

EFFECT OF SOME AGRICULTURAL PRACTICES ON THE POPULATION DENSITY OF FOUR KEY INSECT PESTS INFESTING BROAD BEAN IN SOHAG GOVERNORATE, UPPER EGYPT

Farghal A.A. Slman

Plant Protection Research Institute, ARC, Dokki, Giza, Egypt

Abstract: Two field experiments were carried out at Shandaweel Agricultural Research Station, Sohag Governorate, Upper Egypt during 2004/2005 and 2005/2006 seasons to study the effect of some agricultural practices i.e., distance between rows (60, 70 and 80 cm), sowing on one or two ridges and distance between hills (20, 25 and 30 cm) on the infestation of broad bean with the leafminer, *Liriomyza trifolii* (Burgess), and also to study the effect of 4 sowing dates (15th Oct., 30th Oct., 15th Nov. and 30th Nov.) on the infestation with the cowpea aphid, *Aphis craccivora* (Koch), the cotton whitefly, *Bemisia tabaci* (Genn.), jassids, *Empoasca* spp. and the leafminer, *L. trifolii* as well as the yield loss due to these insect pests.

The obtained data showed that distance between rows (80 cm), sowing on one side of the ridge and distance

between hills (30 cm), each alone recorded the lowest numbers of *L. trifolii* larvae during both seasons. Also, interactions of distance between rows (80 cm), sowing on one side of the ridge and distance between hills (30, 25 and 20 cm), as well as distance between rows (80 cm), sowing on two sides of the ridges and distance between hills (30 cm) also recorded the lowest densities of *L. trifolii* larvae during both seasons. The population density of *A. craccivora* and *L. trifolii* was significantly affected by sowing date. Sowing broad bean on 15th Oct. showed least infestation levels during both seasons. Highly significant positive correlation between total numbers of 4 insect pests and yield loss during 2004/2005 season ($r = 0.981$) and 2005/2006 season ($r = 0.993$) was observed. The highest yield loss (39.56 and 34.28%) was obtained in case of sowing date 30th Nov. during both seasons of study.

Key words: Insect pests, Broad bean, Agricultural practices

Introduction

Faba bean, *Vicia faba* L., is one of the main source of plant protein in Egypt (Metwally *et al.*, 1997). Unfortunately, faba bean plants are subjected to be attacked by several insect pests, affecting the quantity of the yield and also quality of resulted

crop seeds. Piercing and sucking insects (the cowpea aphid, *Aphis craccivora* (Koch), the whitefly, *Bemisia tabaci* (Genn.) and jassids, *Empoasca* spp. are important economic insect pests which cause severe injury by their direct feeding as well as acting as vectors for

important faba bean viruses (Doss *et al.*, 1992, Rizkalla *et al.*, 1994 and El-Khawas *et al.*, 2004). Moreover, the leafminer, *Liriomyza trifolii* (Burgess) has also become an important pest attacking broad bean (Mesbah and Sherif 1994, Awadalla 1998 and Hady 2004). Its larvae mine between tissues and consequently, resulting in getting considerable yield loss (Abd El-Rahman, 2003). Many entomologists supported the using of safe alternative control methods among which agricultural practices (El-Deeb *et al.*, 1987, Hassanein 1994, Salem 1998 and Ahmed 2003). Dent (1991) mentioned that the planting date of the crop is considered one of the effective cultural means in the integrated pest management, where it greatly affects the level of insect pest infestation and, consequently the crop yield. Therefore, the present study aims to throw more light and to clarify: 1- Effect of distance between rows, sowing on one or two ridges and distance between hills on the infestation of broad bean with the leafminer, *L. trifolii* during 2004/2005 and 2005/2006 seasons. 2- Role of sowing date in the management of insect pests of broad bean and the relation between infestation and yield loss during both seasons.

Materials and Methods

Two field experiments were carried out at Shandaweel

Agricultural Research Station, Sohag Governorate during 2004/2005 and 2005/2006 seasons to study the following:

1- Effect of distance between rows, sowing on one or two ridges of the row and distance between hills on the infestation of broad bean with *L. trifolii* larvae :

Split-split plot design with three replicates was used. Distance between rows (60, 70 and 80 cm), sowing on one or two sides of the row and distance between hills (20, 25 and 30 cm) were randomly allocated to the main, sub and sub-sub plots, respectively. The plot size was 10.5 m² (1/400 of fed.). Two seeds of broad bean genotype Misr 1 were sown on the hill. The seed rate was 60 kg/feddan. The sowing date was 15th and 20th October during 2004/2005 and 2005/2006 seasons, respectively. Nitrogen fertilizer (in the form of urea 46.5% N), was added to all the experimental plots with the rate of 15 kg N/fed. at the first irrigation. Phosphorus fertilizer (in the form of calcium superphosphate 15.5% P₂O₅) was also added to all the plots with the rate of 150 kg/fed. before cultivation. Regular conventional agricultural practices were normally performed, and no insecticides were used during the study periods. Samples of 25 leaflets (upper, middle and lower) were chosen randomly from each plot weekly from the post-emergence of plants

(3-weeks from planting) till the harvest time for counting bean leafminer, *L. trifolii*. Samples of each level were separately kept in paper bags until they were investigated in the laboratory. Counts of larvae of the bean leafminer, were made under stereomicroscope. Duncan's multiple range test (1955) was used to detect differences between treatment means at the 5% level of probability.

2- Effect of sowing date on the infestation of broad bean with *A. craccivora*, *B. tabaci*, *Empoasca* spp. and *L. trifolii* :

Four sowing dates 15th Oct., 30th Oct., 15th Nov. and 30th November were distributed in a randomized complete block design, each was replicated 4 times. The plot size was 10.5 m² (1/400 fed.). The broad bean genotype Misr 1 with the rate of 60 kg/fed. (two seeds on both sides of the row and distance between hills was 20 cm) was used. Urea fertilizer (46.5% N) was added with the rate of (15 kg N/fed) at the first irrigation, as well as phosphorus fertilizer (15.5% P₂O₅) with the rate of 150 kg/fed before cultivation. The other normal agricultural practices were followed and no pesticidal treatments were applied. Samples of 10 branches as soon as piercing and sucking insects appeared and 25 leaflets (from different levels of plant height) after three weeks of each sowing date as regard to *L.*

trifolii were taken at random per plot and continued at weekly intervals till harvest. Samples of *L. trifolii* were kept in tightly closed paper bags and the pest was stored and counted in the laboratory in the same day.

Data were subjected to statistical analysis by using "F" test and means were compared by using Duncan's multiple range test (1955).

To estimate the yield loss due to the forementioned insect pests, similar experiment was carried out at the same place and Actellic insecticide at the rate of 300 ml/100 liter water was applied weekly for each replicate. At harvest the seeds were weighted and the percentage of yield loss was calculated according to Walker (1983):

$$W = \frac{m-y}{m} \times 100$$

Where:

W is the % of yield loss.

m is yield in the absence of insect pests.

and y is the yield in the presence of insect pest infestation.

Results and Discussion

1- Effect of distance rows, site of sowing and plant distance between hills on the population density of *L. trifolii* larvae infesting broad bean:

1.1. Effect of row distances regardless of site of sowing and plant distance between hills:

The data given in Table (4) show the effect of three different row distances on the incidence of *L. trifolii* infesting broad bean plants. In both seasons, row distances had a significant influence on incidence of *L. trifolii* infesting broad bean plants. The first distance 60 cm and the second distance 70 cm between rows in both seasons of 2004/2005 and 2005/2006 favoured the suitable environmental conditions for *L. trifolii* larvae development to show the highest averages of (45.94 and 34.17 larvae/25 leaflets) and (31.89 and 25.17 larvae/25 leaflets), respectively.

1.2. Effect of site of sowing regardless of row distances and plant distance between hills :

The relationship between plant density (sowing on one side and two sides of a row) and the leafminer *L. trifolii* larvae infestation on broad bean during 2004/2005 and 2005/2006 seasons is given in Table (4). Results indicated that the mean number of *L. trifolii* larvae was relatively high on plants cultivated on the two sides of the ridge (38.81 and 29.59 larvae/25 leaflets) compared with those planted one side of the ridge (24.93 and 16.70 larvae/25 leaflets) during 2004/2005 and 2005/2006 seasons, respectively.

However statistical analysis revealed significant effect of sowing on the ridges on the number of larvae infesting broad bean crop during the study periods.

1.3. Effect of plant distance between hills regardless of row distances and site of sowing :

The obtained results in Table (4) indicated that the distance between hills (30 cm) minimize the level of abundance of *L. trifolii* larvae. Narrowing space of planting between hills to 20 cm and 25 cm caused an increase in the larvae population density (37.94 and 29.33 larvae/25 leaflets) and (33.56 and 24.17 larvae/25 leaflets) during both seasons, respectively.

Statistical analysis indicated significant differences between larvae density recorded on broad bean plants cultivated at the three tested spaces in both seasons.

1.4. Effect of interaction between row distances and site of sowing regardless of hill distances on the population density of *L. trifolii* larvae:

Table (1) shows that there were significant interactions between row distances and sowing on the ridges for larvae of *L. trifolii* during 2004/2005 and 2005/2006 seasons. The distance of 60 and 70 cm between rows and sowing on two sides of the ridge recorded the highest means of *L. trifolii* larvae (54 and 41.78 larvae/25 leaflets) and

(38.33 and 33.33 larvae/25 leaflets) larvae/25 leaflets), during followed by the distance of 80 cm 2004/2005 and 2005/2006 seasons, between rows and sowing on two respectively. sides of ridges (24.11 and 13.67

Table(1): Effect of interaction between row distances of *L. trifolii* larvae and site of sowing regardless of hill distances on number of infesting broad bean during 2004/2005 and 2005/2006 seasons.

Row distances (cm)	Site of sowing	Avg. no. of larvae of <i>L. trifolii</i> larvae / 25 leaflets	
		2004/2005	2005/2006
60	One ridge	37.89 b	26.56 c
	Two ridges	54.00 a	41.78 a
70	One ridge	25.44 c	17.00 d
	Two ridges	38.33 b	33.33 b
80	One ridge	11.44 d	6.56 e
	Two ridges	24.11 c	13.67 d

Note : Means followed by the same letter within the same column are not significantly different at 0.05 level of probability according to Duncan's multiple range test.

1.5. Effect of interaction between row and hill distances regardless of site of sowing on the population density of *L. trifolii* larvae:

The highest numbers of larvae were recorded when the distance between rows was (60 cm) and between hills (20 cm) (52.83 and 42.50 larvae/25 leaflets), followed by the distance between rows (60 cm) and hills (25 cm) (47.17 and 35

larvae/25 leaflets), and the distance of 70 cm between rows and 20 cm between hills (38.33 and 31 larvae/25 leaflets) during 2004/2005 and 2005/2006 seasons, respectively (Table 2). Statistical analysis of the data showed significant differences in the number of larvae concerning the distance between rows and the distance between hills.

Table(2): Effect of interaction between row and hill distances regardless of site of sowing on number of *L. trifolii* larvae infesting broad bean during 2004/2005 and 2005/2006 seasons.

Row distances (cm)	Hill distances (cm)	Avg. no. of <i>L. trifolii</i> larvae / 25 leaflets	
		2004/2005	2005/2006
60	20	52.83 a	42.50 a
	25	47.17 b	35.00 b
	30	37.83 c	25.00 d
70	20	38.33 c	31.00 c
	25	34.00 d	26.17 d
	30	23.33 e	18.33 e
80	20	22.67 e	14.50 f
	25	19.50 f	11.33 g
	30	11.17 g	4.50 h

Note : Means followed by the same letter within the same column are not significantly different at 0.05 level of probability according to Duncan's multiple range test.

1.6. Effect of interaction between site of sowing and distance between hills regardless of row distances on the population density of *L. trifolii* larvae:

Data in Table (3) show generally the combined effect of sowing on one side of the ridge or the two sides, and distance between hills during 2004/2005 and 2005/2006 seasons. The data compiled in Table (3) indicate that the effect of

interaction of sowing on the ridges and distance between hills was significant in both seasons. It's worthy to mention that the number of *L. trifolii* larvae was relatively higher in case of sowing on two sides of the ridges and the distance of 20 cm between hills (45.11 and 35.22 larvae/25 leaflets) during 2004/2005 and 2005/2006 seasons, respectively.

Table(3): Effect of interaction between site of sowing and hill distances regardless of row distances on number of *L. trifolii* larvae infesting broad bean during 2004/2005 and 2005/2006 seasons.

Site of sowing	Hill distances (cm)	Avg. no. of <i>L. trifolii</i> larvae/ 25 leaflets	
		2004/2005	2005/2006
One ridge	20	30.78 c	23.44 c
	25	26.67 d	17.78 d
	30	17.33 e	8.89 e
Two ridges	20	45.11 a	35.22 a
	25	40.44 b	30.56 b
	30	30.89 c	23.00 c

Note : Means followed by the same letter within the same column are not significantly different at 0.05 level of probability according to Duncan's multiple range test.

1.7. Interaction effect of distance between rows, site of sowing and distance between hills on the population density of *L. trifolii* larvae:

The results compiled in Table (4) show that the effect of different interactions on the incidence of *L. trifolii* larvae attacking broad bean plants appeared to be significant during 2004/2005 and 2005/2006 seasons. The highest number of *L. trifolii* larvae were found on the plants sown on the two sides of the ridge and at 60 cm distance between rows combined with distance of 20 cm between hills (61.33 and 48.67 larvae/25 leaflets) during both seasons, respectively.

The forementioned results are in parallel with those of Yein and Das (1990) and Soliman and Abd El-Aleim (1997), who found that infestation of rice plants with *Scirophaga intertulas* and *Sogatella furcifera* increased with increasing plant densities, Helaly *et al.* (1994), demonstrated that narrowing space of planting cotton to 15 cm resulted an increasing in number of *Thrips tabaci* (Lind.), egg-masses of *Spodoptera littoralis* (Boisd.) and *Tetranychus spp.*, compared with plant distances of 20 and 25 cm. El-Serwy (1998) recorded that the highest average number of the leafminer, *Agromyza nigripes* (Meigen) resulted when wheat plant distance was 20 cm compared with

Table(4): Effect of interaction among row distances, site of sowing and hill distances on number of *L. trifolii* larvae infesting broad bean during 2004/2005 and 2005/2006 seasons.

Row distances (cm)	Site of sowing	Hill distances (cm)	2004/2005		2005/2006	
			Avg. no. of <i>L. trifolii</i> larvae/ 25 leaflets for			
			Row distances x site of sowing x hill distances	Row distances regardless of site of sowing x hill distances	Row distances x site of sowing x hill distances	Row distances regardless of site of sowing x hill distances
60	One ridge	20	44.33 c	45.94 a	36.33 cd	34.17 a
		25	39.67 d		28.00 e	
		30	29.67 ef		15.33 h	
	Two ridges	20	61.33 a		48.67 a	
		25	54.67 b		42.00 b	
		30	46.00c		34.67 d	
70	One ridge	20	31.67 e	31.89 b	23.67 f	25.17 b
		25	27.33 f		18.33 gh	
		30	17.33 g		9.00 ij	
	Two ridges	20	45.00 c		38.33 c	
		25	40.67 d		34.00 d	
		30	29.33 ef		27.67 e	
80	One ridge	20	16.33 gh	17.78 c	10.33 i	10.11 c
		25	13.00 h		7.00 j	
		30	5.00 i		2.33 k	
	Two ridges	20	29.00 ef		18.67 g	
		25	26.00f		15.67 gh	
		30	17.33 g		6.67 j	
Site of sowing regardless of row and hill distances	One ridge		24.93 b		16.70 b	
	Two ridges		38.81 a		29.59 a	
Hill distances regardless of site of sowing and row distances		20	37.94 a		29.33 a	
		25	33.56 b		24.17 b	
		30	24.11 c		15.94 c	

Note : Means followed by the same letter within the same column are not significantly different at 0.05 level of probability according to Duncan's multiple range test.

25 and 30 cm in 1994-1995 season, Salem (1998) showed that the population density of *Liriomyza congesta* (Beck.) larvae was higher when broad bean plants were sown on two sides of the row than those cultivated on one side. Cotton plants cultivated at distance of 80 cm between rows and 20 cm between hills recorded the lowest level of infestation with bollworms, *Pectinophora gossypiella* (Saund.) and *Earias insulana* (Boisd.), comparing with those planted on hills with 10 cm distance between them (Abdel-Wahab 2005).

2- Effect of sowing date on the infestation of broad bean with *A. craccivora*, *B. tabaci*, *Emposca* spp. and *L. trifolii*, and their relation with yield loss:

The average number of *A. craccivora* and *L. trifolii* were significantly higher on broad bean sown on 30th Nov. than those sown on the other dates during 2004/2005 and 2005/2006 seasons. The same trend was observed regarding the total of 4 insect pests during 2004/2005 and 2005/2006 seasons. These results agree with those of Hassanein (1994), Stutzel (1995), Salem (1998), Manna *et al.*, (1999) and Ahmed (2003), who mentioned that broad bean plants which sown lately suffered heavier infestation with *A. craccivora* than when sown early. Also, the results concerning *L. trifolii* larvae are similar to those of Khalil *et al.*, (1974), Saleh *et al.*,

(1983), Guirguis *et al.*, (1983), El-Shakaa *et al.*, (1992), Hassanein (1994), Salem (1998) and Ahmed (2003) who found that the delaying of sowing faba bean (*Vicia faba*) increased the infestation by *L. trifolii* which in turn decreased the yield.

As for both *B. tabaci* and *Emposca* spp. the trend was different, since the sowing date did not influence on these insect pests during both seasons. This could be attributed to the fact that broad bean is the least winter crop to be infested by the two insect pests (El-Sayed *et al.*, 1991). Regarding the yield loss due to 4 insect pests during both seasons, it could be concluded that the relationship between total number of 4 insect pests during the 4 sowing dates and yield loss was clear, where the highest yield loss (39.56 and 34.82%) was obtained in case of the fourth sowing date (30th Nov.) in both seasons, respectively. The early sown date (15th Oct.), recorded the lowest yield loss (23.08 and 20.93%) and also harboured the lowest number of insect pests during both seasons, respectively. So, it could be deduced that sowing date had an obvious effect on yield loss.

Results in Table 5 showed a highly significant positive correlation between total numbers of 4 insect pests and yield loss at four sowing dates, ($r= 0.981$ and 0.993 during 2004/2005 and 2005/2006 seasons, respectively). These results

Table(5): Effect of sowing dates on infestation of broad bean with four key insect pests and their relation with yield loss during 2004/2005 and 2005/2006 seasons.

Sowing date	Avg. no. of piercing and sucking insect pests /10 branches			Avg. no. of <i>L. trifolii</i> /25 leaflets	Total Avg. no. of 4 insect pests ^(a)	Avg. seed yield kg/fed.		Yield loss ^(b) (%)
	<i>A. craccivora</i>	<i>B. tabaci</i>	<i>Empoasca spp.</i>			In the absence of insect infestations	In the presence of insect infestations	
2004/2005 season								
Oct. 15	140.50 d	15.00 a	8.75 a	27.00 d	191.25 d	1462.5	1125.0	23.08 d
Oct. 30	531.00 c	10.75 a	6.50 a	40.75 c	589.00 c	1125.0	837.5	25.56 c
Nov. 15	998.75 b	5.50 b	4.25 a	55.25 b	1063.75 b	750.0	500.0	33.33 b
Nov. 30	1323.0 a	2.25 b	3.00 a	64.00 a	1392.25 a	562.5	340.0	39.56 a
2005/2006 season								
Oct. 15	80.75 d	11.75 a	6.25 a	20.75 d	119.50 d	1612.5	1275.00	20.93 d
Oct. 30	191.25 c	8.25 a	4.75 a	31.50 c	235.75 c	1200.0	912.50	23.96 c
Nov. 15	633.00b	6.00 a	3.00 a	42.00 b	684.00 b	975.0	700.75	28.13 b
Nov. 30	1112.50 a	1.00 b	2.50 a	51.25 a	1167.25 a	637.5	415.50	34.82 a

Note : Means followed by the same letter within the same column are not significantly different at 0.05 level of probability according to Duncan's multiple range test.

Simple correlation coefficient between (a) and (b) was calculated ($r = 0.981$ and 0.933) during both seasons, respectively.

are in agreement with Hassanein (1994), who mentioned that sowing broad bean on 15th Oct. produced the highest yield of seeds as plants harboured low numbers of insects.

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تأثير بعض العمليات الزراعية على الكثافة العددية لأربع آفات حشرية رئيسية تصيب الفول البلدى بمحافظة سوهاج - مصر العليا

فرغل أحمد على سلمان

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - دقى - جيزة - مصر

أقيمت تجربتان بمحطة البحوث الزراعية بجزيرة شنديول - محافظة سوهاج - مصر العليا خلال موسمي ٢٠٠٤/٢٠٠٥ و ٢٠٠٥/٢٠٠٦ وذلك لدراسة تأثير بعض العمليات الزراعية مثل المسافة بين الخطوط (٦٠ ، ٧٠ و ٨٠ سم) والزراعة على ريشة أو ريشتين وكذلك المسافة بين الجور (٢٠ ، ٢٥ و ٣٠ سم) على إصابة نباتات الفول البلدى بصناعة أنفاق أوراق الفول ، وكذلك تأثير أربعة مواعيد زراعة (١٥ أكتوبر ، ٣٠ أكتوبر ، ١٥ نوفمبر و ٣٠ نوفمبر) على إصابة نباتات الفول البلدى أيضاً بأربعة آفات حشرية وهي من البقوليات وذبابة القطن البيضاء والجاسيد وصناعة أنفاق أوراق الفول البلدى بالإضافة إلى دراسة الارتباط بين الإصابة بمجموع الأربعة آفات حشرية فى مواعيد الزراعة المختلفة والفقء فى المحصول .

وكانت النتائج المتحصل عليها كالتالى :

١- تم تسجيل أقل إصابة بصناعة أنفاق أوراق الفول البلدى عندما تم زراعة الفول البلدى على مسافة بين الخطوط ٨٠ سم والزراعة على ريشة واحدة وكانت المسافة بين الجور ٣٠ سم خلال موسمي الدراسة .

٢- كذلك تم تسجيل أقل إصابة بصناعة أنفاق أوراق الفول البلدى فى حالة التفاعل المشترك بين المسافة بين الخطوط ٨٠ سم ، الزراعة على ريشة واحدة والمسافة بين الجور ٣٠ أو ٢٥ أو ٢٠ سم تلاه المسافة بين الخطوط ٨٠ سم والزراعة على ريشتين والمسافة بين الجور ٣٠ سم خلال الموسمين .

٣- تأثرت الكثافة العددية لكل من صناعة أوراق الفول البلدى وكذلك من البقوليات معنوياً بميعاد الزراعة فقء وجد أن زراعة الفول البلدى فى ١٥ أكتوبر خلال الموسمين يعطى أقل إصابة بالآفات الحشرية خلال الموسمين .

٤- وجد أن هناك ارتباط موجب عالى المعنوية بين المجموع الكلى للآفات الحشرية والفقء فى المحصول ($r = ٠,٩٩٣, ٠,٩٨١$) خلال موسمي ٢٠٠٤/٢٠٠٥ ، ٢٠٠٥/٢٠٠٦ م على التوالى

٥- تم تسجيل أعلى نسبة معنوية للفقء فى المحصول (٣٩,٥٦ ، ٣٤,٢٨) فى حالة ميعاد الزراعة ٣٠ نوفمبر حيث تعرض لأعلى إصابة بمجموع الآفات الحشرية جميعها (٥٦٢,٥ ، ٦٣٧,٥ فرد) خلال موسمي الدراسة ٢٠٠٤/٢٠٠٥ ، ٢٠٠٥/٢٠٠٦ م على التوالى .