EGYPTIAN ACADEMIC JOURNAL OF
BIOLOGICAL SCIENCES
ENTOMOLOGY

A

ISSN
1687-8809

WWW.EAJBS.EG.NET

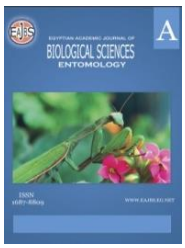
Vol. 14 No. 1 (2021)

Citation: *Egypt. Acad. J. Biolog. Sci. (A. Entomology) Vol. 14(1) pp.1-8 (2021)*
DOI: 10.21608/EAJBSA.2021.137539

Egypt. Acad. J. Biolog. Sci., 14(1):1-8(2021)

Egyptian Academic Journal of Biological Sciences
A. Entomology

ISSN 1687- 8809
http://eajbsa.journals.ekb.eg/



The Effect of Planting Dates and Nitrogen Fertilizer on *Aphis craccivora* (koch) Infestation in Faba Bean (*Vicia faba,* L.) fields

Hamzah. M. Kamel and Megahed M. M. M.
Department of Plant Protection, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt
E. mail: megahed5@azhar.edu.eg

ARTICLE INFO
Article History
Received:2/10/2020
Accepted:6/1/2021
Keywords:
Aphis craccivora, faba bean, nitrogen fertilizer, planting date

ABSTRACT

The present study was carried out at Wadi El Natrun district, El-Behera Governorate during season 2019–2020. In a field study, the effect of two planting dates and three rates of nitrogen fertilizer on a population of Legume aphid, *Aphis craccivora* (Koch) (Homoptera: Aphididae), in faba bean (*Vicia faba*, L.) were investigated. The results show that the higher occurrence of the aphid was recorded on the early planting date than the recommended one. The combination effect of climatic factors and plant age on aphid population density was presented as explained variance which was 75 and 74% in the early and recommended planting dates respectively. The population densities of aphid were significantly lower on faba bean plants fertilized with the lowest rate of nitrogen fertilizer (75 kg feddan^{-1}), compared with those fertilized with recommended and highest rate (100 and 125 kg feddan^{-1} respectively) in both early and recommended planting dates. These results indicate that the recommended planting date and moderately plant nutrition can help plants to avoid insect pests infestation.

INTRODUCTION

In developing countries, faba bean is used as human and animal food, while in rich countries they are used as animal food. In Egypt, faba bean is one of the most important leguminous crops, as it is used as vegetables, dried, or eaten green (Mohamed 2003). Faba bean is known as a meat substitute (Ebadah *et al*., 2006). In addition, faba bean has the ancillary benefits of nitrogen fixation in plants and thus reduce fertilizer requirement (Hendawey and Younes 2013). In the field, faba bean crop is liable to infestation by many insect pests, in the worldwide aphids are the most dangerous insect pests on crops, it is cause damage either by direct feeding by sucking plant sap or by the transmission of plant viruses and honeydew (Pickett *et al.*, 1992).

Legume aphid, *Aphis craccivora* (Koch). (Homoptera: Aphididae) species is widely distributed in different habitats in the world. Aphids are among the most dangerous insect pests that affect crops in Egypt (El-Defrawi *et al.* 2000). Planting date is an important factor for crop production as well as aphid infestation level. The population density of *A. craccivora* was significantly affected by the planting date (Hassanein 1994).

In host plant-herbivore interactions, nutritional plant quality plays an important

role. The fertilizers are sources of mineral elements that the plants required for growth and development (Chau *et al.* 2005). Nitrogen is the most critical macronutrient, which deeply affects the development and fertility of herbivorous insects. Improving the nutritional quality of plant tissues by high nitrogen fertilization increases plants Sensitivity to the infestation of herbivorous insects attributed to their population growth (Fallahpour *et al.* 2015). Agricultural control as planting dates and soil fertilizer management is important alternative pest management as compared to chemical control. The soil fertilizer application as a part of cultural control can impact the physiological susceptibility of plants to insect pests by either affecting the resistance of plants to infestation or by altering plant acceptability to certain insect pests (Letourneau and Goldstein, 2001).

Because the farmers' lack of commitment to planting dates and the recommended fertilization rates, which have an impact on the levels of insect pests infestation on the crops, therefore, this research aims to evaluate the effect of two planting dates and three rates of nitrogen fertilizer on the aphid population density on faba bean in the field to avoid this injurious pest infestation and reduce the application of chemical pesticides.

MATERIALS AND METHODS

Experimental Area and Design:

The present study was carried out at Wadi El Natrun district, El-Behera Governorate during season 2019–2020 on the Spanish variety faba bean (*Vicia faba* L.). The experiment was carried out in a completely randomized design with three replicates (each replicate 42 m^2) with two factors, i.e. planting dates; early (20 October) and recommended (5 November) and nitrogen treatments. All agricultural operations were carried out according to recommendations in all treatments without applying insecticides.

Nitrogen Treatment:

Three rates of nitrogen fertilization were 75, 100 (as the recommended rate of nitrogen feddan^{-1}) and 125 kg feddan^{-1} were added in two batches. The first batch was added with the first irrigation of the crop and the second batch two weeks after the first application. Nitrogen fertilizers had been added to the soil in the form of ammonium sulfate.The aphid samples were taken by direct counting on plants in the field and their numbers were recorded on five randomly selected plants in each replicate from the start of the infestation. Data were recorded weekly from early November till the end of March. The climatic factors such as daily maximum & minimum temperatures (^{0}C) and R.H. (%) recorded during the above studied period were obtained from Central Laboratory for Agricultural Climate, Dokki, Giza, one week earlier from the insect inspection.

Statistical Analysis:

The obtained results of planting date and nitrogen fertilizer were subjected to analysis of variance (ANOVA). Means were determined for significance using Duncan test in SAS (Anonymous 2003). The data of abiotic factors were analyzed using Procedure Correlation and Regression in SAS (Anonymous. 2003). Aphid data were homogenized using running means ((a+b+c)/3) for reducing sampling errors. Weather factors (i.e. max & min. temperatures (^{0}C), and RH (%) were considered as linear ones). Data were fitted to the polynomial model, where plant age (as weeks) was presented as the third degree of polynomial (i.e. Age, Age^2 and Age^3). The multiple polynomial equations become $Y= a \pm b_1$ T. max. $\pm b_2$ T. min. $\pm b_3$ RH $\pm b_6$ Age $\pm b_7$ Age^2 $\pm b_8$ Age^3.

RESULTS AND DISCUSSION

Effect of Planting Date on the Population Density of *Aphis craccivora*:

The results in Fig. (1) show the population density of *A. craccivora* on faba bean in the early and recommended planting dates during season 2019-2020. The higher occurrence of the aphid was significantly (P=0.0001) recorded on an early planting date with an average of 35 aphid plants^{-1} than the recommended planting date with an average of 18 aphid plants^{-1}. Aphid began to appear immediately after the emergence of the seedlings in both planting dates. Then, the numbers increased until they reached their peak during the first half of December with an average of 89 and 54 aphid plants^{-1} for early and recommended planting date respectively, when the average maximum temperature in this period was about 22 ^{0}C (Fig. 2). After that, the population gradually decreased until it reached the lowest population (16 and 7 aphid plant^{-1} for early and recommended planting date, respectively) in late January and early February when the average of max. temp. reached 17^{0}C (Fig. 2). The population reincreases until the end of the season with increasing the temperature. These results are consistent with those obtained by Mahmoud *et al.* (2015) who recorded that *A. craccivora* reached the peak at the end of Nov. to half of Dec. on faba bean plants at El-Menofeyia governorate, Egypt). Abd El-Rahman (2003) recorded one peak for *A. craccivora* on faba bean in the 3rd week of Dec. Saeed and Razaq (2014) and Nisar & Rizvi (2017) found that the different planting dates had a significant effect on the aphid population. Seiter *et al.* (2019) stated that the planting 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 (Cisneros and Godfrey, 2001).

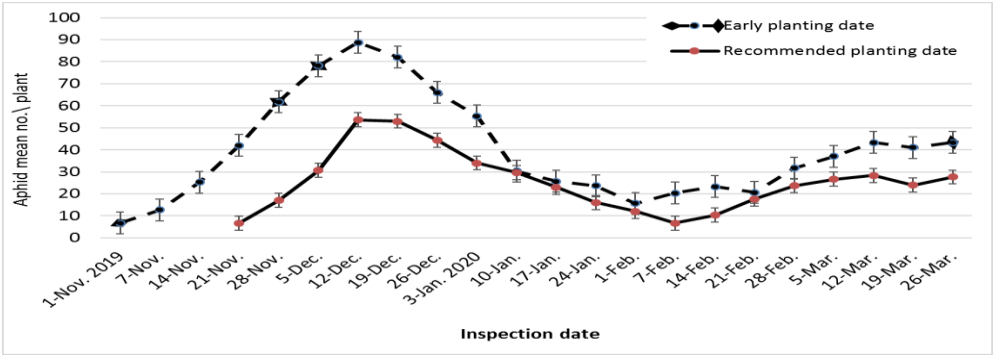


Fig. 1: Weekly mean numbers (±SE) of *Aphis craccivora* per plant of *Vicia faba* in two planting dates during season 2019-2020 at El-Behera Governorate.

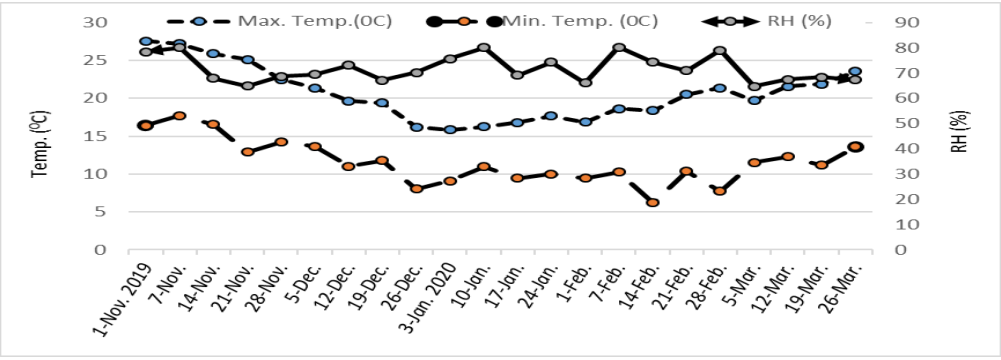


Fig. 2: Weekly mean of max. & min. temperatures (^{0}C) and RH (%) during 2019-2020 at El-Behera Governorate.

Factors Affecting the Population Density of *Aphis craccivora* on *Vicia faba*:

In general, population changes are caused by changes that occur either in weather conditions or in the abundance of food supply as well as in the number of natural enemies. These abiotic and biotic factors normally affecting the biotic potential of insect pests; reproduction and survival potential. The obtained results indicated that a few numbers of natural enemies namely: *Coccinella undecim punctate*, *Hipodamia varigata* and *Syrphus corolaae* were associated with the aphid samples on the faba bean crop.

The combined effect of climatic factors (daily mean of max. & min. temp. and daily mean of percent relative humidity) and plant age on the population density of *A. craccivora* on *Vicia faba* plant in two planting dates during 2019-2020 at El-Behera Governorate (Table 1). As shown in Table (1) the effect of all previous factors in simple correlation had an insignificant effect (P> 0.05) on the aphid population during the early and recommended planting date. The exact relation between the studied factors and aphid population density was determined by estimating the partial regression values. The results show that all values of climatic factors were insignificant (P> 0.05), while plant age values were significant (P<0.01) during both early and recommended planting dates. The effect of the combination of all studied factors on aphid population was presented as explained variance (EV%) which was 75 and 74% in early and recommended planting dates respectively (Table 1). The present results are close to that mentioned by Mahmoud *et al.* (2015) who show that both the climatic factors and plant age vary in their effect on *A. craccivora* population, where the correlation between weather factors, plant age and the insect population density was insignificant. Also, they recorded that the combined effect of the ecological factors on aphid population in season 2011-2012 was 98.98 and 50.42% in season 2012-2013 in El- Menofeyia Governorate. Salman *et al.* (2015) who mentioned that population fluctuations of *A. craccivora* on faba bean are probably due to climatic condition in Aswan Governorate.

Table 1: Simple correlation and Partial regression values of climatic factors and plant ages on the variability of the population density of *Aphis craccivora* on *Vicia faba* plants in two planting dates during season 2019-2020 in El-Behera Governorate.

Planting date	Source of variation		Simple correlation		Partial regression				
			r	P	b	P	F	P	EV %
Early: 20 Oct. 2019	Daily max. temp.		-0.224	0.315	-2.709	0.288	18.11	0.0001	75
	Daily min. temp.		-0.068	0.762	2.534	0.376			
	Daily mean R.H.%		-0.369	0.090	-1.366	0.158			
	Plant age	Age1	-0.138	0.538	31.415	0.0001			
		Age2	-0.193	0.387	-3.177	0.0001			
		Age3	-0.172	0.442	0.087	0.0001			
Recommended: 5 Nov. 2019	Daily max. temp.		-0.219	0.366	4.388	0.053	8.42	0.0011	74
	Daily min. temp.		0.094	0.701	-0.804	0.496			
	Daily mean R.H.%		-0.052	0.832	0.089	0.823			
	Plant age	Age1	-0.223	0.358	27.792	0.0043			
		Age2	-0.211	0.385	-3.140	0.0010			
		Age3	-0.150	0.538	0.096	0.0003			

Effect of Nitrogen Fertilizers on Population Densities of *A. craccivora*:

The results in Figures (3 A & B) indicated that *A. craccivora* population densities varied significantly among the soil nitrogen fertilizer treatments in both early ($LSD_{5\%}$ = 15.07, P = 0.008) and recommended planting dates ($LSD_{5\%}$ = 9.56, P = 0.009).

The population densities of aphid were significantly lower on faba bean plants fertilized with the lowest rate of nitrogen fertilizer (75 kg feddan^{-1}), compared with those fertilized with recommended and highest rates (100 and 125 kg feddan^{-1} respectively) in both early and recommended planting dates. The mean numbers of aphid were 28 & 19 aphid plant^{-1} with 75 kg per feddan nitrogen fertilizer and they were 40 & 24 aphid plant^{-1} with 100 kg per feddan nitrogen fertilizer, while treatment with the highest rate of nitrogen fertilizer (125 kg per feddan) lead to increase aphid numbers to 52 & 34 aphid plant^{-1} in early and recommended planting dates respectively (Fig. 4). Similar results have been reported by Salman *et al.* (2007) who mentioned that the population density of aphid significantly increased with the increase of N fertilizer levels. Hosseini *et al.* (2014); Sinha *et al.* (2018) and Fallahpour *et al.* (2020) who stated that the population of aphid was positively affected by nitrogen fertilization; the highest abundance was recorded in plants growing with the highest rate of nitrogen fertilization. Which could explain the higher number of the aphid on plants fertilized with a higher nitrogen rate. This effect could be achieved directly through changed plant physiology and the composition of plant metabolites and indirectly by a change in plant defense mechanism and decrease regulation of defense pathways (Fallahpour *et al.* 2015). The effect of nitrogen fertilization on plant nitrogen content may have important consequences on nutrition, growth rate, fecundity (Douglas 1993) and the numbers of herbivorous insects (Awmack and Leather 2002; Blazhevski *et al.* 2018).

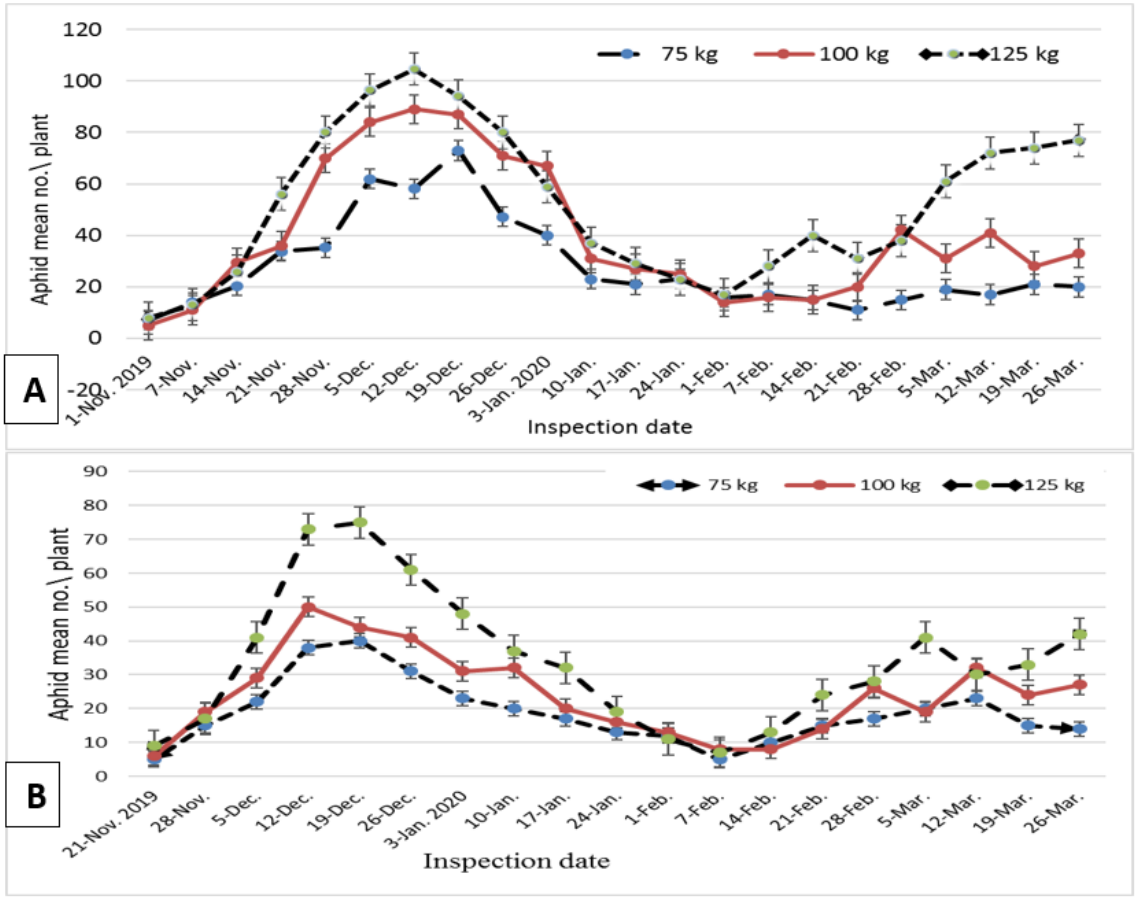


Fig. 3: Effects of nitrogen fertilizer treatments on *Aphis craccivora* population densities (mean±SE) per plant in (A) early and (B) recommended planting date during season 2019-2020 at El-Behera Governorate.

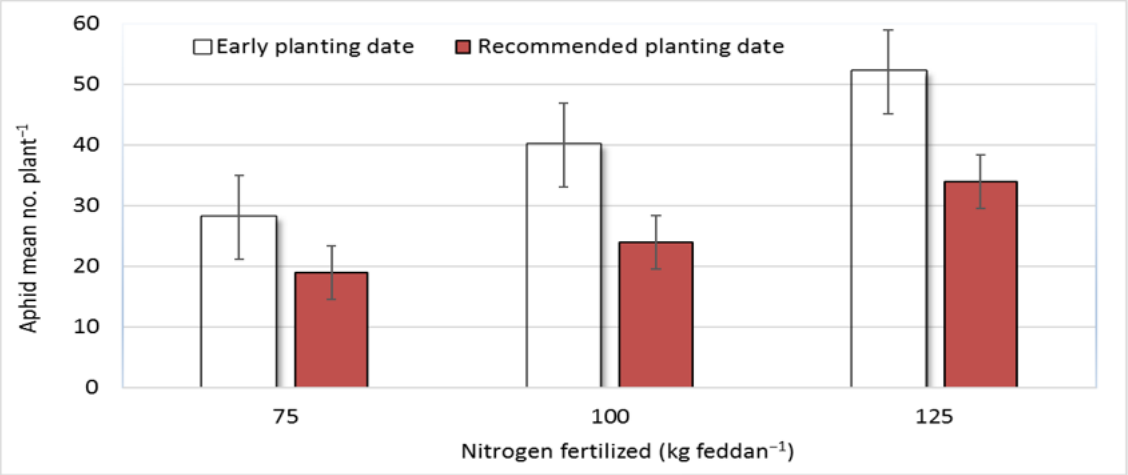


Fig. 4: Mean numbers (±SE) of *Aphis craccivora* per plant with nitrogen fertilizer treatments in early and recommended planting dates during season 2019-2020 at El-Behera Governorate.

CONCLUSIONS

The obtained results indicated that the recommended planting date (5 Nov.) had significantly lower numbers of *Aphis craccivora* on faba bean comparing with the early planting date (20 Oct.). The population density of *A craccivora* on faba bean was increased significantly with increasing soil nitrogen fertilization rate. So, sowing the plants during the recommended planting date and moderately plant nutrition can help plants to avoid insect pests infestation and reduce the application of chemical pesticides.

ACKNOWLEDGEMENTS

The authors would like to thank the members of the Scientific Research Follow-up Committees of the Plant Protection Department, Faculty of Agriculture, Al-Azhar University.

REFERENCES

Abd El-Rahman, S. F. (2003). Damage assessment of certain insects attacking faba bean in the field and store. *M.Sc. Thesis, Fac. Agric., Cairo Univ. Egypt,* 121 pp.

Anonymous, (2003). SAS Statistics and graphics guide, release 9.1. SAS *Institute, Cary, North Carolina* 27513, USA.

Awmack, C.S. and Leather, S.R. (2002). Host plant quality and fecundity in herbivorous insects. *The Annual Review of Entomology*, 47:817–844.

Blazhevski, S.; Kalaitzaki, A.P. and Tsagkarakis, A.E. (2018). Impact of nitrogen and potassium fertilization regimes on the biology of the tomato leaf miner Tuta absoluta. *Entomologia Generalis*, 37(2):157–174.

Chau, A.; Heinz, K.M. and Davies, J.F.T. (2005). Influence of fertilization on *Aphis gossypii* and insecticide usage. *Journal of Applied entomology.* 129 (2): 89–97.

Cisneros, J.J. and Godfrey, L.D. (2001). Midseason pest status of the cotton aphid (Homoptera Aphididae) in *California cotton:* is nitrogen a key factor? *Environmental Entomology*, 30: 501-510.

Douglas, A.E. (1993). The nutritional quality of phloem sap utilized by natural aphid populations. *Ecological Entomology*, 18:31–38

Ebadah, I.M.A.; Mahmoud, Y.A. and Moawad, S.S. (2006). Susceptibility of some faba bean cultivars to field infestation with some insect pests. *Research Journal of Agriculture and Biological Sciences*, 2(6): 537-540.

El-Defrawi, G. M.; Emam, A. K.; Marzouk, I. A. and Rizkalla, L. (2000). Population dynamics and seasonal distribution of *Aphis craccivora* Koch and associated natural enemies in relation to virus disease incidence in faba bean fields. *Egyptian Journal of Agricultural Research.* 78(2): 627-641.

Fallahpour, F.; Ghorbani, R.; Nassiri-Mahallati, M. and Hosseini, M. (2020). Plant fertilization helps plants to compensate for aphid damage, positively affects predator efficiency and improves canola yield. *Journal of Pest Science, 93(1), 251-260.*

Fallahpour, F.; Ghorbani, R.; Nassiri, M. M. and Hosseini, M. (2015). Demogporaphic parameters of *Lipaphis erysimi* on canola cultivars under different nitrogen fertilization regimes. *Journal of Agricultural Science and Technology*, 17: 35-47.

Hassanein, S. S. M. (1994). Effect of some crop management practices on population of certain insects infesting broad bean plants at Khattara region, Egypt. *Zagazig Journal of Agricultural Research,* 21 (6): 1807-1816.

Hendawey, M. H. and Younes, M. A. (2013). Biochemical evaluation of some faba bean cultivars under rainfed conditions at El-Sheikh Zuwayid. *Annals of Agricultural Sciences* 58(2), 183-193.

Hosseini, M.; Ghorbani, R.; Nassiri, M. M and Fallahpour, F. (2014). Evaluation the effect of nitrogen fertilization of canola on performance and population growth rate of mustard aphid, *Lipaphis erysimi* (Hem.: Aphididae). *Plant Pests Research,* 3:27–39.

Letourneau, D. K. and Goldstein, B. (2001). Pest damage and arthropod community structure in organic vs. conventional tomato production in California. *Journal of Applied. Ecology,* 38: 557-570.

Mahmoud, M. A.; El-Khawass, K. A.; Hammad, S. A. and Ali, M. I. (2015). Susceptibility of Three Faba Bean Cultivars to Field Infestation with Legume Aphids *Aphis craccivora* Koch (Homoptera: Aphididae). *International Journal of Environment,* 4(1): 116 -120.

Mohamed, M. A. A. (2003). Studied on certain insect pests infesting faba bean (*Vicia faba*L.) with relation to their natural enemies in Sohag Upper Egypt. *D.Ph. Thesis, plant protection Department, Assiut University, Egypt.*

Nisar, S. and Rizvi, P. Q. (2017). Effect of sowing dates and abiotic variables on natural incidence of predators and parasitoids of aphid species infesting yellow mustard *(Brassica campestris). Journal of Eco-friendly Agriculture, 12(1), 41-46.*

Pickett, J. A.; Wadhams, L. J. and Woodcock, C. M. (1992). The chemical ecology of aphids. *Annual Review of Entomology*,37: 67-90.

Saeed, N. A. and Razaq, M. (2014). Effect of sowing dates within a season on incidence and abundance of insect pests of canola crops. *Pakistan Journal of Zoology*, 46(5), 1193-1203

Salman, A. M. A.; Abd El-Rahman, A. G. and El-Maghraby, W. T.Q. H. (2015). Susceptibility of some Faba Bean (*Vicia faba* L.) arieties to Infestation with Cowpea Aphid, *Aphis craccivora* (Koch) and *Liromyza trifolii* (Burgess) in Toshka region, Aswan, Egypt. *Middle East Journal of Agriculture*, 4(1): 31-36.

Salman, A. M. A.; Abdel-Moniem, A. S. H. and Obiadalla, A. H. (2007). Influence of certain agricultural practices on the cowpea aphid, *Aphis craccivora* Koch, infesting broad bean crops and the relation between the infestation and yield of plants in upper Egypt. *Archives of phytopathology and plant protection*, 40(6), 395-405.

Seiter, N. J.; Miskelley, A. D.; Lorenz, G. M.; Joshi, N. K.; Studebaker, G. E. and Kelley,

J. P. (2019). Impact of planting date on Melanaphis sacchari (Hemiptera: Aphididae) population dynamics and grain sorghum yield. *Journal of economic entomology,* 112(6), 2731-2736.

Sinha, R.; Singh, B.; Rai, P.K.; Kumar, A.; Jamwal, S. and Sinha, B.K. (2018) Soil fertility management and its impact on mustard aphid, *Lipaphis erysimi* (Kaltenbach) (Hemiptera: Aphididae). *Cogent Food & Agriculture,* 4:1450941. https ://doi.org/10.1080/23311 932.2018.14509 41.

ARABIC SUMMARY

تأثير مواعيد الزراعة والتسميد الازوتى على الإصابة بمنّ البقوليات فى حقول الفول البلدى

محمد كامل عبد الصمد حمز ة و محمد محمد محمد مجاهد
قسم وقاية النبا ت كلية الزراعة جامعة الازهر- القاهرة- مصر.

أجريت هذه الدراسة بمركز وادي النطرون بمحافظة البحيرة خلال موسم الزراعة 2019-2020. تم دراسة تأثير موعدين للزراعة وثلاثة معدلات من السماد الآزوتي على تعداد منّ البقوليات، على الفول البلدى فى الحقل. أظهرت النتائج زيادة معنوية فى تعداد المنّ أثناء الزراعة المبكره عنها فى موعد الزراعة الموصى به. كان التأثير المجمع لعمر النبات ودرجات الحرارة العظمى والصغرى وكذلك الرطوبة النسبية على تعداد حشرات المنّ 75 و 74٪ في موعد الزراعة المبكرة والموصى به على التوالي. إنخفض تعداد المنّ معنوياً عند التسميد باقل معدل من السماد الازوتى (75 كجم / فدان) مقارنة بالمعدل الموصى به والمعدل المرتفع (100، 125 كجم/ فدان على التوالى) في كل من موعدى الزراعة المبكر والموصى به. تشير هذه النتائج إلى أن موعد الزراعة الموصى به والتسميد الأزوتي المعتدل للنبات يمكن أن تساعد النباتات على تجنب الإصابة بالآفات الحشرية وتحد من إستخدام المبيدات الحشرية.