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Effect of certain factors on population dynamics of *Aphis craccivora* (Hemiptera: Aphididae) on common bean *Phaseolus vulgaris* in Menoufiya Governorate, Egypt

Ali, M. Mansour; Ibrahim, Labib Ibrahim; Mohammed, Abdel- Ghaffar and Hamzah, M. Kamel
Plant Protection Dept., Fac. of Agric., AL-Azhar Univ., Nasr City, Cairo, Egypt.

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Abstract

The present investigation was carried out to study the population dynamics of *Aphis craccivora* (Koch) (Hemiptera: Aphididae) on the common bean *Phaseolus vulgaris* in relation to certain weather factors at Menoufiya Governorate, Egypt. The study was conducted during 2017 and 2018 seasons. This insect is considered a serious pest in the agricultural fields of Menoufiya Governorate, Egypt. The obtained results showed that maximum population of *A. craccivora* was observed in October and November during Nile plantation and in March during Summer plantation of common bean *P. vulgaris* crop. Statistical analysis showed that *A. craccivora* population had a positive correlation with maximum temperature and minimum temperature during Nile plantation in two seasons while this relation was showing a negative correlation with both minimum and maximum temperature in Summer plantation. However, relative humidity had a negative correlation in Nile plantation. But it was a positive correlation in Summer plantation. The combination of climatic factors on *A. craccivora* population density was prenatal as explained by variance which was 29.02% and 45.31% in the Nile and Summer plantation, respectively during season 2017/2018. But it was 52.08% and 16.58% in the Nile and Summer plantations, respectively during season 2018/2019. Hence the information contained in this paper lead to the identification of the proper integrated pest management (IPM) practices for *A. craccivora*.

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Introduction

Common bean *Phaseolus vulgaris* (L.) is a leguminous plant that belongs to the family Leguminaceae, it is the most important grain legume for direct human consumption with production more than twice that of the next most important grain legume, chickpea (Gepts *et al.*, 2008).

The cultivated area in Egypt was increased especially for exportation. Whereas the production of green pods of beans was 251279 tons from the cultivated area of 57873 feddans while the dry seeds were 59496 tons from the plants cultivated in 57877feddans. Egypt occupies the tenth country among the most important exporting countries. The common bean is also a good source of vitamins and minerals. In addition, contains some anti-nutritional factors such as protease inhibitors, tannins and folic acid (Reyes-Moreno and Octavio Paredes-López 1993).

Aphis craccivora (Koch) (Hemiptera: Aphididae) cause damage to *P. vulgaris* crop by using their rasping-sucking mouth parts to abrade the plant epidermis and suck up the exuding plant sap. Sucking-sap insect pests cause much damage to various vegetable crops, they also play an important role as a vector of plant viruses and produce honeydew. Piercing-sucking insects are some of the most damaging pests for *P. vulgaris* producers due to the direct damage caused by feeding which can cause several plant symptoms including plant death and indirect damage caused by piercing plant protective tissues and vectoring many different plant diseases.

The present work aimed to evaluate the effect of certain weather factors on the population dynamics of *A. craccivora* on common bean *P. vulgaris* in Menoufiya Governorate, Egypt.

Materials and methods

1. Field studies:

Field experiments were planned and conducted to study the population fluctuation of *A. craccivora* infesting common bean plants (*P. vulgaris*) at korus village- Ashmoon city, Menoufiya Governorate throughout two successive seasons; (2017/2018) and (2018/2019). The experiments were carried out on two different cultivars of *P. vulgaris* plants (Flantena and Nebraska).

2. Sampling techniques:

The experiment was carried out in a completely randomized design with three replicates (Each replicate 42 m^2) for each of the two varieties. Five plants were chosen randomly in five positions (4 corners+ center) and inspected for the pest. When the plants became high, three leaves per plant were selected at three different levels (Low, middle, and high) for insect counting. The individuals of insect on the plant were directly counted under field conditions and their numbers were recorded. The experiment area 252 m^2 was divided into two parts for the two varieties (Flantena and Nebraska). Samples were collected randomly at the early morning weekly until the plant harvest.

3. Effect of weather factors on the population fluctuation of the *Aphis craccivora*:

This experiment aimed to obtain accurate information about the effect of both temperatures and RH. on the population fluctuation of the pest. Meteorological recorded data were obtained from https://www.wunderground.com. The statistical analyses (Simple correlation and partial regression) of obtained data were performed by using SAS program (SAS, 2003) to test the effect of the weather factors on the population fluctuation of the insect.

Results and discussion

Population fluctuation of *A.craccivora* was studied during both Nile and Summer plantations throughout two seasons.

1. Season (2017/2018):

1.1. Nile plantation:

Data presented in Table (1) and illustrated in Figure (1) show that the first appearance of *A. craccivora* on both Nebraska and Flantena varieties was in the 1st week of October in Nile plantation. The weekly numbers of insects were 30 and 5 individuals, respectively. The insect population increased gradually to give the highest peak in the 3rd week of October with weekly mean numbers of 400 individuals /45 leaves on Nebraska variety.

While the highest number of insects on Flantena variety was recorded in the following week of October with 220 insects. The insect population decreased gradually to reach 64 insects by early December in Nebraska and in the 4th week of November on Flantena75 insects.

The insect population disappeared by the end of the season in both varieties. Data presented in Table (1), proved that Nebraska

variety harbored more numbers of aphid1689 insects than that obtained on Flantena 887 insects. Nebraska variety is more susceptible to infestation with aphids than Flantena.

Table (1): Weekly mean numbers of *Aphis craccivora* on common bean varieties (Nebraska and Flantena) during Nile plantation (2017-2018) season at Korus village- Ashmoon city, Menoufiya Governorate.

Nile plantation 2017- 2018					
Inspection date	**Nebraska**	**Flantena**	**Humidity (%)**	**Temperature (° C)**	
			Rang	**Min**	**Max**
07/10/2017	30	5	57.95	22.14	31.14
14/10/2017	180	15	52.61	22.71	31.85
21/10/2017	400	55	53.94	21.1	29.44
28/10/2017	312	220	62.21	20.14	28.85
04/11/2017	283	188	45.34	20.42	29.28
11/11/2017	210	209	56.75	18.14	25.57
18/11/2017	130	120	62.87	16.28	25
25/11/2017	80	75	62.84	17.14	26
02/12/2017	64	0	60.57	15.14	21.71
09/12/2017	0	0	63	14.28	23.85
Total	1689	887			
Mean	168.9	88.7			

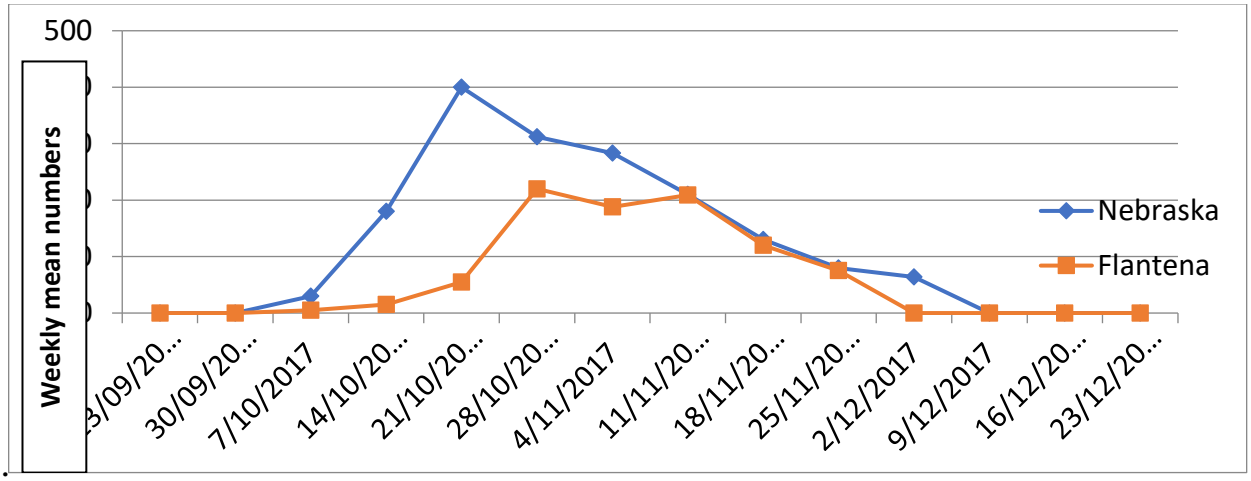

Figure (1): Weekly mean numbers of *Aphis craccivora* on common bean varieties (Nebraska and Flantena) during Nile plantation (2017\ 2018) season at Koras vallage- Ashmoon city - Menoufiya Governorate, Egypt.

1.2. Summer plantation:

Data presented in Table (2) and illustrated in Figure (2) showed that the first appearance of the aphid was observed on 24th of March in the case of Nebraska variety with a weekly mean number of 20 individuals.

However, the insect was recorded one week early on Flantena variety by a weekly number of 7 individuals. The aphid population increased gradually to reach the highest peak on 7th of April with mean numbers of 72 and 35 individuals in Nebraska and Flantena, respectively.

Another peak of aphid population was observed on Nebraska variety, by 21st of April. The aphid population then started to decline until the end of the season. It is obvious from data presented in Table (2) that Nebraska variety harbored more aphids than Flantena variety. The total numbers of aphid

were 237 and 82 individuals on Nebraska variety, and Flantena variety, respectively. In other words, Nebraska variety is more susceptible to the infestation of *A. craccivora*, than the other variety.

Table (2): Weekly mean numbers of *Aphis craccivora* on common bean varieties (Nebraska and Flantena) during summer plantation (2017-2018) season at Korus, village- Ashmoon, city, Menoufiya, Governorate.

Summer plantation 2017\2018			Humidity (%)	Temperature (° C)	
Inspection date	**Nebraska**	**Flantena**	**Avg**	**Min**	**Max**
10/3/2018	0	0	38.85	17.42	29.57
17/3/2018	0	7	58.72	15.42	24.57
24/3/2018	20	13	32.38	17.42	32.14
31/3/2018	45	19	47.88	15.71	26.57
07/4/2018	72	35	58.07	15.28	26.57
14/4/2018	35	8	44.78	17.71	28.42
21/4/2018	53	0	39.04	20	32.14
28/4/2018	12	0	55.08	17.42	26.71
05/5/2018	0	0	32.25	23.57	36.28
12/5/2018	0	0	50.34	21.14	31
Total	237	82			
Mean	23.7	8.2			

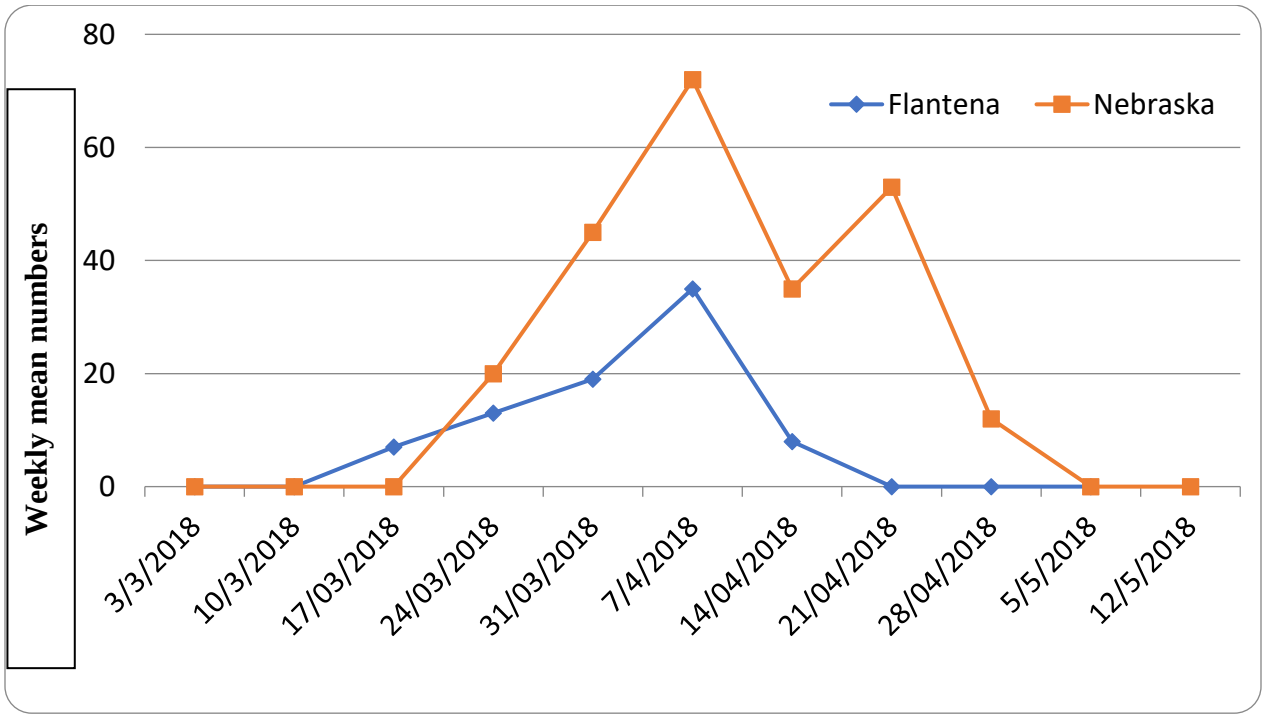

Figure (2): Weekly mean numbers of *Aphis craccivora* on common bean varieties (Nebraska and Flantena) during summer plantation (2017- 2018) seasons at Koras, vallage- Ashmoon, city – Menoufiya, Governorate, Egypt.

2. Season (2018/2019):

2.1. Nile plantation:

Data presented in Table (3) and illustrated in Figure (3) showed that the first appearance of *A. craccivora* on Flantena variety was observed in the 4th week of September in Nile plantation. The weekly number of insects was17, while it was 27 insects in Nebraska in the 1st week of October.The insect population increased gradually week by week to give the highest peak in the 3rd week of October with weekly numbers of 210 in Nebraska. However, the highest weekly number of the pest was recorded in the 2nd week of October by 146 individuals on Flantena. The insect population decreased gradually during November in both Nebraska and Flantena. The insect population disappeared by the end of the season in both varieties.

Table (3): Weekly mean numbers of *Aphis craccivora* on common bean varieties (Nebraska and Flantena) during Nile plantation (2018-2019) season at Korus village- Ashmoon city, Menoufiya Governorate.

Nile plantation 2018/2019			Humidity (%)	Temperature (° C)	
Inspection date	**Nebraska**	**Flantena**	**Avg**	**Min**	**Max**
20\9\2018	0	0	53.87	20.71	32.85
27\9\2018	0	17	59.82	20.28	32.57
04/10/2018	27	55	60.54	24.71	34.42
11/10/2018	177	146	59.82	22.71	30.57
18/10/2018	210	88	57.24	21	28.85
25/10/2018	183	92	47.14	22.42	31.57
01/11/2018	95	27	48.55	18.57	28.42
08/11/2018	14	18	55.54	18.28	28.14
15/11/2018	0	0	60.77	17.28	24.85
22/11/2018	0	0	62.15	13.85	25.14
Total	706	443			
Mean	70.6	44.3			

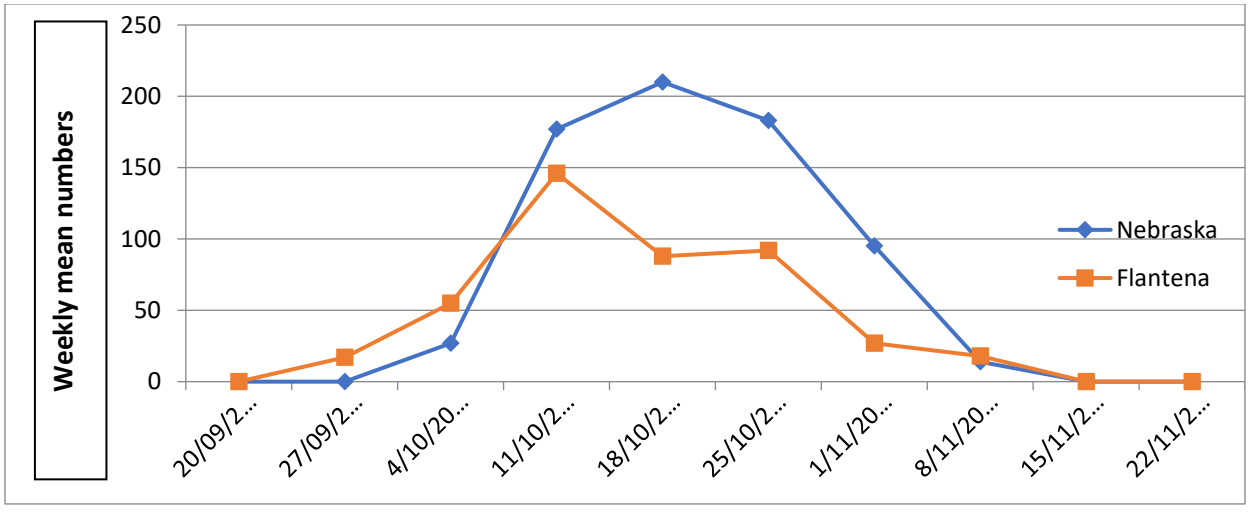

Figure (3): Weekly mean numbers of *Aphis craccivora* on common bean varieties (Nebraska and Flantena) during Nili plantation (2018\2019) season at Koras vallage- Ashmoon city - Menoufiya Governorate, Egypt.

2.2. Summer plantation:

Data presented in Table (4) and illustrated in Figure (4) showed that infestation with *A. craccivora* on the plants was observed at early of March on Nebraska variety. The insect population increased gradually to give the highest peak in the 3rd week of March with a weekly number of 604 in Nebraska. While on Flantena the best infestation started in the 3rd week of March. The insect population increased gradually to give the highest peak in the 4th week of March with a weekly number of 47 insects. The insect fluctuated and disappeared by the end of season.

The obtained data seem to have corresponded to the results of El-Defrawi *et al*. (2000) in Egypt, who observed that the population density of the cowpea aphid *A. craccivora* had two main periods of activity, highest counts were recorded during the third week of December and February season, and during the fourth week of December and third week of March in the second season. Similar findings were reported by Also, Ekram *et al.* (2019) who stated that the highest total number was recorded by *A. craccivora* and the lowest total number was recorded by *Ophiomyia phaseoli* (Tryon) (Diptera: Agromyzidae). The highest total number recorded during spring seasons in both 2017 and 2018, was represented by *A. craccivora* and the lowest number was by *O. phaseoli*. However, Gamila *et al.* (2016) reported that *A. craccivora* showed a peak of population density during two seasons of study.

While El-Dash *et al.* (2018) cleared that the Summer season had the highest abundance of *A. craccivora* on green bean plants. Helaly *et al.* (1982) in Egypt, studied the population fluctuation of *A. craccivora* on two commonly cultivated varieties of cowpea (Fertriat and Azmerly) and during two plantations in Summer and Nile. They found that the infestation started after 30 – 92 days from sowing date in the summer plantations and after 28 days in the Nili plantations. The aphid population reached a peak on 22 of August and 4 of September for Fertriat variety and on 17 of July and 15 of August for Azmerly variety in the first and second seasons of 1979, 1980, respectively.

Table (4): Weekly mean numbers of *Aphis craccivora* on common bean varieties (Nebraska and Flantena) during summer plantation (2018-2019) season at Korus, village-Ashmoon, city, Menoufiya, Governorate.

Summer plantation 2018/2019			Humidity (%)	Temperature (° C)	
Inspection date	**Nebraska**	**Flantena**	**Avg.**	**Min.**	**Max.**
02/03/2019	63	0	60.78	12.28	20.71
09/3/2019	194	0	54.65	13.14	23.28
16/3/2019	604	20	58.25	13.85	23.42
23/3/2019	310	47	47.78	15.28	24.57
30/3/2019	98	21	53.64	12.14	22
06/4/2019	25	33	45.75	16.85	27.28
13/4/2019	35	12	52.37	15.57	25.71
20/4/2019	14	0	48.84	14.71	26
27/4/2019	2	0	40.41	20.28	33.28
04/5/2019	1	0	46.54	17.42	28.85
Total	1346	133			
Mean	134.6	13.3			

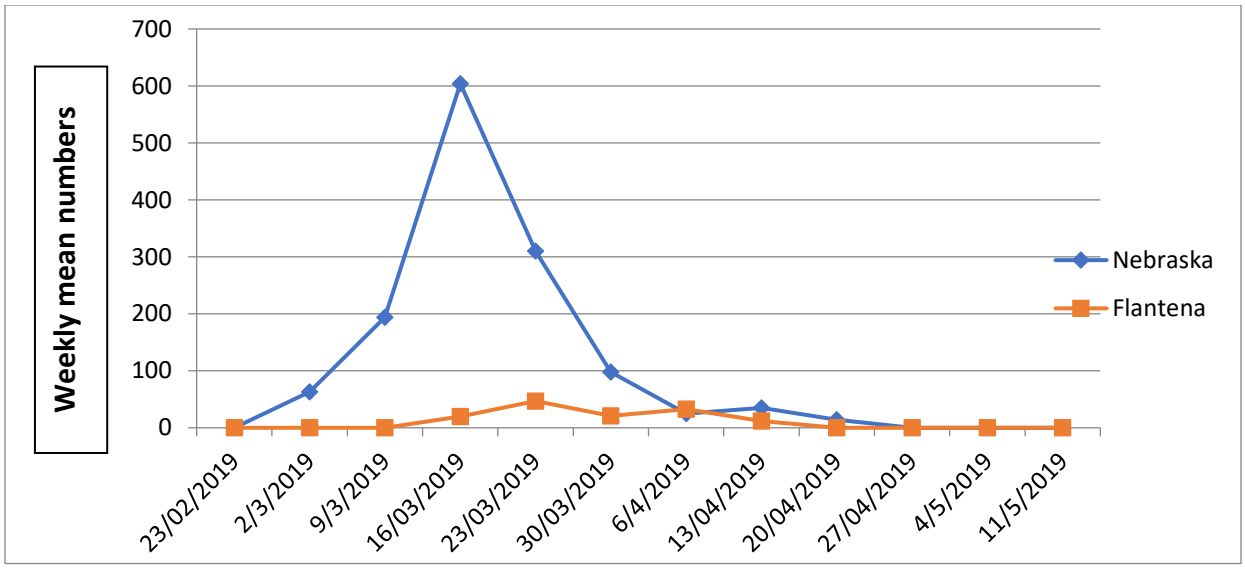

Figure (4): Weekly mean numbers of *Aphis craccivora* on common bean varieties (Nebraska and Flantena) during summer plantation (2018-2019) seasons at Koras vallage- Ashmoon city - Menoufiya Governorate, Egypt.

3. The effect of weather factors on the population fluctuations of *Aphis craccivora* on common bean:

Statistical analysis of data obtained in (2017/2018) Nile plantation which is illustrated in Table (5) indicated that a simple correlation between mean numbers of *A. craccivora* and daily maximum temperature was positive and insignificant correlation coefficient, while daily minimum temperature had a positive and significant effect on the numbers of this insect. However, the daily relative humidity recorded a negative and highly significant influence on the insect numbers (r=-0.05). In the Summer plantation simple correlation coefficient between mean numbers of *A. craccivora* and daily maximum temperature was negative and insignificant, while daily minimum temperature had a negative and significant correlation with the insect numbers. On the other hand, the daily relative humidity had a positive and insignificant effect on the numbers of this insect (r= 0.15). In Nile plantation the partial regression value mean numbers of *A. craccivora* and daily maximum temperature was negative and significant, while daily minimum temperature had a positive and significant effect on the numbers of this insect. The daily relative humidity had a negative and highly significant effect on the numbers of insect *A. craccivora* in season (2017/2018). In summer plantation, the partial regression between mean numbers of *A. craccivora* and daily maximum temperature was positive and highly significant, while daily minimum temperature had a negative and highly significant effect on the numbers of this insect. Also, the daily relative humidity had a positive and highly significant effect on the numbers of this insect. In the 2nd season (2018/2019), Nile plantation data in Table (5), showed that a simple correlation between mean numbers of *A. craccivora* and both daily maximum and minimum temperature had a positive, however, it was insignificant effect for maximum temperature, but it was a highly significant effect in case of minimum temperature. While the daily relative humidity recorded a negative and significant effect (r=-0.28). The partial regression analysis gave a positive and highly significant relation between daily mean minimum temperature and mean numbers of

A. craccivora. Values were negative and highly significant for each of the daily mean maximum temperatures, and RH.%.

In the Summer plantation data obtained the simple correlation between mean numbers of *A. craccivora* and daily maximum temperature was negative and significant while daily minimum temperature had a negative and highly significant correlation with the insect numbers. On the other hand, the daily relative humidity had a positive and highly significant effect on the numbers of this insect r= (0.32). The partial regression analysis of (2018/2019) season summer plantation gave a positive and insignificant effects between the mean numbers of *A. craccivora* and the daily mean maximum temperatures. But the relations were positive and insignificant effect correlation between mean numbers of *A. craccivora* and the daily mean minimum temperature. On the other hand, the daily relative humidity had a positive and highly significant effect on the numbers of this insect. The combination of climatic factors on *A. craccivora* population density was prenatal as explained by variance which was 29.02% and 45.31%in the Nili and Summer plantation during season 2017/2018. But it was 52.08% and 16.58% in Nili and summer plantation during season 2018/2019.

Table (5): Statistical analysis of the effect of some ecological factors on the population of *Aphis craccivora* during seasons (2017/2018) and (2018/2019) on common bean varieties at Korus, village- Ashmoon, city- Menoufiya, Governorate.

Years	Season	*Aphis craccivora*							
		Factors	Simple correlation		Partial Regression		F. value	P.	E.V. %
			r.	P.	b.	P.			
2017/2018	Nile	Temp. Max.	0.09	0.25	-2.43	0.0162	13.8	<.0001	29.02
		Temp. Min.	0.024	0.0041	2.53	0.0124			
		R.H.%	-0.05	<.0001	-4.71	<.0001			
	Summer	Temp. Max.	-0.12	0.179	3.73	0.0003	21.75	<.0001	45.31
		Temp. Min.	-0.29	0.001	-3.94	0.0001			
		R.H.%	0.15	0.1101	3.33	0.0012			
2018/2019	Nile	Temp. Max.	0.17	0.0861	-5.99	<.0001	26.6	<.0001	52.08
		Temp. Min.	0.497	<.0001	9.28	<.0001			
		R.H.%	-0.28	0.004	-3.16	0.0021			
	Summer	Temp. Max.	-0.23	0.015	0.43	0.6657	5.22	0.0007	16.58
		Temp. Min.	-0.24	0.008	0.05	0.9613			
		R.H.%	0.32	0.0005	3.03	0.0031			

E.V. (%): Explained variance. r: Simple correlation P: Probability value b: Partial regression coefficient value.

Similar findings were reported by Kuroli *et al.* (1999) who studied species distribution, dominance relationships and population density of aphids (Aphidoidea) flying over faba bean fields from 1982-98. The flight activity of 24 aphid species was observed. Among them, the species representing a risk to the faba bean crop were *Acyrthosiphon pisum* (Harris), *Aphis fabae* Scopoli, *A. craccivora*, *Macrosiphum euphorbiae* (Thomas) and *Myzus persicae* (Sulzer) (Hemiptera: Aphididae). The number of individuals differed yearly, depending on air temperature, relative humidity, and rainfall. Also, Elango *et al.* (2023) studied the impact

of weather factors on the insect populations and showed that minimum temperature negatively correlated with aphids (r =0.189).

Sharmin *et al* (2021) studied that aphid negatively showed a correlation with temperature and rainfall, and a positive correlation with relative humidity, and the correlations were not significant. Multiple regression equation showed that temperature had the highest effect which contributed 16.1 - 19.2% role on the population of aphid.

References

Ekram, A. A.; Refaei, E. A. and Taha, R.A (2019): Field evaluation of insect pests infesting *Phaseolus vulgaris* and their natural enemies in Beheira Governorate. Egypt. J. Plant Prot. Res. Inst., 2 (3): 514 – 525.

Elango, K. K.; Jayaprakash, S. A. ; Dinesh Kumar, P. and Govindaraju, K. (2023): Population phenology of insect pests in vegetable French bean, *Phaseolus vulgaris* L. and environmental forecast modeling for major pests using ARIMAX analysis International Journal of Tropical Insect Science , 43:475–484.

El-Dash, A.A.; Kolaib, M.O.; El-Defrawy, B.M. and Hossiny, M. (2018): Seasonal variation of the green beans aphid, *Aphis craccivora* (Koch) and its natural enemies on the green beans plants, *Phaseolus vulgaris*. at Menoufia Governorate . Menoufia J. Plant Prot., 3: 93 – 98.

El-Defrawi, G. M.; Emam, A. K.; Marzouk, L.A. and Rizkalla, L. (2000): Population dynamics and seasonal distribution of *A. craccivora* Koch and associated natural enemies in relation to virus disease incidence in faba bean fields. Egyptian J. of Agric. Res., 78(2): 627-64**1.**

Gamila, S. S.; Ismail, H. A. and Abd Elsamad, A. A. (2016): Population fluctuations of the main pests infesting kidney beans and its relation with some weather factors. Annals of Agric. Sci., Moshtohor, 54(4): 969–976.

Gepts, P.; Francisco, A.; Everaldo, G.D. and Blair, M.W. (2008): Genomics of *Phaseolus Beans*, a Major Source of Dietary Protein and Micronutrients in the Tropics Book cover Genomics of Tropical Crop Plants, pp. 113–143.

Helaly, M.M.; Ibrahim, A.E. and Saleh, M.R.A. (1982): Fluctuation of population densities of *Empoasca* sp, *Aphis craccivora* Koch.and *Tetranycus arabicus* Attiah attacking cowpea plants at Zagazig. Egypt. Bull Soci. Ent. Egypt, 64:35-43.

Kuroli, G.; Pocsai, K. and Nemeth, L. (1999): Flight activity and population changes of aphids in faba bean. Noveny vedelem, 35(11): 545-554.

Reyes-Moreno and Octavio Paredes-López (1993): Hard-to-cook phenomenon in common beans--a review, 33(3):227-286.

SAS Institute (2003): SAS Version 9.1. SAS Institute Inc., Cary, North Carolina.

Sharmin, M. A.; Amin, M. R.; Miah, M. R. U. and Akanda, A. M. (2021): Seasonal dynamics of bean aphids and its relationship with the abundance of Lady Bird Beetles. Bangladesh Journal of Zoology, 48(2): 357–363.