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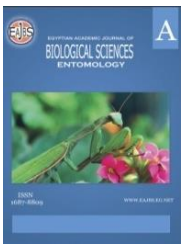

Impact of Sowing Dates and Relation to the Population of *Aphis craccivora* (Koch) on the Broad Bean (*Vicia faba* L.) under Climate Changes

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ABSTRACT

The aim of the study was to evaluate the effect of sowing dates and their relation to the population density of *Aphis craccivora* (Homoptera: Aphididae) and its associated predators with the effect of weather factors. The Field experiments were conducted at Qaha city, Qalyubiya Governorate, during the winter seasons 2021-2022 & 2022-2023 on the Spanish broad bean, (*Vicia faba* L.) cultivar. Three sowing dates on the 15th of November (Recommended); the 1st of December and the 15th of December during winter cultivation were evaluated. Results showed that the sowing date of 15th December in the first and second winter seasons was the preferable date for sowing. Where the lowest general mean numbers of *A. craccivora* were 21.25± 1.80& 24.01±1.29 individuals/two successive seasons, with higher productivity recorded 980.15±43.46&1000.00±38.93 Kg./two seasons, respectively. while, the highest general mean numbers of *A. craccivora* for sowing dates on the 15th of November and 1st of December were 46.09±2.52&48.85±2.75 and 41.34±2.43&43.57±1.87 individual/two seasons, respectively. Also, the lower productivity on the 15th of November and 1st of December were 538.8±33.46 & 590.60±24.62 and 680.00±43.41&646.71±26.50 Kg. for two seasons. Statistical analysis showed that there were highly significant differences between the sowing date on the 15th of December and each of the sowing dates on the 15th of November and the 1st of December. Also, there were no significant differences between the sowing dates on the 15th of November and the 1st of December. Furthermore, showed result the effect Plant ages, Natural enemies, Temperature, R.H.% and wind speed had different effects (significant or insignificant) on the population *A. craccivora*.

INTRODUCTION

Broad bean plant *Vicia faba,* L. is one of the most important leguminous crops, as it is used as vegetables, dried, or eaten green (Mohamed, 2003). It is also known as a meat substitute (Ebadah, *et al*., 2006). In addition, broad beans are the ancillary benefits of nitrogen fixation in plants and thus reduce fertilizer requirements (Hendawey and Younes 2013). In the field, the broad bean plant is susceptible to infestation by many insect pests. Aphids are the most dangerous insect pests attacking broad bean crops worldwide (Pickett *et al*., 1992) including Egypt (Mahmoud *et al*., 2017). Among them, the cowpea aphid, *Aphis craccivora* (Koch) (Homoptera: Aphididae) is widely distributed in different habitats

in the world. Sowing dates based on weather factors are important ecological factors that affect both infestation levels and crop productivity. The population density of *A. craccivora* was significantly affected by the sowing date (Nisar and Rizvi, 2017). In Addition, natural enemies and weather conditions are the most important factors affecting the population dynamic of insects. However, the population densities of the natural enemies and their relation to the insects are believed to be important in enlightening integrated control of the insect pests. The interaction between insects and their natural enemies is an essential ecological process that contributes to the regulation of the insect population (Yadav, *et al.* 2015; Nayak *et al*., 2021 and Awadalla *et al.* 2016). The common predators observed in faba bean fields were *Coccinella undecimpunctata, Coccinella septempunctata, Chrysoperla carnea, Syrphus corollae* and *Orius* sp. (El-Defrawi *et al*., 2000; Abdel-Samad and Ahmed (2006); Khodeir, *et al.* 2020).

The aim of this study is to the effect of sowing dates on the population of legume aphids *A. craccivora* (Koch), and the effect of predators with effect weather factors.

MATERIALS AND METHODS

Field experiments were conducted in Qaha city, Qalyubiya Governorate, during the winter seasons 2021-2022 and 2022-2023 on the Spanish broad bean (*Vicia faba* L.) cultivar. An area of 1200 m^2 was divided into four replicates for each sown date [Each replicate was 100 m^2, and each sample was collected weekly and consisted of 10 plants/ replicate =40 plants/ sowing date] using direct count was a random technique. The experiment was conducted to study the effect of three sowing dates [15th of November (Recommended); 1st of December and 15th of December] during the winter season with the relation between the population of aphid, *Aphis craccivora* (Koch) (nymphs and adults) and its associated predators species (immature and adult) were recorded in the field they. The sampled predators were the eleven-spotted ladybird beetle, *Coccinella undecimpunctata* L.; the seven-spotted ladybird, *Coccinella sptemunctata* L.; the green lacewing *Chrysoperla carnea* (Stephens), and the hoverfly *Syrphus corolla* (Fabricius). The agricultural practices were done as recommended and absence of any insecticidal application. The weather factors (daily mean maximum; minimum temperatures; daily mean wind speed (mph) and daily mean R.H.%) were obtained from the central laboratory for agricultural climate, at Sheben El-Qanater Meteorological Station, Qalyubiya Governorate. The effect of weather factors on the population of *A. craccivora* and their predators was examined. Samples were identified by the aid of the Taxonomy Research Department, Plant Protection Research Institute, Giza, Egypt. The crop yield was estimated as follows:1- Average number of flowers/ plant (x) average weight of fruit/plant = weight kg /plant. 2- Weight kg. /Plant (x) number of plants /replicate= productivelly /kg. replicate. 3- Productivity/kg. replicate (x) number replicate /sowing date = productivelly /kg. for sowing date. (Omran, *et al*. 2010 & Rehab, *et al*. 2019).

The statistical analysis (Simple correlation and partial regression) of the obtained data was done by using SAS Institute (1997) program. Whereas the means were compared through LSD tests, least significant differences at P=0.05 level.

RESULTS AND DISCUSSION

Data in Figure (2) Show that infestation of *Aphis craccivora* appeared during the fourth week of November (29.75&17.80 individuals (indiv.)/plant) at sowing date 15th of November (Recommended) for 2021-2022 and 2022-2023 seasons. Similarly, the sowing date of 1st of December shows the infestation of *A. craccivora* appeared during the second week of December (27.50&18.75 indiv./plant) during the 2021-2022and2022-2023 seasons. Overall,

the highest population was sowing dates on the 15th of November and 1st of December with suitable climatic factors (Fig. 1) during 2021-2022and 2022-2023 seasons. The sowing date on the 15th of December the infestation of *A. craccivora* appeared 4th week of December and the lower population (8.25&6.25 indiv./plant) with decreased climatic factors in the 2021-2022and 2022-2023 seasons.

The population fluctuation of *A. craccivora* recorded two peaks on all sowing dates as follows: The first peak for sowing date on 15th of November on Dec. 2nd week record 64.50&58.40 and the second peak were 91.23&92.05 indiv./ plants on Jan. 4th week with high climatic factors during 2021-2022and2022-2023 seasons, respectively, (Figs. 1,2&3A). The first peak of *A. craccivora* for sowing date on 1st of December recorded 59.50&46.25 on Dec. 4th week and the second peak was 89.50&95.00 indiv. /Plants on Fab. 3rd week during seasons 2021-2022and2022-2023, respectively, with suitable climatic factors (Figs. 1,2&3B). Whereas, the first peak of *A. craccivora* for sowing date on 15th of December recorded 33.75&31.25 on Fab. 1st week during 2021-2022and2022-2023 seasons, respectively. The second peak on the Apr. 1st week was 43.75 indiv./ plants during the 2021-2022 season. The second peak for the 2022-2023 season on Mar. 3rd week was 46.00 indiv./plants with not favorable climatic factors for *A. craccivora* population development [show Figs. (1,2&3C)]. The population of *A. craccivora* increases and decreases until the end of the season with high and lower weather factors.

The data in Table (1) showed that the highest general mean numbers of *A. craccivora* per season and no significant differences between the sowing date on the 15th of November and 1st of December were 46.09±2.52&48.85±2.75 and 41.34±2.43 &43.57±1.87 indiv. /Seasons 2021-2022 and 2022-2023, respectively. While the lower general mean numbers of *A. craccivora* per season and highly significant differences between the previous sowing dates and sowing date on the 15th of December (21.25±1.80&24.01±1.29 indiv. /Seasons 2021-2022 and 2022-2023, respectively.

Statistical analysis in Table (1) showed that the simple correlation coefficient values for effect between mean numbers of *A. craccivora* on the 15th of November (Recommended) and each of the plants age[1&2], *C. sptemunctata*, temp. max. and wind speed were positive and significant during the 2021-2022 and 2022-2023 seasons. While the *C. undecimpunctata* and *C. carnea* were positive and highly significant for 2021-2022 and 2022-2023 seasons. Whereas, the plant age[3] and R.H.% were negative and significant during 2021-2022 and 2022-2023 seasons. While, the temp. Min. was negative and significant during 2021-2022 and 2022-2023 seasons. Hence, *S. corolla* was positive and nonsignificant for 2021-2022 and 2022-2023 seasons.

The results in Table (1) indicated that the partial regression line values the effect on mean numbers of *A. craccivora* to sowing date on 15th of November for plant age[1&2] was positive and highly significant during 2021-2022 and 2022-2023 seasons. However, the plant age was negative and highly significant during 2021-2022 and 2022-2023 seasons. Whereas, the *C. undecimpunctata* and *C. sptemunctata* were positive and significant during 2021-2022 and 2022-2023 seasons. While the *C. carnea* and temp. Min. were negative and nonsignificant during 2021-2022 and 2022-2023 seasons. But, the *S. corolla*, temp. max., R.H.% and wind speed were positive and nonsignificant for 2021-2022 and 2022-2023 seasons.

The combined effect of all plant ages, natural enemies and weather factors on mean numbers of *A. craccivora* were highly significant for probability value "P" during 2021-2022 and 2022-2023 seasons. The explained variance (E.V.%) showed very high on 15th November and Which explains the combined effect of these different factors on *A. craccivora* population as well as the remaining percentage is due to other factors.

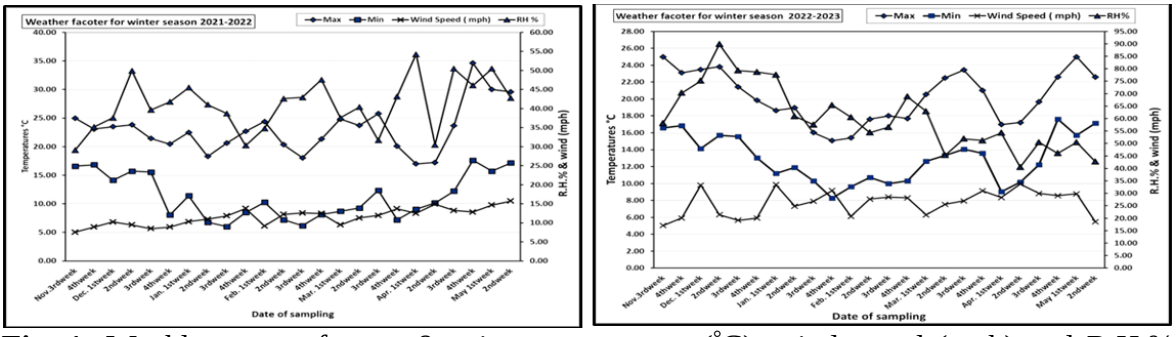

Fig. 1: Weekly mean of max. & min. temperatures (˚C), wind speed (mph) and R.H.% during two winter seasons at Qalyubiya Governorate.

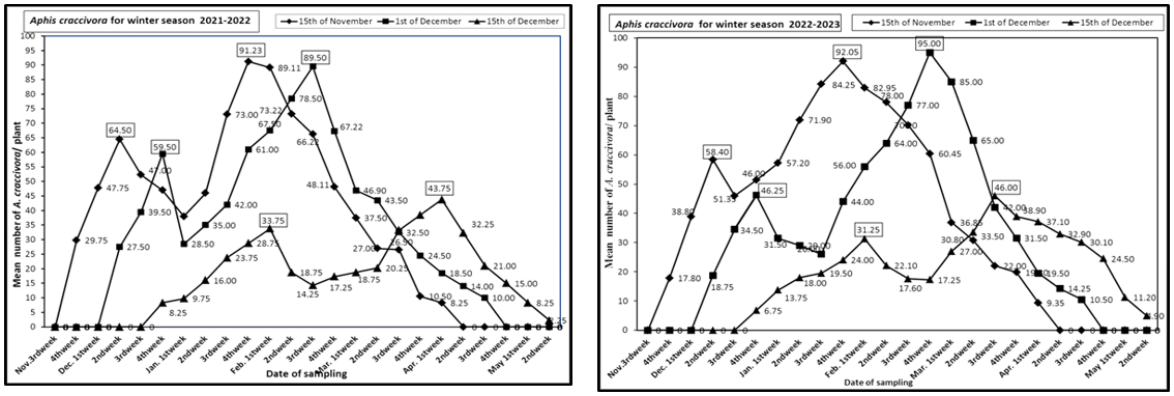

Fig. 2: Weekly mean numbers for three plantation dates on population *Aphis craccivora* per plant on *Vicia faba* during two winter seasons at Qalyubiya Governorate.

Statistical analysis in Table (1) showed that the simple correlation coefficient values for effect between mean numbers of *A. craccivora* for sowing date on 1st of December and each of plant age[1] and R.H.% were positive and nonsignificant for 2021-2022 and 2022-2023 seasons. The plant age[2&3] and wind speed were positive and significant in 2021-2022 and 2022-2023 seasons. Whereas, the *C. undecimpunctata* was positive and significant during the 2021-2022 season, it differed was positive and highly significant during 2022-2023 season. On the other side, the *C. sptemunctata*, *C. carnea*, *S. corolla* and temp. Max. were positive and highly significant in 2021-2022 and 2022-2023 seasons. The temp. Min. recorded negative and significant during 2021-2022 and 2022-2023 seasons.

The partial regression line values revealed that the effect on mean numbers of *A. craccivora* for sowing date on 1st of December and each of plant age[1] and *C. carnea* were positive and highly significant during 2021-2022 and 2022-2023 seasons. While, the plant age[2&3], *C. sptemunctata* and temp. max. were positive and significant for 2021-2022 and 2022-2023 seasons. The *C. undecimpunctata* was negative and significant for 2021-2022 and 2022-2023 seasons. Whereas, the *S. corolla* recorded positive and nonsignificant for the 2021-2022 season, but it recorded negative and highly significant for 2022-2023 season. Additionally, the temp. Min. recorded negative and significant for 2021-2022 season, but it recorded negative and nonsignificant for 2022-2023 season. The R.H.% record was negative and nonsignificant for 2021-2022 and 2022-2023 seasons. However, the wind speed was positive and nonsignificant for 2021-2022 season and it recorded positive and significant for 2022-2023 season. The "P" value was highly significant during 2021-2022 and 2022&2023 seasons. The E.V.% showed very high and which explains the combined effect of these different factors on *A. craccivora* population as well as the remaining percentage is due to other factors.

The data in Table (1) showed the simple correlation coefficient values for effect between mean numbers of *A. craccivora* for the sowing date on the 15th of December and each of the plant age[1], *C. undecimpunctata*, *C. carnea* and the temp. max recorded positive and highly significant during 2021-2022 and 2022-2023 seasons. While, the plant age was positive and significant for 2021-2022 and 2022-2023 seasons. However, the plant age and the temp. min. were negative and significant for 2021-2022 and 2022-2023 seasons. Whereas the *S. corolla* was positive and nonsignificant for the 2021-2022 season, it recorded positive and significant for 2022-2023 season. Additionally, the R.H.% recorded negative and nonsignificant for 2021-2022 and 2022-2023 seasons. The wind speed recorded positive and nonsignificant for 2021-2022 and 2022-2023 seasons.

Fig. 3: Growth of plants at three sowing dates.

Table 1: Simple correlation coefficient and Partial regression line values for different factors on mean numbers of *A. craccivora* /plant for three sowing dates and productivelly/Kg for Spanish broad bean cultivar, (*Vicia faba* L.) during winter seasons 2021-2022 and 2022-2023.

year	Planting date	15th of November							1st of December							15th of December						
	Factors	Simple correlation		Partial regression		Analysis of variance			Simple correlation		Partial regression		Analysis of variance			Simple correlation		Partial regression		Analysis of variance		
		r	P	b	P	F	P	E. V. %	r	P	b	P	F	P	E. V. %	r	P	b	P	F	P	E. V. %
2021-2022	Plant age[1]	0.108	0.058*	0.420	0.006**	9.35	0.003**	93.63	0.166	0.494	0.387	0.002**	22.23	0.0002**	96.22	0.149	0.002**	0.623	0.040*	7.72	0.006**	97.38
	Plant age[2]	0.760	0.057*	0.910	0.007**				0.354	0.036*	0.492	0.058*				0.199	0.035*	1.146	0.041*			
	Plant age[3]	-0.213	0.379	-0.121	0.005**				0.462	0.046*	0. 152	0.048*				-0.151	0.055*	-0.509	0.006**			
	C. undecimpunctata	0.795	0.001**	0.544	0.054*				0.574	0.020*	-0.336	0.036*				0.720	0.001**	-0.377	0.002**			
	C. sptemunctata	0.417	0.050*	0.945	0.055*				0.864	0.001**	0.182	0.051*				0.183	0.051*	-0.154	0.057*			
	C. carnea	0.806	0.001**	-0.269	0.313				0.756	0.002**	0.133	0.001**				0.671	0.001**	-0.340	0.029*			
	S. corolla	0.295	0.219	0.818	0.109				0.577	0.009**	0. 914	0.248				0.205	0.398	0.614	0.023*			
	Temp. Max.	0.568	0.021*	0.734	0.671				0.632	0.003**	0.711	0.027*				0.308	0.001**	-0.481	0.025*			
	Temp. Min.	-0.552	0.034*	-0.411	0.245				-0.548	0.025*	-0.704	0.047*				-0.326	0.052*	0.334	0.023*			
	R. H. %	-0.112	0.961	0.469	0.240				0.156	0.523	-0.825	0.785				-0. 541	0.825	0.256	0.151			
	Wind speed (mph)	0.294	0.021*	0.740	0.614				0.226	0.052*	0.103	0.162				0. 891	0.716	-0.248	0.867			
	General mean of *A. craccivora* ±S.E (L.S.D.=10.08· F= 14.08· P=0.001**)	46.09±2.52 (a)							41.34±2.43 (a)							21.25±1.80 (b)						
	Productivity/Kg/planting date (L.S.D.=215.84· F= 14.80·P=0.001**)	538.80±33.46 (b)							680.00±43.40 (b)							980. 15±43.46 (a)						
2022-2023	Plant age[1]	0. 628	0.028*	0.168	0.005**	13.84	0.001**	95.60	0.201	0.408	0.974	0.005**	22.38	0.0002**	95.23	0.253	0.006**	0.539	0.042*	14.46	0.009**	97.78
	Plant age[2]	0.117	0.032*	0.271	0.005**				0.398	0.051*	0.954	0.030*				0.759	0.057*	0.520	0.022*			
	Plant age[3]	-0.251	0.299	-0.116	0.007**				0.509	0.025*	0. 180	0.036*				-0. 651	0.041*	-0.050	0.006**			
	C. undecimpunctata	0.784	0.001**	0.205	0.025*				0.623	0.004**	-0.918	0.050*				0.843	0.001**	0.581	0.001**			
	C. sptemunctata	0.493	0.031*	0.373	0.056*				0.834	0.001**	0.851	0.032*				0.186	0.001**	0.334	0.036*			
	C. carnea	0.846	0.001**	-0.592	0.478				0.752	0.002**	0.484	0.001**				0.765	0.001**	-0.893	0.049*			
	S. corolla	0.317	0.185	0.426	0.523				0.594	0.007**	-0.813	0.001**				0.145	0.053*	0.598	0.272			
	Temp. Max.	0.591	0.037*	0.766	0.663				0.652	0.002**	0.508	0.052*				0.320	0.001**	0.140	0.051*			
	Temp. Min.	-0.545	0.025*	-3.879	0.199				-0.539	0.027*	-0.916	0.737				-0.395	0.043*	0.860	0.048*			
	R. H. %	-0.416	0.865	0.326	0.411				0.197	0.417	-0. 867	0.815				-0.267	0.782	0.280	0.036*			
	Wind speed (mph)	0.271	0.050*	0.406	0.688				0.215	0.035*	0.634	0.049*				0.175	0.472	-0.579	0.298			
	General mean of *A. craccivora* ±S.E (L.S.D.= 9.81· F= 13.92· P=0.001**)	48.85±2.75 (a)							43.57±1.87 (a)							24.01±1.29 (b)						
	Productivity /Kg/planting date (L.S.D.=200.79· F= 21.46· P=0.001**)	590.60±24.62 (b)							646.71±26.50 (b)							1000.00±38.93 (a)						

Plant age[1] = Form date from sowing to 45th days of plant age. Plant age[2] = Form 45th to 90th days of plant age. Plant age = Form 90th days of plant age to the end of growing season.

Temp. Max.: Maximum temperature. Temp. Min.: Minimum temperature. Means followed by the same litter in each row are not significantly different.

(r): correlation coefficient value. (b): Partial coefficient value (slope). (P): Probability value. (*): Significant at probability level 5%. (**): Highly significant at probability level 1%. (+) = Positive correlation. (–) = Negative correlation. General mean ±S.E = General Mean of *A. craccivora* population /sowing date/season ± standard error.

The results in Table (1) showed that the partial regression line values for the sowing date on the 15th of December for effect on mean numbers of *A. craccivora* and each of plant age[1&2] and temp. min. were positive and significant for 2021-2022 and 2022-2023 seasons. Hence, the plant age was negative and highly significant for the 2021-2022 and 2022-2023 seasons. However, the *C. undecimpunctata* was negative and highly significant for 2021-2022 season, but it recorded positive and high significance in 2022-2023 season. Also, the *C. sptemunctata* was negative and significant for 2021&2022 season, as well as, it recorded positive and significant for 2022-2023 season. Whereas, the *C. carnea* was negative and significant for 2021-2022 and 2022-2023 seasons. Additionally, the *S. corolla* was positive and significant for 2021-2022 season, but, it recorded positive and nonsignificant for 2022-2023 season. The temp. max was negative and significant for 2021-2022 season, but it recorded positive and significant for 2022-2023 season. However, the R.H.% recorded positive and nonsignificant for 2021-2022 season, and it recorded positive and significant for 2022-2023 season. Finally, the wind speed was negative and nonsignificant for 2021-2022 and 2022-2023 seasons.

The results in Table (1) revealed that the "P" value was highly significant for 2021-2022 and 2022-2023 seasons. The E.V.% value was very high on the 15th of December and which explains the combined effect of these different factors on *A. craccivora* population, as well as the remaining percentage due to other factors.

Productivity/Kg for Three Sowing Dates (Yield/sowing date):

The data in Table (1) indicated that the sowing date on the 15th of December gave the highest productivity (980.15±43.46 and 1000.00±38.93 kg) at 2021-2022 and 2022-2023 seasons, respectively. Whereas, the lower productivity for sowing dates on the 15th of November and 1st of December record 538.80±33.46 & 590.60±24.62 and 680.00±43.41 & 646.71±26.50 kg at 2021-2022 and 2022-2023 seasons, respectively. Statistically, there were highly significant differences between the sowing dates on the 15 of December and the sowing dates on the 15th of November and 1st of December. Also, there were no significant differences between the 15th of November and the 1st of December. The study found that the sowing date of 15th December is the preferable date for sowing broad beans compared to other sowing dates.

Table 2: Weekly total numbers of natural enemies /40 plants of broad bean plant (*vicia faba* L.) for winter sowing at 2021-2022 and 2022-2033 seasons.

Inspection date	*Coccinella undecimpunctata*		*Coccinella Sptemunctata*		*Chrysopa carnea*		*Syrphus corolla*	
	2021-2022	2022-2023	2021-2022	2022-2023	2021-2022	2022-2023	2021-2022	2022-2023
Nov.3rdweek	0	0	0	0	0	0	0	0
4thweek	0	0	0	0	0	0	0	0
Dec. 1stweek	2	1	0	0	0	0	0	0
2ndweek	3	2	6	8	1	3	4	3
3rdweek	4	9	11	10	2	5	8	5
4thweek	7	15	15	11	8	11	14	8
Jan. 1stweek	12	11	5	12	7	9	8	12
2ndweek	10	6	7	9	5	7	7	7
3rdweek	9	7	6	9	3	6	4	7
4thweek	8	6	8	8	2	5	5	4
Feb.1stweek	8	5	18	10	6	2	11	4
2ndweek	9	8	10	11	9	2	4	3
3rdweek	12	9	9	14	11	3	5	3
4thweek	15	9	7	6	9	4	4	4
Mar.1stweek	12	9	6	6	8	6	4	9
2ndweek	10	12	4	5	7	9	3	3
3rdweek	8	8	6	5	6	7	2	2
4thweek	7	7	5	5	3	6	2	2
Apr.1stweek	6	6	3	3	2	4	0	1
2ndweek	5	5	2	2	0	3	0	1
3rdweek	3	3	1	1	0	1	0	0
4thweek	2	2	0	0	0	0	0	0
May1stweek	0	0	0	0	0	0	0	0
2ndweek	0	0	0	0	0	0	0	0
Total /season	152	140	129	135	89	93	85	78
Average ±SE/season	6.35± 0.35	5.83± 0.22	5.38± 0.34	5.63± 0.44	3.72± 0.33	3.88± 0.42	3.53± 0.38	3.26± 0.26

Number = peak of natural enemy

The Natural enemies associated with *A. craccivora* on broad bean plants.

Data in Table (2) indicated that the predator *C. undecimpunctata* appeared in 1st week of December for 2021-2022 and 2022-2023 seasons. While, the *C. Sptempunctata*, *C. carnea* and *S. corolla* appeared in the 2nd week of December for 2021-2022 and 2022-2023 seasons. Additionally, *C. undecimpunctata* the first peak on Jan. 1st week, but recorded the second peak on Feb. 4th week during season 2021-2022, but the first peak was Dec. 4th week and the second peak on Mar. 2nd week for 2022-2023 season. While the *C. Sptempunctata* recorded the first peak on Dec. 4th week for 2021-2022 season and the second peak on Feb.

1st week season 2021-2022, and it recorded the first peak on Jan. 1st week and the second peak on Feb. 3rd week for 2022-2023 season. The *C. carnea* recorded the first peak on Dec. 4th week for 2021-2022 and 2022-2023 seasons, while, it recorded the second peak on Feb. 3rd week during season 2021-2022 and it gave the second peak on Mar. 2nd week during 2022-2023 season. Finally, record the *S. corolla* the first peak on Dec. 4th week for 2021-2022 season, and it recorded on Jan. 1st week during 2022-2023 season. The second peak was recorded on Feb. 1st week for 2021-2022 season, and it recorded the second peak on Mar.1st week for 2022-2023 season.

The largest total numbers/season for *C. undecimpunctata*, while showed the lowest total numbers/season for *C. Sptempunctata* and the lower total numbers/season for *C. carnea* and *S. corolla* during 2021-2022 and 2022-2023 seasons.

DISCUSSION

The study showed that the sowing date of 15th December is the preferable date for sowing seeds for green broad beans compared to other sowing dates for infestation of *A. craccivora*. The climate changes played an important role in the growth of green broad bean plants. These results are similar to those of Mahmoud *et al.* (2015&2017) who recorded that *A. craccivora* reached a peak at the end of Nov. to half of Dec. on faba bean plants and the humidity positively affected *A. craccivora* population in faba bean plant at Menofeyia governorate, Egypt. Also, Nisar & Rizvi (2017) found that the different sowing dates had a significant effect on the aphid population and recorded one peak for *A. craccivora* on faba bean in the 3rd week of Dec. while, Seiter *et al.* (2019) stated that the sowing date affects the aphid density, and this is an effective tactic to reduce aphids damage to the crops. In determining insect population dynamics on a host plant, ambient temperature, natural enemies of insects and host plant status are key factors. In addition, Mohamed, *et al.* (2021) the Results indicated that *A. craccivora* infested faba bean plants from 21st November 2019 to 12th March 2020 during the first growing season and from 22nd November 2020 to 13th March 2021 through the second one. According to the findings, the combined impacts of environmental conditions and plant ages can explain changes in *A. craccivora* population density.

Conclusion

The study showed that the sowing date of 15th December is the preferable date for sowing the green broad bean compared to the sowing dates on 15th of November and 1st of December for infestation of *A. craccivora*. This is reflected in higher productivity of the sowing date of 15th December than sowing dates on 15th of November and 1st of December. Therefore, we recommend of sowing date on 15th December for sowing the green broad bean crop.

Declarations:

Ethical Approval: Ethical Approval is not applicable.

Competing interests: The authors declare no conflict of interest.

Funding: No funding was received.

Availability of Data and Materials: All datasets analysed and described during the present study are available from the corresponding author upon reasonable request.

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ARABIC SUMMARY

تأثير مواعيد الزراعة وعلاقتها بتعداد *Aphis craccivora* (Koch) على الفول الأخضر (*Vicia faba* L.) Broad Bean تحت التغيرات المناخية

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تهدف الدراسة إلى تقييم مواعيد الزراعة وعلاقته بتعداد حشرة منّ البقوليات *Aphis craccvora* والأعداء الحيوية المرتبطة بها مع تاثير العوامل الجوية. أجريت التجربة بمدينة قها بمحافظة القليوبية خلال الموسم الشتوي 2021-2022 و2022-2023م على صنف الفول الأسباني broad bean (*Vicia faba* L.). أظهرت النتائج أن موعد الزراعة 15 ديسمبر هو الموعد المفضل لزراعة نباتات الفول الأخضر حيث أعطى أقل متوسط عام لتعداد *A. craccivora* سجل 21.25±1.80&24.01±1.29 فرداً/ للموسمين مع أعلى إنتاجية كانت 980.15±43.46 &1000.00±38.93 كجم/ للموسمين2021-2022 و2022-2023م على التوالى. بينما سجل أعلى متوسط عام لتعداد *A. craccivora* لتاريخ الزراعة 15 نوفمبر و1 ديسمبر سجلت 46.09±2.52&48.85±2.75 و41.43±2.43 & 43.75 ±1.87 فرداً/للموسمين 2021-2022 و2022-2023م على التوالي. أيضاً، كان تاريخ الزراعة 15 نوفمبر و1 ديسمبر أقل إنتاجية حيث أعطت 538.80±33.46&590.60±24.62 و680.00±43.40 &646.71±26.50كجم/ للموسمين2021 -2022 و2022-2023م على التوالى. أظهر التحليل الإحصائي أن هناك فروق معنوية عالية بين موعد الزراعة 15 ديسمبر وكل من موعد الزراعة 15 نوفمبر و1 ديسمبر خلال الموسمين. كما لايوجد فروق معنوية بين مواعيد الزراعة 15 نوفمبر و 1 ديسمبر. أيضاً كان كلاً من عمر النبات والأعداء الحيوية ودرجة الحرارة والرطوبة النسبية والرياح لهما تأثيرات مختلفة (معنوية أو غير معنوية) على تعداد *A. craccivora* للثلاث مواعيد الزراعة بالدراسة.

* ويستفاد من هذة الدراسة أن موعد الزراعة 15 ديسمبر هو الموعد المفضل لزراعة الفول الأخضر حيث أظهرت النتائج التجربة لهذاء الموعد أقل متوسط عام لتعداد *A. craccivora* مع أعلى إنتاجية بالمقارنة مع مواعيد الزراعة 15 نوفمبر(الموصى) و1 ديسمبر هما الاكثر فى تعداد المن والاقل أنتاجية خلال موسمى الدراسة. ايضاً، لعبت العوامل الجوية دوراً هاماً إيجابياً لنمو نباتات الفول الأخضر ولم تلائم العوامل الجوية نمو تعداد افراد *A. craccivora* عند موعد الزراعة 15 ديسمبر بلمقارنة بمواعيد الزراعة 15 نوفمبر و 1 ديسمبر.