POPULATION DYNAMICS OF *APHIS CRACCIVORA* (KOCH) AND *EMPOASCA* SPP. ON FABA BEAN IN RELATION TO ASSOCIATED PREDATORS AND SOME CLIMATIC FACTORS

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Abstract

Leguminous aphid, *Aphis craccivora* (Koch) and jassids, *Empoasca* spp. are serious insect pests attacking faba bean crop. Therefore, the present work was carried out to study the population density of the two insect species in relation to associated predators (*Chrysoperla carnea Steph., Coccinella undecimpunctata L., Paederus alfierii* (Koch) and *Scymnus* spp.) and some related climatic factors (temperature, relative humidity and wind speed).

The obtained results cleared that aphid populations were higher than those of jassids and had three peaks of abundance during January, February and March in both seasons. The three climatic factors affected aphids insignificantly in the two seasons except for relative humidity which affected it highly significantly. On the other hand, the predators affected aphids highly significantly in 1991/92 season and significantly in 1992/93.

Concerning jassids, three peaks also occurred in the two seasons. The population was affected insignificantly with the three climatic factors. The predators affected jassid populations significantly in the first season and insignificantly in the second one. The joint effect of the four pronounced on aphids than on Jassids during the two seasons, since these factors were responsible for 74.60 and 50.83% of changes in aphid populations and for 37.1 and 21.7% of changes in jassids during 1991/92 and 1992/93 seasons, respectively. The populations of both aphids and jassids as well as 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 both aphids and jassids during the inspection period in the two seasons.

INTRODUCTION

Faba bean, Vicia faba (L.) is one of the most and important crops as a source of plant protein for man and animal in Egypt. Faba bean plants are heavily attacked

by several insect pests in the field. Of which, certain sucking insects, mainly the leguminous aphid, *Aphis craccivora* (Koch) and Empoasca spp. cause severe damage to the plants and are more associated with the transmission of several virus diseases resulting in large reduction in the yield (Kamel, 1982, Bishara et al., 1984, El-Defrawi, 1987, Abd El-Fatah, 1991 and Riskalla et al. 1994).

Insects become pests as a result of a wide variety of factors and often an understanding of these will lead to improved systems of management. So, the pests of crops and their status vary according to local environmental conditions (Kumar, 1984 and Dent, 1991).

In addition, when more is known about the interactions between insects and their natural enemies, the natural enemies density may become an important integrated part of the insect management system (Kogan and Herzog, 1980).

Therefore, the present work aims to study the population density of both leguminous aphid, *A.craccivora* (Koch) and jassids, *Empoasca* spp on faba bean plants in relation to associated predators and some related climatic factors during two successive growing seasons.

MATERIALS AND METHODS

An experiment was carried out at the Experimental Farm of Sakha Research Station, Kafr El-Sheikh during 1991/92 and 1992/93 seasons.

The field was divided into four plots of 1/2 feddan each, cultivated with Giza 3 variety in mid-November of 1991 and 1992. Experimental plots received the usual recommended agricultural practices and were left without any chemical control throughout the growing seasons.

To assess the population of aphids, jassids and main associated predators, weekly samples of ten tillers from each plot were chosen at random 40 days after cultivation (on December 22). The total number of aphids, jassids (nymphs and adults) and predators were counted and recorded. The considered predators were *Chrysoperla carnea* (Steph), *Coccinella undecimpunctata* (L.), *Paederus alfierii* (Koch) and *Scymnus* spp.

The number of generations for aphids and jassids were calculated according to

Audemard and Milaire (1975) and lacob (1977).

Records of temperature, relative humidity and wind speed during 1991/92 and 1992/93 seasons were obtained from Meteorological Station at Sakha. Daily mean of these climatic factors during the week preceding the sampling date and weekly mean number of predators were used for calculating the simple correlation and partial regression values according to Fisher (1950).

RESULTS AND DISCUSSION

Population density of aphid, Aphis craccivora and jassids, Empoasca spp. and associated predators on faba bean

Data presented in Table 1 clear that in 1991/1992 season, initial jassid populations started to appear early with low numbers and reached a moderate peak of 7.2 insects/10 tillers while aphid populations appeared suddenly in large numbers after three weeks from the appearance of jassids, recording the first peak of 212.5 insects/10 tillers in late January. Then, jassid populations fluctuated until another peak took place in first March (6.5 insects/10 tillers). On the other hand, aphid populations recorded the second peak on 23rd February with a mean of 282 aphids. It is apparent that aphids population was higher than jassid allover the season. This may be attributed to the competition of food source, or the natural enemies or other factors. The third peak of aphids was recorded on March 23 representing 352 aphids/ 10 tillers which coincided with the corresponding third jassids peak (16.2 jassids/ 10 tillers). In general, this synchronization is of great importance in developing and utilizing effective pest chemical control strategies. The third peak of both insects was followed by a continuous decline of the populations until the end of the growing seasons .

Concerning the considered predators, Table 1 shows that all predators were firstly observed in faba bean field nearly at the same time as the first appearance of aphids and were following the build up of jassids. It is apparent that Scymnus spp. was the most common predator in faba bean field followed by Paederous alfierii and *C.undecimpunctata* while *C.carnea* came in the third place .

Considering the total predators, two intermediate peaks occurred; the first peak was in late January and the second was by February 23 with mean of 14.1 and 11.9 predators/10 tillers. It was clear that these two peaks coincided with the peaks of aphids and to some extent with low numbers of jassids. The maximum popu-

lation of predators was observed by March 23 recording 23.4 predators. This high increase of predators commonly occurred in association with large populations of both aphids and jassids.

Table 1. Weekly mean number of *Aphids craccivora* Koch and *Empoasca* spp. and associated predators per 10 tillers of faba bean plants during 1991/92 season at Sakha region Kafr El-Sheikh.

Samping date	No.of aphids	No.of jassids	No. of predators					No. of predators		
			C. Carnea	*P. alffieri*	*C.undecimpuntata*	*S.pp*	Total of predators	Air temp (oC)	Air temp (oC)	Air temp (oC)
Dec 22	0	3.5	0	0	0	0	0	11.7	67.9	3.2
29	0	3.7	0	0	0	0	0	12.0	69.4	7.1
Jan 5	0	7.2	0	0	0	0	0	10.4	72.3	8.9
12	100	4.0	0.6	3.0	2.0	1.8	7.4	12.4	72.3	6.7
19	182.5	3.7	2.2	3.7	4.4	3.8	14.1	12.8	71.2	4.6
26	212.5	3.7	3.8	3.5	2.2	4.6	14.1	12.1	71.3	5.7
Fep 2	120	4.5	1.3	2.2	1.9	3.3	8.7	12.4	76.7	6.6
9	80	4.5	15	2.0	1.9	3.5	8.9	11.8	79.7	8.8
16	65	3.7	1.9	2.5	2.1	4.9	11.4	11.2	65.9	8.2
23	282	4.0	2.3	4.1	1.9	3.6	11.9	10.3	68.5	8.8
Mar 2	120	6.5	2.0	2.6	2.1	4.1	10.8	7.6	74.2	8.8
9	60	3.7	1.9	2.7	2.7	3.9	11.2	12.2	70.1	9.7
16	40	10.5	2.9	2.8	2.3	5.5	13.5	14.8	65.0	9.7
23	352	16.2	5.0	5.6	5.1	7.7	23.4	14.8	66.2	5.4
30	80	6.5	3.3	2.3	2.5	4.5	12.6	16.6	70.5	7.6
Apr. 6	40	4.5	1.7	2.3	1.7	2.9	8.6	16.8	64.4	5.4
13	20	1.5	0.8	0.8	0.9	1.3	3.8	20.6	64.8	5.5
Total	1754	119.7	31.2	40.1	33.7	55.4	160.4	220.5	1190.2	120.7
Mean	103.1	7.0	1.8	2.4	2.0	3.3	9.4	12.9	70.0	7.1

Data recorded in Table 2 show the fluctuations of aphids, jassids and associated predators on faba bean plants during the second season (1992/93). The results indicated that aphid populations seemed to appear two weeks after jassids and the population increased reaching the first peak of 302 aphids/10 tillers on 19th January while jassid population recorded its first peak one week before (19.5 jassids/10 tillers). After that, the mean number of aphids attained a maximum of 307 and 401 aphids/10 tillers by February 16 and late March, while jassid population peaked on 23rd February and on 16th March with a mean of 20.5 and 33.2 insects, respectively. It should be pointed out that aphid populations were higher than jassids during the growing season.

As indicated in Table 2, the occurrence of predators particularly *C.carnea* started to appear one week later than the build up of jassids. Generally, the preda-

tors had the same trend of the first season, where, Scymnus spp was the most prevalent predator on faba bean plants, followed by Paederus alfierii and *C.undecimpunctata* while *C.carnea.* was the least dominant.

Based on the total count of predators, two peaks of populations were observed in late January and mid-February with mean of 21.9 and 18.7 predators/10 tillers. The maximum number of predators occurred by March 23, represented by 33.2 predators/10 tillers.

Table 2. Weekly mean numbers of *Aphids craccivora* (Koch) and *Empoasca* spp. and associated predators per 10 tillers of faba bean plants during 1992/93 season at Sakha region Kafr El-Sheikh.

Samping date	No.of aphids	No.of jassids	No. of predators					No. of predators		
			C. Carnea	*P. alffieri*	*C.undeci mpuntata*	*S.pp*	Total of predators	Air temp (oC)	Air temp (oC)	Air temp (oC)
Dec 22	0	12.0	0	0	0	0	0	12.2	50.9	5.7
29	0	10.0	0.6	0	0	0	0.6	11.6	54.0	4.8
Jan 5	60	15.0	0.3	1.2	0	2.5	4.0	11.5	58.2	6.8
12	160	19.5	0.9	2.9	0	3.9	7.7	9.6	59.9	8.5
19	302	15.2	2.1	4.4	3.0	4.4	13.9	10.9	56.3	8.1
26	125	8.2	3.7	2.3	6.5	9.4	21.9	11.5	52.5	8.5
Fep 2	130	6.0	1.6	2.3	2.9	4.9	11.7	11.7	61.2	4.3
9	180	7.5	1.9	2.3	3.3	5.0	12.5	9.6	62.2	6.2
16	307	10.7	1.4	4.5	3.6	9.2	18.7	9.7	62.0	4.4
23	180	20.5	1.7	2.7	3.3	5.3	13.0	11.5	58.0	7.3
Mar 2	140	1.5	1.8	2.9	4.2	7.0	15.9	15.9	59.1	8.7
9	80	12.7	2.2	2.5	3.9	9.6	18.2	14.5	58.9	9.8
16	100	33.2	2.1	3.0	4.4	7.2	16.7	11.6	58.8	9.7
23	200	15.7	4.6	7.0	9.5	12.1	33.2	13.5	56.2	6.8
30	401	12	2.1	3	4.0	6.3	15.4	15.5	61.1	8.2
Apr. 6	50	8	1.5	2	3.3	3.8	10.6	14.3	50.7	6.8
13	20	3	0.3	0.7	2.6	1.3	4.9	16.1	51.4	6.6
Total	2435	210	28.8	43.7	54.5	91.9	218.9	211.1	971.4	117.7
Mean	143.2	12.3	1.7	2.6	3.2	5.4	12.9	12.4	57.1	6.9

In general, the population of the two tested insect pests and associated predators were relatively higher in the second season than in the first one. This difference may be due to changes in the environmental conditions prevailing in both seaons and/or other factors.

Data illustrated in Figs 1 and 2 showed three overlapping generations of both aphids and jassids through the inspection period in both seasons. In the first seaon, the duration of the three generations of aphids was 6,4 and 4 weeks, respectively, while the duration lasted 3,8 and 6 weeks for jassids, respectively. In the second

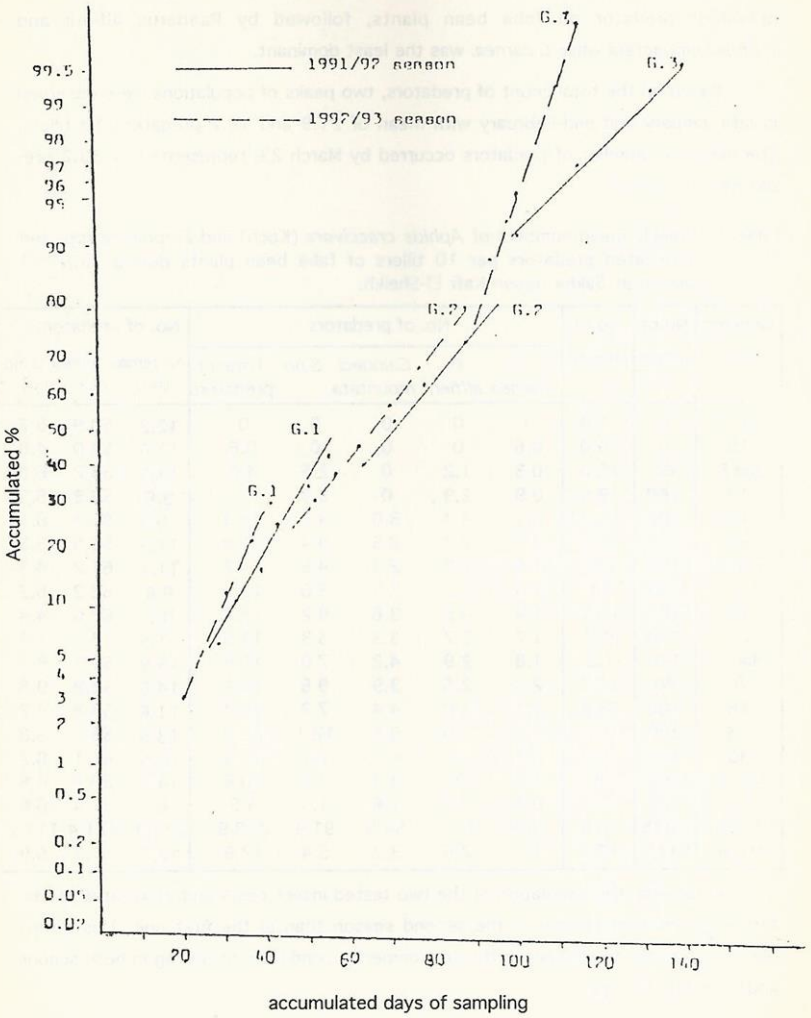

Fig. 1. The duration and number of *Aphis craccivora* Koch field generations on broad bean plants according to Audemard and Milaire (1975) and Lacob (1977) during the seasons 1991/92 and 1992/93 at Sakha region, kafr El-Sheikh Governorate.

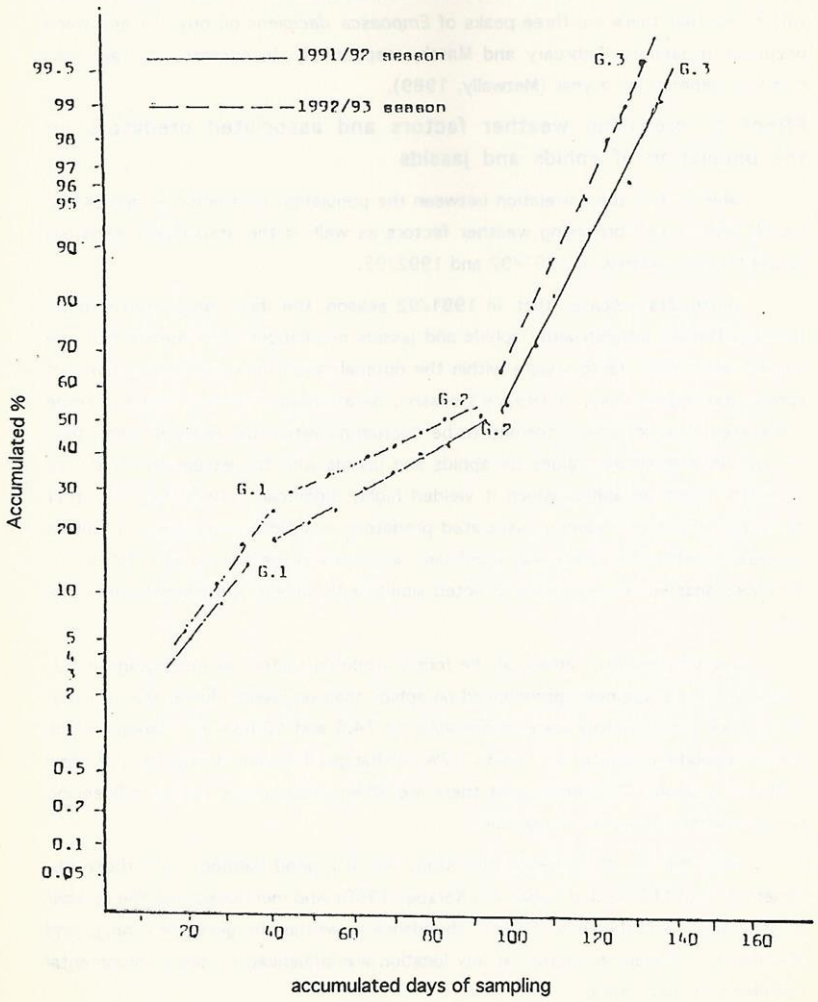

Fig. 2. The duration and number of *Empoasca* spp. field generations on broad bean plants according to Audemard and Milaire (1975) and Lacob (1977) during season 1991/92 and 1992/93 at Sakha region, kafr El-Sheikh Governorate.

season, the three generations occupied 4,6 and 5 weeks for aphids and 4,6 and 7 weeks for jassids, respectively.

The mentioned results are fitted with those obtained by Abd El-Fatah, 1991 who found that there are three peaks of *Empoasca decipiens* on broad bean, which occurred in January, February and March, respectively. In contrast, A.craccivora had four generations a year (Metwally, 1989).

Effect of prevailing weather factors and associated predators on the population of aphids and jassids

Table 3 clear the correlation between the population fluctuation of aphids and jassids and certain prevailing weather factors as well as the associated predators during the two seasons of 1991/92 and 1992/93.

The results indicated that, in 1991/92 season, the three considered climatic factors affected insignificantly aphids and jassids populations. This means that the considered climatic factors were within the optimal range for population activity of aphids and jassids. Also, in 1992/93 season, data obtained cleared that the three considered climatic factors seemed to be fluctuating within the optimal range, thus yielding an insignificant values for aphids and jassids with the exception of relative humidity effect on aphids which it yielded highly significant effect. On the other hand, the effect of common associated predators was highly significant on aphids populations while the effect was significant on jassids in the season of 1991/92. In 1992/93 season, the predators affected significantly aphids and insignificantly jassids.

However, the joint effect of the four considered factors as percentage of explained variance was more pronounced on aphids than on jassids during the two seasons, since these factors were responsible for 74.6 and 50.83% of changes in the aphids populations and for 37.1 and 21.7% of changes in jassids during 1991/92 and 1992/93 seasons. This means that there are other unconsidered factors influencing the populations of aphids and jassids.

Thus, the results gained in this study are in a good harmony with those obtained by Dent (1991) and Kagan and Kerzog (1980) who mentioned that the number of generations and the level of insect abundance as well as the geographic range and abundance of various predators at any location are influenced by the environmental conditions at that location.

Generally, it could be concluded that the populations of aphids and jassids as well as the associated predators were relatively higher during 1992/93 season than

in 1991/92 season. Also, aphids were more abundant than iassids, this holds true in both seasons. The associated predators and the three climatic factors play a role on aphid and jassid abundance. Such informations are of great importance in developing integrated pest management programmes on faba bean.

Table 3. Simple correlation (r), partial regression (p) and explained variance (E.V.) for Aphis craccivora Koch and Empoasca spp. under weekly mean number of associated predators, temperature (Temp.), relative humidity (R.H.) and wind speed (W.S.) on faba bean plants during the two seasons 1991/92 and 1992/93 at Sakhr region, Kafr El-Sheikh.

Season	Factor	Aphids			Jassids		
		(r)	(P)	% E.V.	(r)	(P)	% E.V.
1991/92	Weekly mean predators	0.795**	14.135**		0.587*	0.321*	
	Daily mean temp.	-0.140	-9436		0.034	-0.068	
	Daily mean R.H.	0.038	1.195	74.6	-0.170	-0.132	37.1
	Daily mean W.S	-0.116	-15.276		0.125	0.180	
1992/93	Weekly mean predators	0.520*	4.648		0.142	0.129	
	Daily mean temp.	0.054	3.275		-0.309	-0.887	
	Daily mean R.H.	0.607**	15.366*	50.83	0.189	0.112	21.7
	Daily mean W.S	0.116	0.624		0.214	1.318	

* = Significant

** = highly significant

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ديناميكية تعداد من البقوليات والجاسيد على الفول البلدى وعلاقتها بالمفترسات المصاحبة وبعض العوامل الجوية

هلال أحمد هلال١ ، رمضان محمد بهى الدين سالم ٢ ، عبد المنعم سليمان الخولى١ ،
منير محمد متولى ١ ، الانصارى بلتاجى المزين٢

١ كلية الزراعة – جامعة الازهر – القاهرة.

٢ معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى .

من البقوليات والجاسيد اكثر الحشرات التى تهاجم الفول البلدى خطورة – ولذا اجرى هذا البحث فى مزرعة محطة البحوث الزراعية بسخا – كفر الشيخ خلال موسمى ١٩٩١ / ١٩٩٢ ، ١٩٩٢ / ١٩٩٣ لدراسة الكثافة العددية لهاتين الحشرتين وعلاقتهما بالمفترسات المصاحبة (اسد المن – حشرة الرواغة – حشرة أبو العيد ذو احدى عشر نقطة – حشرة الاسكيمنس)، وبعض العوامل الجوية (الحرارة – الرطوبة النسبية – سرعة الرياح).

أوضحت النتائج المتحصل عليها ان تعداد المن كان اكثر من تعداد الجاسيد فى كلا الموسمين كما انه حدث للمن ثلاث ذروات فى يناير وفبراير ومارس من كل موسم. واتضح ايضا من هذه الدراسة ان للمن ثلاث اجيال متداخلة خلال الموسم الواحد. أثرت الثلاث عوامل الجوية على المن تأثيرا غير معنوي في كلا الموسمين عدا الرطوبة النسبية التي اثرت علي المن تأثيرا عالي المعنوية ومن ناحية أخرى اثرت المفترسات على المن تأثيرا عالى المعنوية فى موسم ١٩٩١ / ١٩٩٢ ومعنويا فى موسم ١٩٩٢ / ١٩٩٣.

حدث للجاسيد ايضا ثلاث ذروات وثلاث اجيال لكل موسم كما تاثر تعداده تأثيرا غير معنويا بالعوامل الجوية الثلاثة ، كما ان المفترسات المصاحبة اثرت على تعداد الجاسيد تأثيرا معنويا فى الموسم الأول وغير معنويا فى الموسم الثانى.

كان التأثير المشترك للمفترسات والحرارة والرطوبة النسبية وسرعة الرياح أكثر وضوحا على المن منه على الجاسيد خلال الموسمين حيث كان مسئولا عن ٧٤,٦٪ ، ٥٠,٨٣٪ من التغيرات فى تعداد المن ، ٣٧,١٪ ، ٢١,٧٪ من التغيرات فى تعداد الجاسيد خلال موسمى ٩١ / ١٩٩٢م ، ٩٢ / ١٩٩٣ م على الترتيب. تعداد كل من المن والجاسيد وكذا تعداد المفترسات المصاحبة كان عاليا نسبيا في الموسم الثانى عنه فى الموسم الأول ولقد وجد ان حشرة الاسكيمنس المفترسة اكثر سيادة فى كلا الموسمين.