J. Plant Prot. and Path., Mansoura Univ., Vol. 3 (9): 935 - 942, 2012

POPULATION FLACTUATIONS OF SOME INSECT PESTS INFESTING BROAD BEAN PLANTATIONS IN RELATION TO CERTAIN ECOLOGICAL FACTORS

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ABSTRACT

Field experiments were conducted at Kafr El-Sheikh governorate during two successive seasons 2008/2009 and 2009/2010 to study the population fluctuations of some insect pests infesting broad bean plantations namely *Liriomyza trifolii* (Burgess) ; *Aphis craccivora* (koch) and *Empoasca discipiens* Poali. In addition, the effect of certain weather factors (daily mean temperatures and daily mean R.H.) and plant age were studied on the population fluctuations of the previously mentioned pests. The weather factors and plant age had significant effect on the population fluctuations of *L. trifolii A. craccivora* and *E. discipiens*,. Also, the relative humidity had shown no significant effect on population fluctuations of the three insect pests during the two seasons 2008/2009 and 2009/2010. The percentage of Explained variance was 83.5& 81.9 % during the two seasons, respectively. The phytochemical contents of the broad bean plant stages, in leaves of Foliage phase, of *A. craccivora* ; *L. trifolii*, and *E. discipiens* were significant during two successive seasons.

INTRODUCTION

Broad bean, (*Vicia faba* L) is becoming one of the most important vegetable crops grown for local consumption. *Liriomyza trifolii* (Burg.) (Diptera: Agromyzidae) was recorded on cotton in some Governorates in Egypt. Chang and Chen (1993) concluded that *L. trifolii* is a potential pest in the cotton fields in Egypt and more research is needed **(**Abd-El-Wahab ;1998 and Shalaby *et al* 2009. Throughout the growing season, broad bean plants are liable to infestation by phytophagous pests such as *Aphis craccivora* (koch), *Empoasca discipiens* Poali, which considered the most common and important insect pests of broad bean plants. In heavy infestation, these pests are causing serious damage to plants, leading to great reduction in the yield (Helal *et al* 1996 and El-Defrawi *et al.* 2000). Aphids play an important role as a vector of plant viruses and produce honeydew (Li *et al* 1994). Therefore, the purpose of this work was to study the effect of plant age and certain weather factors on the population fluctuations of some insect pests infesting broad bean and the effect of insect infestation on chemical components of broad bean leaves.

MATERIALS AND METHODS

Experiments were carried out at Plant Protection Institute Experimental at Kafr El-Sheikh Governorate during two successive seasons, (2008/2009 and 2009/2010) . An area of one feddan was sown with broad bean, seeds (*Vicia faba* L) variety ; Balady on November 10^{th} &15^{th} during 2008 and 2009.

Population study was conducted in an area of one feddan, divided into four replicates. The plants received all normal recommended agricultural practices of bean seeds with the absence of any insecticides application. Population study of *Liriomyza trifolii*, (Burg.); *Aphis craccivora* (koch) and *Empoasca discipiens* Poali started after about one month form sowing and continued until the end of the season.

Weekly direct count of the gassid, *Empoasca discipiens* Poali was done by counting its numbers on sample of 80 leaves chosen randomly (20 leaves/replicate) Four replicates were chosen randomly early in the morning before the gassid adults tend to be more active (Gameel, 1973).

After direct count of adults, the previous samples were picked and then put in a paper bags and examined on the same day in the laboratory with the aid of a stereoscopic-microscope for counting the legume aphid, *Aphis craccivora* (Koch) "nymphs and adults" the broad bean leaf miner, *Liriomyza trifolii* (Burgess) "larvae" .

The records of meteorological data, the daily mean of minimum, maximum temperature and daily mean relative humidity were obtained from the meteorological records of Central Laboratory for Agriculture Climate, Agriculture Research Center at Dokki, The daily records of these factors were recalculated to get the daily averages within one week of the sampling date.

Chemical analysis of broad bean leaves:

The samples were cleaned and washed with distilled water. The fresh weight was determined, and then leaves were put in a drying oven at 60°c for one day. The dry leaves was stored in glass bottles to devote for total carbohydrate, total sugar (reduced sugar and non-reduced sugar), total nitrogen and total lipid.

Total nitrogen was determined according to the method of micro kjeldahl as described by Peach and Tracy (1956). Total carbohydrates were determined according to Forsee (1941). Readings were taken calorimetrically using spectoromic 20 with 420 mm wave length. It was calculated according to the following equation:

$$C/n = \frac{\text{carbohydrate content (gm)}}{\text{Nitrogen content (gm)}}$$

Statistical analysis:

The statistical analysis (ANOVA and Simple correlation) of the obtained data were performed by using SAS program (SAS Institute, 1988) which run under WIN.

RESULTS AND DISCUSSION

Population fluctuations studies showed that *Liriomyza trifolii* (Burgess); *Aphis craccivora* (koch)., and *Empoasca discipiens* Poali, were studied during two seasons (2008/2009 and 2009/2010).

The data in Table (1) show that the infestation of broad bean with *L. trifolii* were started at 29 days after sowing on 9th December (7 individuals

/20 leaves) then it was increased sharply to reach its maximum (85 individuals /20 leaves) at 57 days after planting date on 7th January. After that the insect population fluctuated and decreased gradually to moderate level (39 individuals /20 leaves) on 21st January after 71 days from planting and fluctuated and increased to reach (291 individuals/ 20 leaves) at 11th February. Finally the insect population decreased sharply to reach a lower level (1 individual/ 20 leaves) at 141 days after planting on 2nd April. These results were in agreement with those of Sharaf El-Din *et al*. (1997).

The first appearance of the broad bean aphid *A. craccivora* was at 22 days after sowing on 2nd December (26 individuals /20 leaves) then it was increased sharply to reach its maximum (73 individuals /20 leaves) at 57 days after planting date on 7th January. After that the insect population fluctuated and decreased gradually to reach (5 individuals /20 leaves) on 21st January after 92 days. It is that population of *A. craccivora* was obviously higher on young plants than on older one. These results ara in agreement with findings of Li *et al* and 1994 Helal *et al*. 1996 .

The results indicated that the infestation of the broad bean leaves with *E. discipiens* appeared after 29 days from planting date on 9th December 2008(1 individuals/20 leaves) then disappeared absolutely until 7 January 2009 (16 individuals/ 20 leaves) after 57 days from planting. After that the numbers were increased sharply after 85 days on 4th February and reached 57 individuals/ 20 leaves . Finally, the insect population decreased gradually on 25th March after 134 days from planting date (7 individuals/ 20 leaves). These results indicated that high number of insects infested the moderate plants of broad bean than the younger one , (Table 1).

In Table (2), the results indicated insignificant correlation between the populations of insects and mean daily maximum, minimum temperatures (r= 0.511& 0.793), during 2008/2009 season. In addition, significant correlation was found between the insect populations and daily relative humidity (r= 0.774) during the season of 2008/2009 . The partial regression analysis for the effect of weather factors on the populations revealed that means of daily maximum and minimum temperatures had significant effect. during the season of 2008/2009. Also, the means of daily relative humidity had significant effect. These results are in agreement with El- Khouly *et al*. (1998).

The obtained results revealed that the combined effect of the tested plant age and weather factors was significant on the insect population where the calculated "f" value was 11.60.

The analysis of the variance revealed that the weather factors and the plant age are responsible for about 83.5% of the variability in the populations of the observed pests on the broad bean during 2008/2009 season.

In Table (1) show that broad bean leaves infestation with *L. trifolii* were started at 43 days after sowing on 28th December (2.33 individuals /20 leaves) then it was increased sharply to reach its maximum (123 individuals /20 leaves) at 85 days after planting date on 9th February. After that the insect population fluctuated and decreased gradually to moderate level (72 individuals /20 leaves) on 16th February after 92 days from planting and

fluctuated and increased to reach (184 individuals/ 20 leaves) at 2nd March. Finally the insect population fluctuation decreased sharply to reach a lower level (12.33 individuals/ 20 leaves) at 141 days after planting on 7th April.

The broad bean leaves infested with *A. craccivora* after 22 days of planting on 17th December 2009 (5 individuals/ 20 leaves). Then the population increased to reach 11 individuals/ 20 leaves after 36 days of planting on 21st December 2009. After that the insect population decreased to reach 1 individual/ 20 leaves after 57 days of planting on 12th January 2009. These results indicated that *A. craccivora* preferred the younger globe bean plants than the older ones. These results are in agreement with Shalaby (2004) and Shaalan. (2005).

Data in Table (1) showed that the infestation of broad bean leaves with *E. discipiens* started on 7th December 2009 after 36 days of planting date (7 individuals/ 20 leaves). Then, the population increased rapidly to reach 33 individuals/20 leaves after 85 days from cultivation on 9th February. Finally, the populations decreased. Theses results indicated that *E. discipiens* preferred the older broad bean plants than the younger one.

Table (1) : Population fluctuation of some insects on broad bean plants at Kafr El-Sheikh Governorate during 2008 / 2009 and 2009 / 2010 seasons.

Inspections after plantation (Week)	Plant age (days)	2008/2009			Inspections after plantation (Week)	Plant age (days)	2009/2010		
		Leaf miner Larvae	Aphid	Jassid			Leaf miner Larvae	Aphid	Jassid
2/12	22	0.00	26.0	0.00	7/12	22	0.00	5.00	0.00
9/12	29	7.00	28.0	1.00	14/12	29	0.00	13.00	0.00
16/12	36	63.00	72.0	0.00	21/12	36	0.00	11.00	7.00
23/12	43	43.00	63.0	0.00	28/12	43	2.33	8.00	4.00
30/12	50	57.00	90.0	0.00	5/1	50	3.67	3.00	5.00
7/1	57	85.00	73.0	16.00	12/1	57	9.00	1.00	7.00
14/1	64	63.00	23.0	4.00	19/1	64	24.67	0.00	8.00
21/1	71	39.00	5.00	8.00	26/1	71	33.67	0.00	2.00
28/1	78	95.00	0.00	4.00	2/2	78	46.33	0.00	4.00
4/2	85	79.00	0.00	57.00	9/2	85	123.0	0.00	33.00
11/2	92	291.00	0.00	4.00	16/2	92	72.00	0.00	12.00
18/2	99	159.00	0.00	18.00	23/2	99	108.0	0.00	31.00
25/2	106	130.00	0.00	19.00	2/3	106	184.67	0.00	12.00
4/3	113	90.00	0.00	17.00	9/3	113	150.67	0.00	15.00
11/3	120	36.00	0.00	17.00	16/3	120	63.00	0.00	16.00
18/3	127	3.00	0.00	18.00	23/3	127	36.33	0.00	9.00
25/3	134	4.00	0.00	7.00	30/3	134	25.33	0.00	14.00
2/4	141	1.00	0.00	14.00	7/4	141	12.33	0.00	3.00
Total	-	1245.00	380.	204.0	Total	-	895.0	41.00	182.00
Mean	-	69.17	21.11	11.33	Mean	-	49.72*	5.00	10.11
LSD		9.6			LSD		5.2		

***= Significant at 5% level. A LSD=1.7 LSD=6.0 LSD=Non-significant**

Table (2): Effect of plant age and weather factors on the population fluctuations of some pests infesting broad bean cultivar at Kafr El-Sheikh Governorate during 2008 / 2009 and 2009 / 2010 seasons.

.Factors			Simple correlation and regression values		Partial regression values		Analysis of variance		E.V. %
			r	B	b	p	F	P	
pests	2008/2009	*Liriomyza trifolii*,	0.604	3.05	2.891	0.01	11.60	0.001	83.5
		Aphis craccivora	0.742	2.658	2.614	0.01			
		Liriomyza trifolii,	0.604	3.05	2.891	0.01			
Weather factors		Daily mean max. temp.	0.511	2.667	4.77	0.01			
		Daily mean min. temp.	0.793	2.934	2.852	0.01			
		Daily mean R.H.	0.774	2.561	3.555	0.01			
pests	2009/2010	*Liriomyza trifolii*,	0.730	2.22	3.129	0.01	8.75	0.001	81.9
		Aphis craccivora	0.581	1.19	1.982	0.01			
		Empoasca discipiens	0.622	2.04	2.375	0.01			
Weather factors		Daily mean max. temp.	0.531	2.027	4.32	0.01			
		Daily mean min. temp.	0.733	2.011	2.034	0.01			
		Daily mean R.H.	0.641	2.300	3.810	0.01			

r: Simple correlation value. b.reg.: Partial regression coefficient value.
b: Simple regression coefficient value. E.V: Explained variance.

As shown in Tables (2), the simple correlation "r" indicated significant correlation between the age of broad bean plants and the population of *L. trifolii*, *E. discipiens* and *A. craccivora* on broad bean (r= 0.730, 0.622 and 0.581) respectively. The effected of this factor which appears from the partial regression values on *L. trifolii*, *E. discipiens* and *A. craccivora* population revealed significant effect during 2009/2010 season.

The results indicated significant correlation between the populations of insects and mean daily maximum, minimum temperatures and daily mean of relative humidity (r= 0.531; 733 and 0.641), respectively, during 2009/2010 season. The partial regression analysis for the effect of weather factors on

the populations revealed that means of daily maximum, minimum temperatures and daily relative humidity had significant effect during the season of 2009/2010. These results are in agreement with El- Khouly *et al*. (1998).

The obtained results revealed that the variance of combined effect of the tested plant age and weather factors was 81.9% on the insects population where the calculated "f" value was 8.75.

Generally, the results in Table (3) of the two seasons of 2008/2009 and 2009/2010 showed that incidence of infestation with *L. trifolii* increased gradually with the increase of plant age during the two seasons. This result indicated clearly fruiting phase plants are more suitable for *L trifolii*.

A. carccivora during the first season, and second season's infestation occurred on the stages foliage only in both seasons.

E. discipiens during two seasons increased gradually with the increase of plant age. This result indicated clearly fruiting phase plants are more suitable for *E. discipiens*.

Table (3): Rate of infestation of broad bean by some insects and, plant stage during 2008 / 2009 and 2009 / 2010 seasons.

Insects	Plant age	1st Seasn:2008/2009		Plant age	2nd Seasn:2009/2010		Average two seasons
		Plant stages.	Infested plant		Plant stage	Infested plant .	
Leaf miner	78	Foliage phase	456	78	Foliage phase	119.7	287.9
	92	Blooming phase	370	92	Blooming phase	195	282.5
	99-141	fruiting phase	423	99-141	fruiting phase	580.3	501.7
Aphids	78	Foliage phase	380	78	Foliage phase	41	210.5
	92	Blooming phase	0	92	Blooming phase	0	0.0
	99-141	fruiting phase	0	99-141	fruiting phase	0	0.0
Jasid	78	Foliage phase	33	78	Foliage phase	37	35
	92	Blooming phase	61	92	Blooming phase	45	53
	99-141	fruiting phase	110	99-141	fruiting phase	100	105

The relation between phytochemical components of broad bean and plant stages infested of *A craccivora* ; *L. trifolii*, and *E. discipiens* are shown in Table (4) indicated that the simple correlation between the phytochemical contents of the broad bean plant stages, in leaves of foliage phase, infested with of *A. craccivora* ; *L. trifolii*, and *E. discipiens* were significant during two seasons.

A significant correlation was found between the two insects, *L. trifolii*, and *E. discipiens* and the content in the blooming phase and fruiting phase while no infestation with *A. craccivora* in two plants stages.

The relation between the phytochemical contents of protein, carbohydrate and lipids contents in broad bean were significantly differed ($P<0.01$, ANOVA, Duncan's multiple range test). Where, the infested leaves

have the higher contents of Protein, carbohydrate, ratio indicated low ratio in infested leaves.

In this regard, the authors from their opinion stated that, the relationship between phytochemical contents of broad bean leaves and the infestation of *A craccivora* need more investigation in Foliage phase ; infestation of *L. trifolii* and.*E. discipiens* investigation in Foliage phase; the blooming phase and fruiting phase, These results agree with those of Helal *et al.* (1996) , Abd-El-Wahab (1998) and Shalaby *et al*. (2009).

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ديناميكيـة التعداد لـبعض الآفـات الحشـرية التـى تصـيب زراعـات الفـول وعلاقتهـا بـبعض العوامل البيئية

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أجريت التجارب الحقلية فى محافظة كفر الشيخ خلال سنتين متتـاليتين ٢٠٠٨/ ٢٠٠٩ ، ٢٠٠٩/٢٠١٠ لدراسة ديناميكية التعداد لبعض الآفات التى تصيب زراعات الفول وهى حشرة منّ البقوليـات *Aphis craccivora* Koch ، نطـاط أوراق البطـاطس) *Empoasca discipiens* Poali و ذبابـة أوراق الفول *Liriomyza trifolii* Burgess وأيضـا دراسـة تأثير بعض العوامل الجوية وهى درجة الحرارة الصغرى والكبرى والرطوبة النسبية وعمر النبات على التغيرات فى تعداد الآفات المذكورة .

وأظهـرت التحلـيلات الاحصـائية للعلاقـة بـين اعـداد الحشـرات وبعـض العوامـل البيئيـة (الحرارة العظمي والصغري والرطوبة النسبية وعمر النبات) وجود علاقة أرتباط معنوية مختلفة بين درجـة الحـرارة العظمـي والصـغري وتعداد الحشـرات محـل الدراسـة ، بينمـا بالنسـبة للرطوبـة النسبية. توجد علاقة ارتباط معنوية مختلفة علي نبات الفول خلال عامي الدراسة وكانت نسبة الاختلاف بين العوامل83.5 ، 81.9 % خلال عامي الدراسة.

قام بتحكيم البحث

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