obtained in Table (2) revealed that *A. craccivora* population began to appear with a number of 1.6 individuals. on 11 Dec. then increased to reach the highest peak 5 individual /5 plants on 18 Dec. at (20.7°C, Max. temp., 72.3% RH. 67.2 km/hr Wind velocity), respectively. As well, the plant age was (39 days). The population decreased in the end season, and the plant age of faba bean plants was (144 days). *A. craccivora* insects recorded two peaks; 100 and 133 individuals. /30 plants on 27 of December .2013 and 24 of Jan. 2014, respectively at (14.57°C, 92.7% RH. 00 mm and 14.45°C, 95.2 % RH. 00mm/ day Ran fall), respectively. Hawila (2016). In the first season of 2012, the highest peak of Aphids (19.3 aphids/plants) on faba bean variety, Sakha 1 recorded in 9 of Dec, and the maximum mean number (8.4 aphids/plant) was recorded in 28 of Dec. in the second season. Mahmoud *et al* (2015). *A. craccivora* had two peaks through two seasons (1st week of December and 3rd week of January) and (1st week of December and 1st week of January) in the 1st and 2nd seasons respectively Saleh *et al.* (2021).

El-Khawass *et al.* (2004) found that the population of *A. craccivora* started to appear on faba bean plants in Egypt after 33 days from planting and continued to appear until 114 days. The lowest total number of *A. craccivora* was recorded in the first week of January. Khalil, (2014): observed that the Maxima numbers of *Aphis craccivora* noticed during December 2008 at the two investigated localities; by 695.8 and 304.7 insects per plant shoot with mean of maximum, minimum and mean temperatures were (24.08°, 12.14°, 18.14°C) and (22.45°, 13.37°, 17.94°C) and relative humidity values were (54.43 %) and (54.74 %) at Beni-Suef and Qalubya, respectively.

2. Population Fluctuations of Insect Predators Associated with Faba Bean Insect Pests:

Three predatory insects were found: *Chrysoperla carnea*, *Coccinella undecimpunctata* and *Scymnus* spp. *C. carnea* was the most dominant.

The First Season, 2020- 2021:

As for, the common predators with insect pests, data in Table (1) cleared that predatory fluctuated during the sampling period and the population started in little numbers (1.2 individuals / 5 plants) in 19 of December, then, the population increased gradually forming one peak in 23 of January by means of 6 individuals /5plants and the maximum peak was recorded (7 individuals /5 plants) at 6 of February. No record of any individuals at the end of the season in 1st week of April, the total number of common predatory was 27.8 individuals (1.05±0.34).

The Second Season, 2021- 2022:

Predatory insects started with low numbers (1 individual / 5 plants) in 11 of December and the highest peak (6 individuals /5 plants) was registered on 5th March 2022, the total number of common predatory was 31.6 individuals (1.8±0.39). Table (2).

Hawila (2016) revealed that the total numbers of *C. undecimpunctata* and *C. carnea* beginning of December till the first week of April ranged from 1 to 7 individuals and 2 to 26 individuals, respectively, and the lowest total number of *C. undecimpunctata* (1 individual) was recorded during March.

Ibrahim (2006) found that *C. carnea* was considered the dominant species, followed by *C. undecimpunctata*, *P. alfieri* and *Metasyrphus corollae* (F.) was the least in that category. Four predaceous insects associated with *A. craccivora* Koch on Faba bean plants,

C. undecimpunctata, *Coccinella septempunctata* L. *C. Carnea* and *Orius* spp. Peaks of insect predators occurred in the 2nd Week of December and 3rd week of March (15.8 and 56.7 individuals /10 plants, respectively) for the first season and 3rd week of both December and March (25.3 and 26.1 individuals /10 plants) for the second season (Khalil, 2014). The green lacewing, *C. carnea* is one of the most predaceous species to control aphids in Egypt. Amer and Marei (2001) and Henry *et al.* (2002).

Table 1: Weekly numbers of main insect pests and predators in relation to certain ecological factors on faba bean plants cultivated in Kafr El-Sheikh region, Egypt. during the growing season 2020- 2021.

Inspection date	Plant age (Days)	Mean No. of <i>Liriomyza trifolii</i> larvae/25 leaflet	Mean No. of insects/5plants			Average			
			<i>Aphis crassivora</i>	<i>Empoasica spp</i>	Predators	Max. Temp. (C°)	Min. Temp. (C°)	R.H.%	Wind velocity km/hr)
12 Dec.	32	2.0	3.0	1.6	0.0	22.9	14.4	75.7	51.2
19 Dec.	39	2.2	0.0	2.4	1.2	21.6	13.9	75.9	45.2
26 Dec.	46	3.9	2.0	2.8	1.2	22.4	13.3	73	56.0
2 Jan.	53	5.0	0.0	1.4	1.0	22.5	15.7	77.7	47.2
9 Jan.	60	5.6	0.0	0.0	0.0	23	15.6	79.7	14.8
16 Jan.	67	7.5	6.0	4.0	0.6	18.5	11.7	73.4	42.9
23 Jan.	74	6.4	5.0	3.0	6.0	20.2	11.3	63.4	51.4
30 Jan.	81	4.5	0.0	2.4	4.0	20.8	11.3	60	50.0
6 Feb.	88	4.0	3.0	5.0	7.0	23.4	12.9	61.5	50.0
13 Feb.	95	4.2	2.0	5.8	0.0	23.3	13.3	73.7	64.2
20 Feb.	102	4.6	0.0	6.8	0.0	16.8	10.4	74	61.8
27 Feb.	109	5.3	2.0	4.8	0.6	21	14	72.7	58.7
6 Mar.	116	6.0	2.0	3.0	0.6	24	13.8	65	70.7
13 Mar.	123	4.5	2.0	3.0	0.6	24.4	14.6	66.8	84.7
20 Mar.	130	3.1	2.0	3.2	5.0	24.5	13.4	59.4	92.4
27 Mar.	137	2.6	5.0	3.0	0.0	22.7	13.9	64.6	88.8
3 Apri.	144	2.4	4.0	3.0	0.0	26.2	15.8	64	67.0
Total		73.80	38.00	55.20	27.8		-		
Mean ±S. E		4. 34 ±0.37	2. 23 ±0.46	3. 24 ±0.40	1. 63 ±0.56	22.24 ±5.55	13.48±0.38	69.44 ±1.60	58.6±4.5

Table 2: Weekly numbers of main insect pests and predators in relation to certain ecological factors on faba bean plants cultivated in Kafr El-Sheikh region, Egypt. during growing season 2021- 2022.

Inspection date	(Days)	Mean No. of <i>Liriomyza trifolii</i> larvae/25 leaflet	<i>Aphis crassivora</i>	<i>Empoasica spp</i>	Predators	Max. Temp. (C°)	Min. Temp. (C°)	R.H.%	Wind velocity (km/hr)
11 Dec.	32	0.6	1.6	0.0	1.0	22.1	12.2	76.5	45.5
18 Dec.	39	3.2	5.0	2.2	1.0	20.7	13.4	72.0	67.2
25 Dec.	46	3.0	3.6	4.6	2.0	17.6	12.7	75.5	71.5
1 Jan.	53	2.6	2.2	5.8	2.0	18.3	10.8	77.2	73.4
8 Jan.	60	2.4	1.0	7.0	1.0	20.7	10.6	73.5	34.2
15 Jan.	67	4.6	0.6	4.4	2.0	19.0	10.5	67.0	104.5
22 Jan.	74	4.8	0.9	2.2	1.0	18.0	8.7	75.2	55.8
29 Jan.	81	4.7	0.5	8.0	0.0	14.1	9.1	76.5	59.0
5 Feb.	88	5.3	0.4	4.4	1.0	18.4	11.3	72.0	93.0
12 Feb.	95	5.7	0.0	4.8	0.0	19.7	10.0	71.0	78.5
19 Feb.	102	6.1	0.4	5.8	0.0	14.0	10.8	73.3	80.1
26 Feb.	109	5.1	1.2	7.4	3.6	18	11.4	73.0	76.0
5 Mar.	116	4.1	2.0	9.5	6.0	20.7	11.5	69.5	88.0
12 Mar.	123	5.0	0.0	12.0	3.0	21.9	11.4	72.3	110.5
19 Mar.	130	5.2	2.0	6.2	2.0	16.6	11.0	68.0	103.0
26 Mar.	137	8.2	0.0	14.6	3.0	16.6	10.1	68.5	82.0
2 Apri.	144	5.0	0.0	18.0	4.0	25.5	14.8	67.7	95.2
Total		75.60	21.4	116	32.6				
Mean ±S. E		4. 44±0.41	1. 25± 0.33	6. 67± 1.10	1. 91± 0.39	18.93±0.70	11.1±0.36	72.2±0.8	77.5±5.08

Effect of Biotic and Abiotic Factors on The Population Density of Certain Insect Pests on Faba Bean Plants During The 2021 And 2022 Season:

1- leafminer, *Liriomyza trifolii* (Burgess):

The results of the analysis Table (3) showed that in the first season (2020- 2021), data showed an insignificant simple correlation between 4 weather factors, predators and *Liriomyza trifolii* population. The data correlation between *Liriomyza trifolii* population and plant age was found negatively insignificant (Table 3). The combined effect of the ecological factors and the insect population was 38%.

In the 2022 season, for the simple correlation, data showed a negative and significant relationship between population density and R.H% $r = - 0.549$, whereas, a positive significance with a daily mean of wind velocity $r = 0.540$, and the regression coefficients were significantly different ($P < 0.05$). The relationships were not significantly correlated for (max. temperature, $r = -0.38$; min. temperature, $r = -0.33$; predatory insects, $r = 0.14$, while, the relationship was significant with plant age, $r=0.77$.

The effect of the combination of all studied factors on the *Liriomyza trifolii* population was 84%. The relative humidity had shown no significant effect on *Liriomyza trifolii* population during the 2009 and 2010 seasons Shalaby *et al.* (2012). The relationships of correlation were positive or negative insignificant (or significant) effects between predators and the *Liriomyza congesta* population varied according to the planting date and year of study. El-Mashaly (2013).

Table 3: Correlation and regression coefficient and Partial regression values between certain weather factors, plant age, predatory insects and population density of *Liriomyza trifolii* on faba bean plants during 2020-2021 and 2022season.

Season.	Factors	Simple correlation and regression values			Partial regression values			E.V%
		r	b	P	p. reg.	P	t	
2020-2021	Daily mean max. temperature	-0.465	-0.315	0.060	-0.37	0.41	-0.41	38%
	Daily mean mini. Temperature	-0.351	-0.343	0.084	-0.14	0.82	-0.21	
	R.H	0.103	0.024	0.69	0.053	0.53	0.29	
	Mean of wind velocity	-0.350	-0.029	0.169	-0.028	0.29	-1.38	
	plant age	-0.081	-0.004	0.75	0.026	0.25	1.21	
	Predators	0.096	0.064	0.715	0.13	0.66	0.40	
2021-2022	Daily mean max. temperature	- 0.384	- 0.277	0.06	-0.18	0.12	-1.67	84%
	Daily mean mini. Temperature	-0.306	- 0.254	0.11	-0.12	0.57	-0.58	
	R.H	-0.549	- 0.236	0.01	-0.138	0.21	-1.32	
	Mean of wind velocity	0.540	0.044	0.02	0.006	0.73	0.34	
	plant age	0.77	0.038	0.00	0.03	0.00	3.37	
	Predators	0.146	0.155	0.57	-0.22	0.25	-1.20	

F value first season = 1.04

F value second season = 8.32

2- The Leafhoppers, *Empoasca* spp:

In 2020- 2021 season, the results of analysis Table (4) showed that the data correlated were insignificant between *Empoasca* spp population and the 5 factors tested (max. temperature, $r = -0.38$; mean of R.H%, $r=0.17$, mean of wind velocity $r = 0.35$, plant age, $r = 0.38$, predators $r = 0.07$), and the regression coefficients were not significantly (p) values were 0.12, 0.65, 0.16, 0.12, 0.76 for 5 factors tested respectively.

For the effect of min. temperature, the relationship was significantly correlated $r = - 0.58$. The data of partial regression showed that the values were significant with min.

temperature, mean of R.H% and plant age, whereas, not significant with max. temperature, daily mean of wind velocity and predators.

In the 2022 season, the data of simple correlation was significantly negative with a mean of R.H% $r = -0.49$, whereas, significantly positive between the insect population and plant age, $r = 0.79$, predatory insects $r = 0.58$. The relationships were not significantly correlated with a daily mean of maximum temperature, $r = 0.25$; daily mean of minimum temperature, $r = 0.24$, mean of wind velocity $r = 0.43$ (Table 4).

The effect of the combination of all studied factors on *Empoasca* spp population was presented as explained variance (E.V.) which was 75% in the first season and 74 % in 2nd season of the study. Similar results were recorded by Abou-Setta (2020) who reported that the change in obtainable nutritional value (that is varied through the growing season) becomes the main factor effects on the population of *Tetranychus urticae*, that factor is affected by host plant biological phenomena (different stages of growth and their nutritional contents). El-Mashaly (2013) reported a positive or negative insignificant correlation between the predators and *Empoasca* spp. Shalaby *et al.* (2012) found that the relative humidity had shown an insignificant effect on population fluctuations of *A. craccivora*, *E. discipiens* and *L. trifolii* during the 2009 and 2010 seasons.

Table 4: Correlation and regression coefficient and Partial regression values between certain weather factors, plant age, predatory insects and population density of *Empoasca* spp on faba bean plants during 2020-2021 and 2022season.

season.	Factors	Simple correlation and regression values			Partial regression values			E.V%
		r	b	P	p. reg.	P	t	
2020-2021	Daily mean max. temperature	-0.38	-0.277	0.12	0.47	0.17	1.46	75%
	Daily mean mini. Temperature	-0.581	-0.606	0.01	-1.39	0.01	-2.94	
	R.H	-0.174	-0.043	0.650	0.35	0.01	2.90	
	Mean of wind velocity	0.35	0.03	0.16	0.17	0.47	0.75	
	plant age	0.38	0.018	0.12	0.045	0.01	3.09	
	Predators	0.07	0.057	0.76	0.32	0.16	1.51	
2021-2022	Daily mean max. temperature	0.252	0.398	0.32	0.18	0.68	0.41	74%
	Daily mean mini. Temperature	0.24	0.759	0.33	0.52	0.46	0.76	
	R.H	-0.491	-0.682	0.04	0.14	0.69	0.40	
	Mean of wind velocity	0.432	0.094	0.08	-0.037	0.50	-0.69	
	plant age	0.79	0.103	0.00	0.11	0.005	3.57	
	Predators	0.587	1.66	0.01	0.42	0.51	0.67	

F value first season= 5.13

F value second season= 4.80

3- Cowpea Aphid, *Aphis craccivora*:

In the 2020- 2021 season, the results of analysis Table (5) showed that the data of simple correlation were not significant between aphid population for the 4 weather factors, predators, plant age and aphid population.

In the 2022 season, the simple correlation relationships were insignificant for the climatic weather factors, predatory insects and aphid population. The data correlation between *Aphis craccivora* population and plant age was found negatively significant, $r = -0.57$. On the other hand, the overall explained variance of the four tested weather factors, plant age, and predators with the population fluctuation of *A. craccivora* was 16% in the first season and 70% in 2nd season of the study. El-Mashaly (2013) reported a highly positive significant correlation between insect predators and *A. craccivora* except *C. undecimpunctata* was a positive insignificant effect. During the 2nd season *A. craccivora*

population with *C. carnea* was a positive insignificantly effect. Khalil (2014) found that the correlation coefficient “r” values were (-0.4339; $P = >0.01$) in 1st season and (- 0.1792) in the 2nd season for the effects of total insect predators on the population of cowpea aphids, while, the aphid population appears, significant negative correlation from max. temperature and average temperature $r = - 0.61$, and $- 0.57$ for the 2010 season, whereas maximum temperature, minimum, and average temperature were negatively insignificant correlations in the 2011 season. Mohamed *et al* (2021) reported that the partial regression values for the effect of daily mean max. the temperature on the *A. craccivora* population were a significant positive relation (P. reg. value; 3.61) in 1st season and highly significant positive effect (P. reg. value; 5.73) in 2nd season. Saleh *et al* (2021) recorded a significant positive correlation between *A. craccivora* and *C. undecimpunctata* during two seasons while with *C. carnea* relationship was not significantly negative in the 1st season and positive in the 2nd season.

Table 5: Correlation and regression coefficient and Partial regression values between certain weather factors, plant age, predatory insects and population density of *Aphis craccivora* on faba bean plants during 2020-2021 and 2022season.

Season	Factors	Simple correlation and regression values			Partial regression values			E.V %
		r	b	P	p. reg.	P	t	
2020-2021	Daily mean max. temperature	0.043	0.036	0.87	-0.18	0.79	-0.26	16%
	Daily mean mini. Temperature	- 0.132	-0.161	0.612	0.15	0.88	0.14	
	R.H	-0.342	-0.099	0.179	-0.18	0.49	-0.71	
	Mean of wind velocity	0.266	0.027	0.302	0.00	0.90	0.11	
	plant age	0.26	0.014	0.306	0.06	0.85	0.18	
2021-2022	Predators	0.119	0.099	0.650	-0.20	0.67	-0.43	70 %
	Daily mean max. temperature	0.028	0.013	0.916	-0.26	0.05	-2.23	
	Daily mean mini. Temperature	0.400	0.371	0.11	0.54	0.03	2.45	
	R.H	0.24	0.10	0.347	-0.07	0.53	-0.65	
	Mean of wind velocity	-0.241	-0.016	0.352	-0.006	0.74	-0.33	
	plant age	-0.574	-0.022	0.016	-0.033	0.01	-3.11	
Predators	0.028	0.024	0.91	0.36	0.10	1.77		

F value first season= 0.29

F value second season= 3.79

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ARABIC SUMMARY

التقلبات العددية لآفات الفول البلدى الرئيسية وعلاقتها ببعض العوامل البيئية بمنطقة كفر الشيخ-مصر

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اجرى هذا البحث بمحطة البحوث الزراعية بسخا بمحافظة كفر الشيخ بمصر خلال موسمى -2020 و2021 و2021-2022 على صنف الفول البلدى (سخا4) وذلك لدراسة التقلبات العددية لحشرات الفول الرئيسية وهى ذبابة اوراق الفول، الجاسيد ومن البقويات وكذلك دراسة تأثير بعض العوامل الجوية والحيوية على نشاط الآفات محل الدراسة وتم الزراعة فى 10 نوفمبر لمدة موسمين. أوضحت النتائج ان لحشرة ذبابة اوراق الفول قمتين فى شهرى يناير ومارس بمتوسط اعداد 7.5 و 8 يرقة /25 وريقة خلال موسمى الدراسة على التوالي، وبالنسبة لنشاطات الاوراق فقد تم تسجيل اعلى تعداد (6.8 فرد) فى 20 فبراير خلال الموسم الاول- بينما فى الموسم الثانى فتم تسجيل اعلى تعداد لنشاطات الاوراق فى نهاية الموسم خلال ابريل (18 فرد). اوضحت نتائج الارتباط خلال الموسم الاول بالنسبة لحشرة صانعات الأنفاق فكانت نتائج الارتباط غير معنوية التأثير مع العوامل الحيوية وغير الحيوية، بينما فى الموسم الثانى كانت العلاقة معنوية التأثير مع الرطوبة النسبية، سرعة الرياح وعمر النبات وبالنسبة للتأثير المشترك للعوامل الحيوية وغير الحيوية على تعداد حشرة صانعة الأنفاق فكانت 38 و84% خلال الموسمين على التوالي. وكان لعمر النبات باليوم تأثير معنوى على التقلبات العددية لمن البقوليات ونشاط الأوراق خلال الموسم الثانى اوضحت النتائج ان التأثير المشترك لكل من العوامل الحيوية وغير الحيوية على تعداد حشرة نشاط الأوراق فكانت 75 و74% وتعد نتائج دراسة هذا البحث مهمة لتطوير برنامج مكافحة المتكاملة لآفات محصول الفول البلدى خلال نشاط تأثير الحرارة والرطوبة والرياح على تعداد الحشرات موضع الدراسة.