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Effect of Different Sowing Dates of Faba Bean on the Population Density of the Legume Aphid, *Aphis craccivora* (Koch.) (Homoptera: Aphididae).

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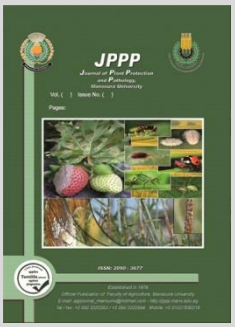

ABSTRACT

The legumes aphid, *Aphis craccivora* (Koch.) (Homoptera: Aphididae) is one of the most destructive pests affecting faba bean in Egypt. This study investigated the impact of different planting dates on the population density of *A. craccivora* in Faraskour region during 2022/23 and 2023/24 seasons. The effects of natural enemies and mean temperature (°C) and relative humidity (%), were performed. The findings revealed that there were three seasonal population peaks of *A. craccivora*, in each of plantation dates with the 3rd plantation date recorded the highest number of *A. craccivora* followed by the second and first ones during the two years. Statistical analysis revealed that the populations of *A. craccivora* were not significantly influenced by daily mean temperature, relative humidity, or predators. Four predatory insect species were recorded on faba bean: the eleven-spotted ladybird (*Coccinella undecimpunctata*) (Coleoptera: Coccinellidae), the whiplash beetle (*Paederus alferii*) (Coleoptera: Staphylinidae), the lacewing aphid lion (*Chrysoperla carnea*) (Neuroptera: Chrysopidae), and the minute pirate bug (*Orius* spp.) (Heteroptera: Anthocoridae).

***Keywords**: Aphis craccivora,* Faba bean, Plantation dates.

INTRODUCTION

The faba bean (*Vicia faba* L.) is one of the most significant economical crops, ranking as the leading leguminous food and serving as a primary source of plant protein in Egypt. However, its production is often challenged by insect pests and diseases (Metwally *et al*., 1997). Faba beans, originally domesticated in the Hindustani region of Central Asia, are cold-tolerant leguminous crops now grown across a diverse range of climates, spanning from tropical to sub-arctic zones (Zeven and Zhukovsky, 1975). In Egypt, they represent a vital source of protein for human diets and are also an important component of livestock feed. The Assiut Governorate is considered one of the primary areas for faba bean cultivation within the country (Elsayed *et al*., 2021). In Egypt, faba bean is not only a major source of protein for both human consumption and livestock feed but also provides valuable pollen and nectar that attract natural enemies of insect pests (Bazazo, 2010).

However, faba bean crops are vulnerable to a range of insect pests that can inflict considerable damage. Among the most destructive is the legume aphid, *Aphis craccivora* (Koch) (Homoptera: Aphididae), which significantly reduces both the quality and quantity of yield (Aly and Markadey, 1990; Abdallah *et al*., 2000; Mohamed and Slman, 2001). One of the key factors contributing to yield fluctuations is the cowpea aphid, *A. craccivora*, which causes substantial crop losses. This occurs not only through direct feeding damage but also due to its role as a vector and transmitter of several viral diseases (Mahmoud *et al*., 2015; Jaskulska *et al*., 2017; Popat *et al*., 2019).

An integrated pest management program requires evaluating the impact of various agricultural practices, such as planting dates, on *Aphis craccivora* populations in faba bean crops and their associated predators.

This study aimed to examine the effect of planting date on the population density of *Aphis craccivora* and its associated predators in faba bean crops.

MATERIALS AND METHODS

This study was conducted on a private farm in the Faraskour region over two successive seasons, 2022/23 and 2023/24, on an area of approximately 525 m² per season.

The occurrence and seasonal abundance of the legume aphid, *Aphis craccivora* and its associated predators on faba bean plants were monitored, along with the impact of planting dates on the population density of this insect and its natural enemies. The area about 525 m² divided to three equal plots175 m², each plot divided to four replicate represented one of the plantation date. The replicates arranged in Completely Randomized Design. The experimental area was planted with faba bean variety Sakha 2 on different sowing dates at early October, November, and December. Observations began one month after planting and continued until the end of the season. Standard agricultural practices were followed consistently, with no insecticidal treatments applied throughout the growing period.

Influence of planting dates on the legume aphid and its associated predators:

The main insect pests:

The experiment was conducted to study influence of planting dates on the legume aphids (*A. craccivora* Seeds were sown in three consecutive dates at 30 days intervals i.e. October 1st; November 1st and December 1st for both seasons. Sakha 2 variety was used in cultivation.

Two sample methods were used to monitor populations of *A. craccivora* and its predators. The leaf samples consisted of 100 leaflets (25 leaflets x 4 replicates) which were collected weekly in plastic bags and directly transferred to the laboratory to count number of *A. craccivora*

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and its predators using stereomicroscope. Concerning predators, they were directly counted on 25 plants per plot in the field. The second method was the sweep-net**.** Throughout the growing season, in the same experimental area, fifty double strokes were taken weekly from faba bean plants. The collected predators were placed in plastic bags and transported to the laboratory, where they were anesthetized with diethyl ether for recording, counting, and identification.

Influence of weather factors

The Central Laboratory for Agricultural Climate supplied data on the average air temperature (°C) and relative humidity (R.H. %) in the experimental area over the duration of the study.

Statistical analysis

The data were analyzed using Analysis of Variance (ANOVA), and mean comparisons were conducted using Duncan's Multiple Range Test (1955) and Least Significant Difference (LSD) at a 5% probability level.

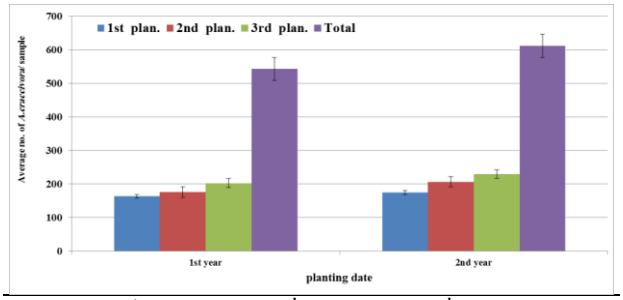
RESULTS AND DISCUSSION

Seasonal numbers of *A. craccivora*:

Data represented in (Fig. 1) show the seasonal average number of *A. craccivora* on faba bean, the data showed that the total numbers were higher in the second year than first year and represented by 612.1 and 543.2 indiv./ sample respectively .

During the 1st year, the 3rd plantation date recorded the highest number of *A. craccivora* (203.1 insects), followed by the second (176.4 insects) and first (163.7 insects) plantation dates. A similar trend was observed in the 2nd year, where *A. craccivora* numbers were highest on the 3rd plantation date (229.4 insects), followed by the second (207.3 insects) and first (175.0 insects) plantation dates.

In Kafr El-Sheikh Governorate Aassar *et al*. (2017) found that, *A. craccivora* and *Liriomyza trifolii* accounted for 26% and 74% of the total insect population, respectively. In Qaliobia Governorate, their relative densities were 48.5 and 51.5%, respectively.



Year	1st plan.	2nd plan.	3rd plan.	Total
1st	163.7±21.2 a	176.4±13.8 a	203.1±15.8 a	543.2
2nd	175.0±19.4 b	207.3±14.4 ab	229.8±17.6 a	612.1

Fig. 1. Seasonal average numbers of *A. craccivora* insects per/ sample during two years in Faraskor region. Means followed by the same letter indicate no significant difference. LSD 0.05 = 48.89 and 48.99 insects for 1st and 2nd years.

Population fluctuation of *A. craccivora*:

Data presented in (Fig. 1) illustrate the population density of *A. craccivora* and the number of peaks on faba bean leaves during the 1st year of the study across the three planting dates.

During the first year, the first planting date (Fig. 1), *A. craccivora* on faba bean leaves exhibited three peaks of infestation, with the highest peak recorded on December 8, 2022 (324 adults/100 leaves). The daily average temperature and relative humidity (Temp. and R.H.) were 20.2°C and 66.6%, respectively.

In the second planting date, *A. craccivora* on faba bean leaflets also showed three peaks of infestation, with the highest peak recorded on March 16, 2023 (286 adults/100 leaves). The daily average (Temp. and R.H.) were 18.7°C and 65% respectively.

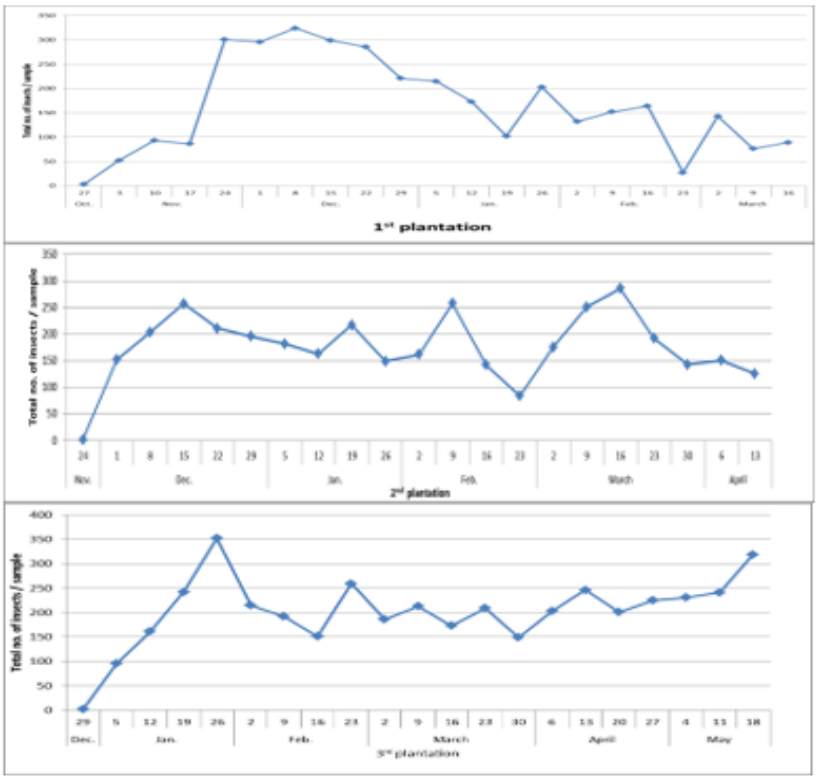


Fig. 1. Total numbers of *A. craccivora* insects per/ sample in three plantation dates during the 1st year in Faraskor region.

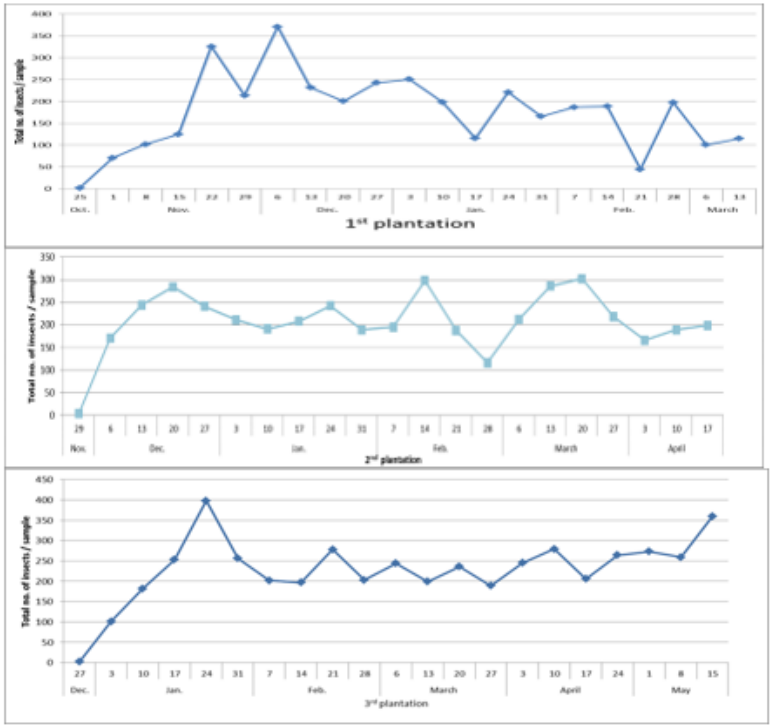


Fig. 1. Total numbers of *A. craccivora* insects per/ sample in three plantion dates during the 2nd year in Faraskor region.

While in the 3rd plantation date, *A. craccivora* on faba bean leaves also showed three peaks of infestation, with the highest peak recorded on 26th of Jan. 2023 (352 adults /100 leaves) with daily means, daily range of (Temp. and R.H.) were 17.4Co and 74.7% respectively.

During the second year of study, the data presented in (Fig. 1) illustrate the population density of *A. craccivora* and the number of peaks on faba bean leaves across the three planting dates.

During the first planting date (Fig. 1), *A. craccivora* on faba bean leaves exhibited three peaks of infestation, with the highest peak recorded on 6th of Dec. 2023 (371 adults/100 leaves), the daily average (Temp. and R.H.) were 21 Co and 75.1% respectively .

During the second planting date, *A. craccivora* on faba bean leaves also showed three peaks of infestation, with the highest peak recorded on 20th of March 2024 (302 adults/100 leaves), the daily average (Temp. and R.H.) were 17.5 Co and 68.1% respectively .

During the 3rd plantation date, *A. craccivora* on faba bean leaves also showed three peaks of infestation, with the highest peak recorded on 24th of Jan. 2023 (398 adults /100 leaves) with daily means, daily range of (Temp. and R.H.) were 17.9Co and 65.1% respectively.

Helal *et al*. (1997) reported that *A. craccivora* populations exhibited three abundance peaks in January, February, and March during both seasons on faba bean crops. Aphid and predator populations were relatively higher in the second season, with *Scymnus* spp. being the most prevalent predator. Additionally, three overlapping aphid generations were observed throughout the inspection period. Borad *et al*. (2020) found that aphids first appeared in early March during the summer season, initially in low numbers, peaking from flowering to pod development in early April, and disappearing by early May. In the *kharif* season, aphids emerged in late August, peaked in early October, and disappeared by early November. No significant impact of abiotic factors on aphid population dynamics was observed.

Influence of mean temp. (℃) and relative humidity (R.H.%) and associated predators on *A. craccivora*:

The predatory insects that recorded on faba bean were; eleven spotted ladybird, *Coccinella undecimpunctata* (Coleoptera: Coccinellidae), whiplash beetles, *Paederus alferii* (Coleoptera: Staphylinidae), lacewing aphid lion, *Chrysoperla carnea* (Neuroptera: Chrysopidae), minute pirate bug, *Orius* spp. (Heteroptera: Anthocoridae).

The simple correlation (r) and regression (b) coefficients between the mean temp., R.H., associated predators, and *A. craccivora* during the 1st and 2nd years are shown in Table (1-2).

During the 1st year, the correlation between *A. craccivora* and each of temp., relative humidity and predators are non-significant in the first, second and 3rd plantation.

Table 1.Simple correlation, regression coefficients and explained variance (E.V.) between tested weather factors and weekly means of *A. craccivora* populations during 2022 & 2023 at Damietta Governorate.

Plantation	Factor	Simple correlation analysis		Multiple Partial regression analysis		
		r.	P.	b.	p.	E.V.
Oct.	Temp.	-0.029	0.90	-6.630	0.63	5.50%
	R.H.	0.126	0.59	1.823	0.82	
	P. alferii	-0.105	0.65	0.720	0.98	
	C. undecimpunctata	-0.066	0.78	-5.410	0.63	
	Orius spp.	0.106	0.65	2.86	0.79	
	C. carnea	-0.117	0.62	-3.968	0.57	
Nov.	Temp.	-0.172	0.46	-3.988	0.60	27.10%
	R.H.	0.120	0.61	1.138	0.80	
	P. alferii	0.265	0.25	5.266	0.37	
	C. undecimpunctata	0.391	0.08	2.807	0.55	
	Orius spp.	0.302	0.18	7.255	0.29	
	C. carnea	-0.002	0.99	-0.989	0.64	
Dec.	Temp.	0.220	0.34	5.563	0.46	53.90%
	R.H.	0.319	0.16	6.560	0.15	
	P. alferii	0.228	0.32	12.431	0.06	
	C. undecimpunctata	0.215	0.35	2.330	0.60	
	Orius spp.	0.397	0.08	20.695	0.01	
	C. carnea	0.282	0.22	0.989	0.59	

Table 2. Simple correlation, regression coefficients and explained variance (E.V.) between tested weather factors and weekly means of *A. craccivora* populations during 2023 & 2024 at Damietta Governorate.

Plantation	Factor	Simple correlation analysis		Multiple Partial regression analysis		
		r.	P.	b.	p.	E.V.
Oct.	d.m. Temp.	-0.191	0.41	-6.094	0.47	33.50%
	R.H.	-0.041	0.86	-1.528	0.80	
	P. alferii	0.485	0.03	34.55	0.05	
	C. undecimpunctata	0.025	0.92	-1.67	0.78	
	Orius spp.	0.013	0.96	3.174	0.63	
	C. carnea	-0.166	0.47	-4.884	0.25	
Nov.	d.m. Temp.	-0.209	0.36	-6.431	0.49	26.40%
	R.H.	0.204	0.37	2.468	0.49	
	P. alferii	0.132	0.57	0.89	0.84	
	C. undecimpunctata	0.389	0.08	4.667	0.24	
	Orius spp.	0.283	0.21	3.936	0.50	
	C. carnea	0.096	0.68	0.4	0.83	
Dec.	d.m. Temp.	0.172	0.46	-0.6	0.94	50.80%
	R.H.	-0.454	0.04	-9.053	0.04	
	P. alferii	0.191	0.41	8.49	0.16	
	C. undecimpunctata	0.219	0.34	5.317	0.17	
	Orius spp.	0.292	0.20	12.081	0.07	
	C. carnea	0.286	0.21	2.444	0.21	

During the 2nd year, the correlation between the *A. craccivora* and each of temp. relative humidity and predators are non-significant in the first, second and 3rd plantation expect, *P. alferii* was significant positive in the first plantation and R.H. was significant negative in the 3rd plantation.

The obtained results were consistent with those recorded by Aassar et al. (2017) reported the presence of three predatory insects, Coccinella undecimpunctata L., Chrysoperla carnea (Stephens), and Orius albidipennis (Reut.) alongside A. craccivora Koch and Liriomyza trifolii (Burgess) on faba bean plants. In Kafr El-Sheikh Governorate, their relative abundances were 50%, 34%, and 18%, respectively, while in Qaliobia, they were 35.5%, 37%, and 30%, respectively. The study also found that these predators reduced the populations of A. craccivora and L. trifolii by 36% and 12%, respectively. Additionally, C. undecimpunctata was identified as the most effective predator against both pests. Helal, et al. (1997) who revealed that the predators (Chrysoperia carnea Steph., Coccinella undecimpunctata L., Paederus alfierii (Koch) and Scymnus spp.) affected the leguminous aphid, Aphis craccivora (Koch) populations.

The populations of both aphids and associated predators were relatively higher in the second season than in the first one *Scymnus* spp. was the most prevalent in both seasons. The results also showed three overlapping generations of aphids during the inspection period in the two seasons. The same authors discussed the three climatic factors affected the leguminous aphid, *Aphis craccivora* (Koch) populations insignificantly in the two seasons except for relative humidity which affected it highly significantly. Borad *et al.* (2020) reported the presence of natural enemies, including syrphid flies and coccinellids, in cowpea fields. Coccinellids were more active than syrphid flies in both seasons. A significant positive correlation was observed between aphid populations and natural enemies, as their activity increased with rising aphid numbers. The highest population of natural enemies coincided with peak aphid abundance, occurring in the first week of April during the summer season and the first week of October in the kharif season of 2017.

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تأثير مواعيد الزراعة المختلفة للفول البلدى على الكثافة العددية لمن البقوليات

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الملخص

تعد حشرة من البقوليات من أكثر الآفات تدميرًا التي تصيب محصول الفول البلدي في مصر. تهدف هذه الدراسة إلى دراسة تأثير مواعيد الزراعة المختلفة على الكثافة العددية لهذه الحشرة في منطقة فارسكور خلال موسمي 23/2022 و24/2023. كما تم تحليل تأثير الأعداء الطبيعية ودرجات الحرارة المتوسطة (°م) والرطوبة النسبية (%). أظهرت النتائج وجود ثلاث ذروات موسمية لتعداد الحشرة في كل موعد زراعة خلال العامين. حيث سجلت الزراعة في الموعد الثالث أعلى عدد لهذه الحشرة، تلتها الزراعة في الموعد الثاني ثم الموعد الأول، وذلك خلال الموسمين. كما أوضح التحليل الإحصائي أن تعداد الحشرة لم يتأثر بشكل معنوي بدرجة الحرارة المتوسطة اليومية أو الرطوبة النسبية أو وجود المفترسات. تم تسجيل أربع أنواع من الحشرات المفترسة على الفول البلدي، وهي: أبو العيد ذو الأحد عشر نقطة، الحشرة الرواغة (رتبة غمدية الأجنحة)، وأسد المن (رتبة شبكية الأجنحة) وبقة الأوريس (رتبة نصفية الأجنحة).