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Susceptibility of Three Faba Bean Cultivars to Field Infestation with Legume Aphids *Aphis craccivora* Koch (Homoptera: Aphididae)

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ABSTRACT

Three cultivars of the faba bean, *Vicia faba* L.; Sakha 1, Sakha 2 and Sakha 3 were chosen for field trials to study their susceptibility to infestation with legume aphids, *Aphis craccivora* (Koch). A field experiment was performed at El-Menofeyia Governorate, Egypt. The study was conducted in two successive seasons (2011/2012 and 2012/2013). The three tested cultivars showed different susceptibility to aphids. Sakha1 harbored the highest infestation level, Sakha 2 showed the lowest one, while Sakha 3 was intermediate. There were significant differences in infestation level between the two planting seasons (2011//2012 and 2012//2013), where the first season harbored more aphids than the second one. The combined effect of ecological factors on aphid population in the first season was much higher than that of the second season.

Key words: Susceptibility, faba bean, *Vicia faba* L., cultivars, aphids, *Aphis craccivora* (Koch).

Introduction

Cultivated faba bean is generally used as human food in developing countries and as animal food, in both industrialized and developing countries. It remains the most important leguminous food crop in Egypt. Also it can be used as vegetables, green or dried, fresh or canned. Faba bean has been considered as a meat extender or substitute (Ebadah *et al*., 2006). It has the ancillary benefits of nitrogen fixation and thus a reasonably low fertility requirement (Al-Antary *et al*., 2007).

In the Mediterranean region faba bean crop is liable to attacked by several insect pests in the field. Some of them cause extensive damage and require the development of control methods. Aphids are considered to be the most important insect pests in agriculture. They primarily cause damage either by direct feeding or by the transmission of plant viruses (Pickett *et al*., 1992).

Although several aphid species may infest faba beans *Aphis. craccivora* is the most common. It damages the plants by direct feeding causing minimal damage unless they are in high numbers as hot spots where the insects are concentrated at the growing tips of one or more plants causing wilting, stunting and sometimes tip death. The main concern of aphids is their capacity to act as vectors, carrying and transferring virus diseases during feeding. In Egypt, *V. faba* is an important winter host plant of *A. craccivora* where it produces more progeny on plants infected with broad bean mosaic virus than on healthy plants (El-Kady and Salem, 1974). Also, Weigand and Bishara, (1991) stated that *A. craccivora* is the dominant aphid species, occurring in 37% of faba bean fields surveyed compared to only 3% infested by *A. fabae*.

Aphids can also adversely affect crops through toxic compounds in saliva as well as reducing photosynthetic capacity indirectly in leaves through excretion products and saprophytic fungi (Schepers, 1989). The legume aphid, *A. craccivora* (Koch) is the principal pest of bean crops in Egypt (Bishara *et al*. 1984). Indeed, this insect pest causes major yield losses, due to the transmission of the two major viruses, FBNYV and BLRV (Oufroukh, 1997) and commercial losses due to its production of large amounts of honeydew, rendering the pods unsightly and unsalable. Although aphid control in beans is not always necessary, *Aphis craccivora* may be important pest not only for virus transmission, but also for direct damage when plants are heavily infested (Tremblay, 1995).

The purpose of this research was to evaluate the susceptibility of three faba bean cultivars to field infestation with legume aphid *A. craccivora.* Also, the study aimed to evaluate the influence of different ecological factors on the level of infestation with this pest.

Materials and Methods

The population density of legume aphids *Aphis craccivora* on broad bean plants, *Vicia faba* was conducted at Samadon (El-Menofeyia governorate) to evaluate the field infestation of three cultivars (Sakha 1,

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Sakha 2 and Sakha 3) with aphids. The experiment was carried out during two successive seasons 2011/2012, 2012//2013. In each season an area of about 504 m^2 was prepared and divided into 12 plots of about 42 m^2. Four replicate were used for each treatment (cultivar). Every plot was separated from the other by uncultivated two rows. The previously mentioned faba bean cultivars were evaluated in completely randomized design. Bean cultivars were obtained from Ministry of Agriculture. Experimental plots received all regular cultural practices throughout the two growing seasons. No chemical application was used to evaluate the population without any disruption by the insecticides. All broad bean seeds were sown on November 4th and 2nd for first and second season, respectively. Seeds were planted (2 seeds/hill) at distance of 15cm between hills. Each cultivar was replicated in 4 plots. Five plants from each plot were randomly chosen and then examined weekly in the morning.

The numbers of aphids (adult and nymph) were recorded. The first date of the examination was performed after almost 10 days of plantation date. The studied ecological factors are plant age, weather factors (maximum temperature, minimum temperature and relative humidity). Records of these meteorological factors were obtained from the Centeral Department of Meteorological Station at Koubry El-Kobba, Cairo. The obtained data were statistically analyzed by ANOVA according to (SAS Institute, 2002).

Results and Discussion

Population density of A. craccivora on three different cultivars of V. faba during 2011/2012 and 2012/2013 seasons

Data presented in table (1) show that aphid infestation was almost similar during the first season (2011/2012) on the three tested faba bean cultivars, where it ranged between 12.6 and 14.9 aphids/plant. Also during the second season (2012/2013) no significant differences were found between the three investigated cultivars, the mean numbers were ranged between 5.4 and 5.8 aphids/plant. However there were significant differences between the two planting seasons, where the first season harbored more aphids than the second one (13.4 and 5.6 aphid/ plant, respectively).

Table 1: Aphid infestation on three faba bean cultivars (2011-2012 & 2012-2013).

Cultivar	Mean no. of aphids/plant		Mean
	2011-2012	2012-2013	
Sakha 1	12.8 ± 1.2 a	5.8 ± 1.0 b	9.3 a
Sakha 2	12.6 ± 0.9 a	5.5 ± 0.7 b	9.1 a
Sakha 3	14.9 ± 1.4 a	5.4 ± 1.1 b	10.2 a
Mean	13.4	5.6	9.5

Means in the same column followed by the same letter are not significantly different. (P<0.05) Duncan's multiple range test (Duncan 1955).

Population fluctuation of A. craccivora on faba bean cultivars during the first season (2011/2012)

Figure (1) shows that aphid population appeared on the three tested cultivars plants on the week (Nov. 18) (6.5, 6.6 and 6.2 aphids on Sakha 1, Sakha 2 and Sakha 3 respectively). The population increased gradually till reached the peak at Nov. 25th on Sakha 1 (18.9 aphids/plant), Dec. 2nd on Sakha 2 and 3 (18.4 and 24.4 aphids/plant) (Fig. 1). Aphid population fluctuated throughout the season till reached to the second peak (19.3 aphids/plant) at Dec. 9th on Sakha 1 while it was recorded at Dec. 16th on Sakha 2 and 3 (17.2 and 20.0 aphids/ plant respectively. Aphid infestation decreased again till the third week of Jan. 2012 (Fig. 1).

Population fluctuation of A. craccivora on faba bean plants during the second (2012/2013)

Figure (2) shows that aphids were firstly recorded at Nov. 16th 2012 with apparent numbers which could be considered as the first peak of population (6.5, 6.3 and 6.5 aphids/plant) on Sakha 1, Sakha 2 and Sakha 3, respectively). A clear decline of aphid population was recorded at Dec. 7th on all cultivars (2.3, 3.1 and 1.7 aphids/ plant) on Sakha 1, Sakha 2 and Sakha 3, respectively. On the other hand aphid population increased again till reached the maximum mean number at Dec. 28th 2012 (8.0, 8.4 and 8.2 aphids/plant on Sakha 1, Sakha 2 and Sakha 3, respectively). The aphids were recorded on faba bean plants until the third week of Jan. 2013 (Fig. 2). As almost no difference could be found between the three tested cultivars in this study, Soffan and Aldowood (2014) found that there significant differences between three-out of five-faba bean cultivars as regard the performance and life cycle of *A. craccivora* on *V. faba* plants in Saudi Arabia.

Figure (3) demonstrates clear differences in population fluctuation of *A. craccivora* between the two tested seasons, where the number of aphids was significantly higher during the first season (2011/2012) than the second one (2012/2013). Two peaks of aphid population were noticed for both

seasons (19.6 and 17.5 aphids/plant) in the first season at the first and third weeks of Dec. 2011, respectively. The two peaks of the second season were recorded at the third week of November and the fourth week of Dec. 2011 (6.4 and 8.2 aphids/plant, respectively) (Fig. 3).

The present results are close to that mentioned by Soheir Abd El-Rahman (2003) except for recording one peak for *A. craccivora* infestation on faba bean in the 3rd week of December during 1997/1998 and in the 1st week of December during 1998/1999. While Mona (2002) found that the population density of *A. craccivora* on faba bean plants reached its maximum during the 4th week of February and 1st week of March.

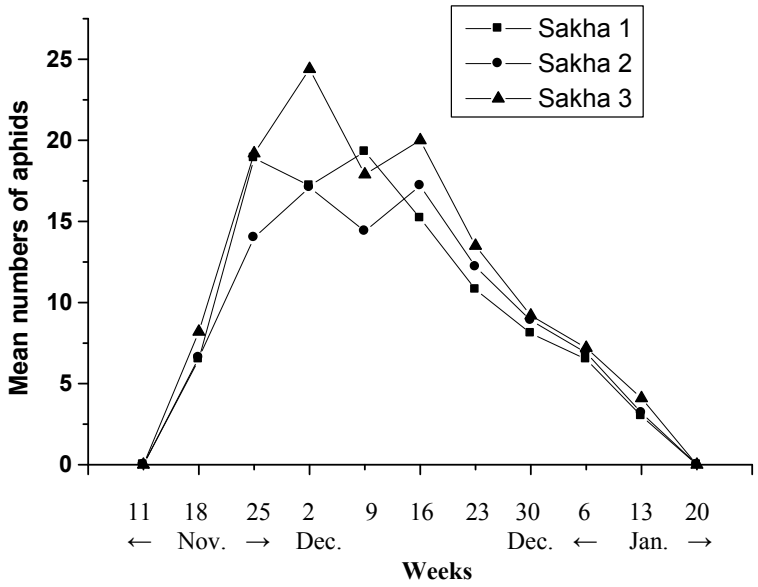

Fig. 1: Weekly mean numbers of aphids (*A. craccivora*) on three different cultivars of faba bean plants during the first season (2011/2012).

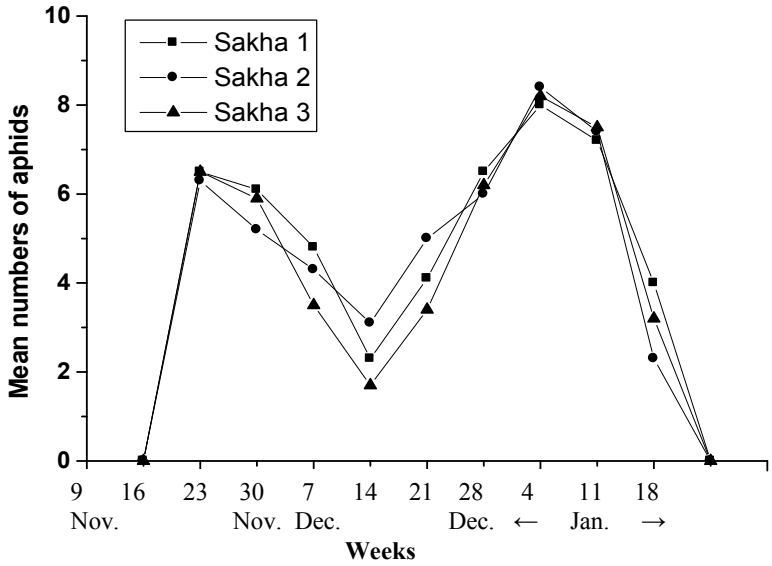

Fig. 2: Weekly mean numbers of aphids (*A. craccivora*) on three different cultivars of faba bean plants during the second season (2012/2013).

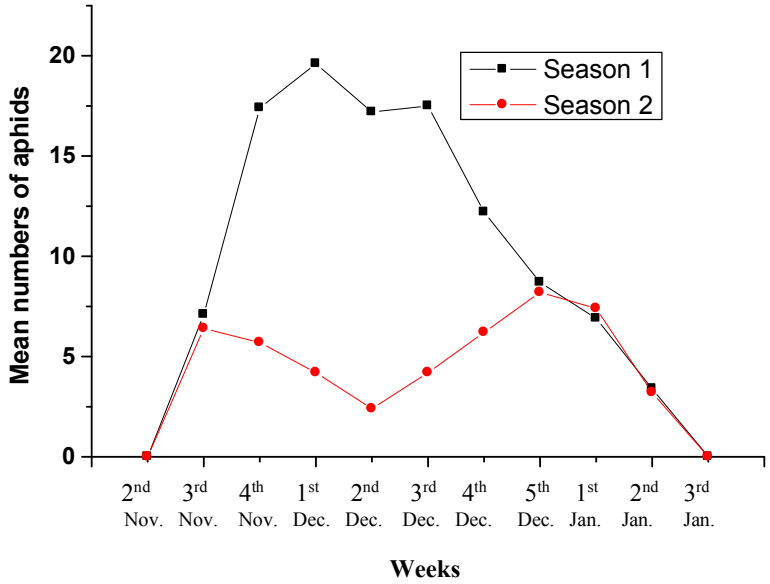

Fig. 3: Weekly mean numbers of aphids (*A. craccivora*) on faba bean plants throughout two successive seasons (2011/2012 and 2012/2013).

Ecological factors affecting the population density of A. craccivora on faba bean plants

Table (2) shows that both weather factors and the plant age vary in their effect on *A. craccivora* population, where in the first season (2011-2012) the correlation between weather factors (maximum temperature, minimum temperature and relative humidity) and the insect population was insignificantly positive (r= 0.322, 0.102 and 0.641 respectively) whereas the relationship between the aphid population and the plant age were insignificantly negative (r= -0.369, -0.538 and -0.617), respectively. The relationship between aphid population and the maximum temperature, minimum temperature, relative humidity and age 2 were insignificantly negative and (b) values were -0.909, -0.086, -0.052 and -3.817 while the relationship between the insect population, age 1 and age 3 was insignificantly positive and (b) values were 18.151 and 0.212. On the other hand, in the second season (2012-2013) the correlation was insignificantly positive between the all weather factors and the aphid population (r= 0.0872, 0.0366, 0.662, 0.215, 0.357 and 0.444) as shown in Table (2). The partial regression values gave the precise numbers of the aphids with its relation to the ecological factors. The relationship between aphid population and the ecological factors were insignificantly positive except the maximum temperature and age 3 which showed insignificantly negative relationship. The (b) values were 2.108, 3.761, 0.607, 713, 0.076 and -0.025 for maximum temperature, minimum temperature, relative humidity, plant age 1, plant age 2 and plant age 3 respectively.

Table 2: Effect of weather factors and plant age on the population of *Aphis craccivora*.

Season	Factor	Correlation		Multiple regression				
		r	p	b	p	f	p	EV%
2011/2012	Temp. Max	0.3220	0.4367	-0.90989	0.5926	16.2	0.1879	98.98
	Temp. Min	0.1021	0.8099	-0.08697	0.9673			
	RH	0.6413	0.0865	-0.05201	0.9105			
	Age 1	-0.3691	0.3682	18.15163	0.1478			
	Age 2	-0.5380	0.1690	-3.81726	0.1475			
	Age 3	-0.6174	0.1029	0.2128	0.1957			
2012/2013	Temp.Max	0.08721	0.8373	-2.10848	0.5888	1.36	0.3758	50.42
	Temp. Min	0.03633	0.9319	3.76194	0.3002			
	RH	0.66269	0.0733	0.60729	0.2330			
	Age 1	0.21572	0.6079	2.71362	0.8314			
	Age 2	0.35731	0.3849	0.07614	0.9839			
	Age 3	0.44462	0.2697	-0.02519	0.9310			

The combined effect of the ecological factors on aphid population in the first season (2011-2012) was 98.98% and the other effects are due to another factors (P= 0.187). Beside that the combined effect of the

second season (2012-2013) was lower than that recorded in the first season (EV= 50.42%) with insignificant relationship (P= 0.375).

Ecology of *A. craccivora* has been extensively studied in Africa in relation to its role as the vector of groundnut rosette virus (A Brook, 1964, Davies, 1972 and Farrell, 1976a, b). In Northern Sudan, the numbers of *A. craccivora* and the incidence of aphid-transmitted broad bean mosaic virus also varied according to the sowing date of *V. faba* crop, those sown during November-December having considerably larger peak numbers of aphids in mid-January and higher virus incidence than those sown in October (Abu Salih *et al,* 1973).

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