

**THE EFFICIENCY OF HONEYBEES AND OTHER INSECT
POLLINATORS IN POLLINATION OF FABA BEAN**
(Vicia faba L.)

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ABSTRACT

The present investigation aimed to identify insect visitors of faba bean (*Vicia faba* L.) during flowering periods of 1999/2000 and 2000/2001 in two sites, the first at Shalakan district, Kalubia Governorate representing the valley land and Kassasin region, Ismailia Governorate as a new reclaimed land.

Obtained results indicated that the total insect counts attained 21 and 22 species in both sites in the two seasons. These species belong to five orders: Hemiptera (2 species), Lepidoptera (2 species), Coleoptera (4 species in the first site and 5 species in the second one), Diptera (6 species) and Hymenoptera (7 species). However, there are some differences in numbers and species in the two sites. Honeybee (*Apis mellifera* L.) proved to be the most abundant pollinator constituting (13.12, 11.84 %) and (11.01, 11.21%) of the total collected insects in the two seasons at the first and the second site, respectively. The highest bee count was around mid seasons and at 2 p.m.

In addition, some insect visitors were swept abundantly. They were considered as pests rather than pollinators, such as house fly and *Tropinota squalida*.

Regarding the effect of prevailing air temperature and RH% on the occurrence of insect pollinators, it is clear that the effects of the

two factors were very slight in the first season, and moderate in the second one.

The effects of open pollination, insect exclusion and honeybee pollination on the yield of faba bean were investigated in Kassasin region, Ismailia Governorate only. The results showed that the mean seed yield / feddan recorded 1119.55, 604.42 and 829.74 kg. for the three types of pollination, respectively.

Statistical analysis showed that the highest significant seed yield/feddan was recorded for open pollination, while the lowest one was recorded for insect exclusion. Honey bees showed an intermediate seed yield.

Key words: *hymenoptera, new reclaimed land, pollination, pollinators, seed yield, Vicia faba.*

1. INTRODUCTION

Faba bean (*Vicia faba* L.) is known to be the oldest popular human food and differs widely in use. This crop thrives in a wide variety of soils (old valley and new reclaimed lands).

Insect pollination increases the productivity of field and horticultural crops, assuring self pollination (Pazy, 1984) and cross pollination (Adlerz, 1966 and Lord, 1985) with its advantages such as producing larger perfectly shaped pods, a greater proportion of early flower set, promotion of hybrid vigor and avoiding pest attack. Also, insect pollination of crops represents an important safe and cheap measure of vertical expansion in agriculture (Free, 1966; Yousif-Khalil *et al.*, 1989).

The present work aimed to determine insect visitors/ pollinators of faba bean with their activities as affected by some climatic factors (ambient daily temperature and relative humidity). This work was carried out in Shalakan district, Kalubia Governorate representing old valley lands and El-Kassasin region, Ismailia Governorate that represents new reclaimed lands.

In addition, the effects of open pollination, insect exclusion and honey bee pollination on the yield parameters of faba bean were evaluated at El-Kassasin region, during the two successive seasons of 1999 / 2000 and 2000 / 2001.

2. MATERIALS AND METHODS

The present study was carried out at Shalakan district, Kalubia Governorate (old valley land) and at El-Kassasin region, Ismailia Governorate (newly reclaimed land). The experiments were performed during the two successive seasons of 1999 / 2000 and 2000 / 2001 to identify insect visitors of faba beans. (var. Giza 9) and the effect of insect pollination on the yield.

2.1. Insect pollinators of faba bean and their foraging behaviour

Seeds of faba bean (cultivar Giza 9) were sown in an area of ½ feddan on October 9, 1999 and October 10, 2000 at Shalakan district, and on October 3, 1999 and October 5, 2000 at El-Kassasin district. The crop was grown in rows 60 cm wide and seeds were sown in hills 30 cm apart. One plant was left in each hill, no insecticides were applied during the flowering period.

Insects visiting and pollinating faba bean flowers were collected during flowering periods which started from January 15, 2000 to February 26, 2000 and from January 14, 2001 to February 25, 2001 at Shalakan and from January 13, 2000 to February 24, 2000 and from January 12, 2001 to February 23, 2001 at El-Kassasin.

Samples were taken a day weekly at two-hour intervals, starting from 8 a.m. until 4 p.m., using an insect net, fifty double sweeps were made at each interval. The surveyed insects were sorted and identified to genera and species when possible, climatic factors including ambient air temperature (°C) and relative humidity (RH%) were recorded at each interval.

The correlation coefficient between the number of surveyed insects and each of °C and RH% was calculated according to Snedecor (1957).

2.2. Effect of insect pollination on the yield of faba bean cultivar Giza 9

2.2.1. Experimental fields

To determine the effect of open pollination, insect exclusion, honeybee pollination on the yield of faba bean cultivar (Giza 9) at El-Kassasin, nine 1.5 x 1.5 random plots were used:

- 1-Three open plots were left as control, open pollination (A).
- 2-Three plots were covered with plastic screen cages 1.5 x 1.5 x 1.5 m to prevent all insect visitors (B).
- 3-Three plots as in (B) but each was provided with honeybee baby nucleus, honeybee pollination (C).

2.2.2. The plastic screen cages

Wooden frame cage measuring 1.5 x 1.5 x 1.5 m was covered with plastic screen of 14 mesh / square inch and had a door to permit observation of plants and honeybees inside the cage, such cages were randomly distributed on the cultivated area. The cages were placed on the field at the beginning of flowering period until its end.

2.2.3. Honeybee baby nucleus

Three baby nuclei were used, each nucleus contained 2 combs, one of which contained sealed brood and the other contained stored honey, each nucleus headed by sister mated queens (first cross Carniolan, and care was taken to avoid other insects inside the cages.

The following yield parameters were recorded during the two successive seasons.

- Total number of flowers per plant
- Total number of pods per plant
- Mean percentage of pod set = $\frac{\text{Total number of pods / plant}}{\text{Total number of flowers / plant}} \times 100$
- Mean number of seeds per pod
- Mean number of seeds per plant
- Mean weight of seeds per plant
- Mean weight of 100 seeds (g)
- Estimated seed yield / feddan (4200 m²).

Analysis of variance was used to analyze the data according to Snedecor (1957).

3. RESULTS AND DISCUSSION

3.1. General survey of faba bean (*Vicia faba* L.) insect visitors

3.1.1. Insect visitors of faba bean at Shalakan district, Kalubia Governorate

Data presented in Tables (1 and 2), revealed 21 insect species belonging to 5 orders: Hemiptera (2 species), Lepidoptera (2 species),

Table (1): Faba bean insect visitors collected a day weekly during flowering seasons of 2000 and 2001 at Kalubia.

Insect name	Year		2000								2001									
	Date of observation		15/1	22/1	29/1	5/2	12/2	19/2	26/2	Total	%	14/1	21/1	28/1	4/2	11/2	18/2	25/2	Total	%
Order: Hemiptera																				
<i>Oxycarenus hyalinipennis</i> Costa	8	7	16	11	7	4	9	62	3.57	6	3	8	12	10	2	-	41	2.73		
<i>Nezara viridula</i> L.	6	8	5	12	9	8	6	54	3.11	5	4	13	7	9	6	4	48	3.19		
Total Hemipterous insects	14	15	21	23	16	12	15	116	6.68	11	16	21	19	19	8	4	89	5.92		
Order: Lepidoptera																				
<i>Pieris rapae</i> L.	4	3	9	6	6	2	-	30	1.73	2	6	2	9	8	4	3	34	2.26		
<i>Polymmatous baeticus</i> L.	5	3	7	9	8	3	1	36	2.07	-	2	5	8	6	4	2	27	1.80		
Total Lepidopterous insects	9	6	16	15	14	5	1	66	3.80	2	8	7	17	14	8	5	61	4.06		
Order: Coleoptera																				
<i>Coccinella undecimpunctata</i> L.	12	5	8	16	10	7	4	62	9.57	9	10	8	12	6	6	-	51	3.39		
<i>Bruchidus trifolii</i> Motsh.	-	-	-	2	8	13	9	32	1.84	-	4	5	3	7	10	8	37	2.46		
<i>Sitona lividipes</i>	1	4	2	1	3	3	3	17	0.98	-	-	1	4	7	3	-	15	1.00		
<i>Tropinota squalida</i>	-	-	1	3	2	4	2	12	0.69	-	1	2	2	4	-	-	9	0.60		
Total Coleoptera insects	13	9	11	22	23	27	18	123	7.08	9	15	16	21	24	19	8	112	7.45		
Order: Diptera																				
<i>Syrphus corollae</i> F.	3	9	13	6	8	4	12	55	3.17	-	-	5	7	16	4	2	34	2.26		
<i>Liriomyza congesta</i> Becker	56	83	61	74	86	55	67	482	27.75	32	72	106	89	114	66	39	518	34.46		
<i>Musca domestica</i> L.	44	63	41	56	52	67	43	366	21.07	26	33	72	55	64	15	29	294	19.56		
<i>Sarcophaga carnaria</i> Meig	-	4	3	3	6	4	2	22	1.27	-	-	4	7	8	-	-	19	1.26		
<i>Lucilia sericata</i> Meig	6	8	12	10	5	13	7	61	3.51	-	6	4	12	5	9	3	39	2.60		
<i>Tabanus taeniola</i> Pal. B.	2	4	7	5	3	6	1	28	1.61	-	4	7	11	6	3	5	36	2.40		
Total Dipterous insects	111	171	137	154	160	149	132	1014	58.38	58	115	198	181	213	97	78	940	62.54		
Order: Hymenoptera																				
<i>Apis mellifera</i> L.	15	27	36	30	47	54	19	228	13.12	11	5	6	42	28	62	24	178	11.84		
<i>Megachile submucida</i> Aflk.	2	5	8	4	4	7	6	36	2.07	-	5	3	6	7	4	2	27	1.80		
<i>M. minutissima</i> Rad	3	8	7	3	3	5	4	33	1.90	1	3	-	4	12	4	7	31	2.06		
<i>Anthophora</i> sp	1	7	8	4	3	3	5	31	1.78	-	-	-	3	5	7	3	18	1.2		
<i>Halictus</i> sp	-	1	3	3	6	1	-	14	0.81	-	-	3	2	1	1	2	9	0.60		
<i>Polistes gallicus</i> L.	4	8	14	17	9	8	10	70	4.03	-	1	4	8	9	12	-	34	2.26		
<i>Ceratina tarsata</i> Mor.	-	1	2	1	-	2	-	6	0.35	-	-	-	1	3	-	-	4	0.27		
Total Hymenopterous insects	12	57	78	62	72	80	44	418	24.06	12	14	16	66	65	90	38	301	20.03		
General total	172	258	263	276	285	273	210	1737		92	168	158	304	326	222	133	1503			
Mean temp. (C°)	18.8	16.3	15.7	17.0	20.40	18.5	17.4	$r_1 = 0.08$		16.8	14.7	15.4	14.3	15.0	16.9	16.0	$r_1 = 0.60$			
Mean R. H. (%)	66.0	63.0	62.0	67.0	63.0	65.0	65.0	$r_2 = -0.40$		70.0	58.0	61.0	64.0	60.0	63.0	64.0	$r_2 = -0.51$			

r_1 = Correlation coefficient value between air temperature (C°) and the number of insects.

r_2 = Correlation coefficient value between R. H. % and the number of insects.

Correlation coefficient value between air temperature & R.H. % and the number of honeybee were (0.29; - 0.33 and 0.23; - 0.10) in the two seasons respectively.

Coleoptera (4 species), Diptera (6 species) and Hymenoptera (7 species) in the two seasons (1999/2000 and 2000/2001).

Hemipterous insects represented 6.68 and 5.92 % of the total visitors in the flowering periods of 2000 and 2001 seasons, respectively.

Lepidopterous insects, represented by *Pieris rapae* L. and *Polymmatous baeticus* L. formed 3.8 and 4.06 % of the total insect count in the two years of study, respectively. The cabbage butterfly *Pieris rapae* L. being more abundant at 10 a.m. while *P. baeticus* was highly counted at 12 noon (Table 2).

Insects belonging to order Coleoptera represented 7.08 and 7.45% of the total catch in the two seasons of study, respectively. This order was represented by 4 species *Coccinella undecimpunctata* L., *Bruchidius trifolli*, *Sitonia lividips* and *Tropinota squalida*.

Dipterous insects formed the majority of insect visitors, six species of flies were swept, representing 58.38 and 62.54 % of the total collected insects in the two seasons of study , respectively (Table 1). Daily peak activity of flies on faba bean flowers was detected at 12 noon in both seasons (Table 2). *Liriomyza congesta* was the most abundant species, followed by *Musca domestica*. The respective percentages of occurrence of the two species were 27.75 & 21.07 % in 2000 and 34.64 & 19.56 % in 2001 flowering seasons .

The total numbers of hymenopterous insects were 418 and 301 insects, representing 24.06 and 20.03 % of the total insect collected in the two years of study, respectively (Table 1). The surveyed insects were (7species) *i.e.* honey bees *Apis mellifera* L. (1 3.12 and 11.84%); *Megachile submucida* Alf. (2.07 and 1.80 %); *M. minutissima* Rad. (1.90 and 2.06 %); *Anthophora* sp. (1.78 and 1.20%); *Halictus* spp. (0.81 and 0.60 %); *Polistes gallicus* (4.03 and 2.26 %) and *Ceratina tarsata* Mor. (0.35 and 0.27%) of the total insect visitors in the two years of study , respectively. El-Berry *et al.*, (1974) found that all visitors of faba bean belonging to superfamily *Apoidea* including *Anthophora* sp. 81.3%. Honey bees proved to be the major pollinator of faba bean flowers . The daily peak activity of honey bees was noticed between 12 noon to 2 p.m. (Table 2). These findings are in agreement with Voluzneva (1971), Stoddard (1991), Varis (1995) and Koltowski (1996a) who stated that honey bees were necessary to pollinate faba bean , representing 44 to 92 % of the total insects

Table (2): Daily activity of faba bean pollinators at two- hour intervals during flowering seasons of 2000 and 2001 at Kalubia.

Year	2000								2001							
	Insect name \ Time of the day	8a. m	10	12noon	2 p. m	4	Total	%	8a. m	10	12noon	2 p. m	4	Total	%	
Order: Hemiptera																
<i>Oxycarenus hyalinipennis</i> Costa	5	23	18	9	7	62	3.57	3	12	16	8	2	41	2.73		
<i>Nezara viridula</i> L.	3	13	22	11	5	54	3.11	7	14	12	6	9	48	3.19		
Total Hemipterous insects	8	36	40	20	12	116	6.68	10	26	28	14	11	89	5.92		
Order: Lepidoptera																
<i>Pieris rapae</i> L.	1	10	9	7	3	30	1.73	3	9	14	8	-	34	2.26		
<i>Polymnctus baeticus</i> L.	5	8	12	5	6	36	2.07	3	10	12	2	-	27	1.80		
Total Lepidopterous insects	6	18	21	12	9	66	3.80	6	19	26	10	-	61	4.06		
Order: Coleoptera																
<i>Coccinella undecimpunctata</i> L.	7	17	24	9	5	62	3.57	5	14	17	9	6	51	3.39		
<i>Bruchidus trifolli</i> Motsh.	9	6	10	5	2	32	1.84	14	7	8	3	5	37	2.46		
<i>Sitona lividips</i>	3	5	7	2	-	17	0.98	3	6	4	2	-	15	1.00		
<i>Tropinota squalid</i>	2	3	4	3	-	12	0.69	-	4	3	1	1	9	0.60		
Total Coleopterous insects	21	31	45	19	7	123	7.08	22	31	32	15	12	112	7.45		
Order: Diptera																
<i>Syrphus Corollae</i> F.	6	19	12	14	4	55	3.17	6	13	10	4	1	34	2.26		
<i>Liriomyza congesta</i> Becker	72	101	132	122	55	482	27.75	46	164	198	73	37	518	34.46		
<i>Musca domestica</i> L.	54	62	104	98	48	366	21.07	28	92	108	47	19	294	19.56		
<i>Sarcophage carnaria</i> Meig	4	7	3	6	2	22	1.27	2	8	5	4	-	19	1.26		
<i>Lucelia sericata</i> Meig	9	14	19	12	7	61	3.57	7	11	12	9	-	39	2.60		
<i>Tabanus taeniola</i> Pal. B.	2	9	11	5	1	28	1.61	4	7	11	8	6	36	2.40		
Total Dipterous insects	147	212	281	257	117	1014	58.38	93	295			63	940	62.54		
Order: Hymenoptera																
<i>Apis mellifera</i> L.	29	46	53	78	22	228	13.12	13	22	57	71	15	178	11.84		
<i>Megachile submucida</i> Afk.	5	11	16	4	-	36	2.07	5	4	8	9	1	27	1.80		
<i>M. minutissima</i> Rad	3	8	14	7	1	33	1.90	4	3	7	16	1	31	2.06		
<i>Anthophora</i> sp.	4	7	9	8	3	31	1.78	2	4	6	4	2	18	1.20		
<i>Halictus</i> sp.	2	3	6	2	1	14	0.81	1	1	3	4	-	9	0.60		
<i>Polistes gallicus</i>	8	17	24	11	10	70	4.03	5	7	10	8	4	34	2.26		
<i>Ceratina tarsata</i> Mor.	-	1	3	2	-	6	0.35	-	3	1	-	-	4	0.27		
Total Hymenopterous insects	51	93	125	112	37	418	24.06	30	44	92	112	23	301	20.03		
General total	233	386	516	420	182	1737		161	415	522	296	109	1503			

visiting faba bean flowers and supplementary hives are needed to ensure adequate pollination .

As regards insect pollinators of faba bean at El-Kassasin region, Ismailia Governorate, the results (Tables 3 and 4), revealed that insects species visiting faba bean flowers reached 22 species of 5 orders *i.e.*, Hemiptera (2 species), Lepidoptera (2 species), Coleoptera (5 species), Diptera (6 species) and Hymenoptera (7 species).

Hemipterous visitor insects represented by *Oxycarenus hyalinipennis* and *Nezara viridula* formed 4.26 and 3.35 % of the total insect counts in 2000 and 2001 seasons , respectively.

The lepidopterous counted 56 and 62 insects , forming 4.11 and 4.43% of the total insect catch in the two years of the study, respectively. *Pieris rapae* was more abundant than *Polymmatius baeticus* , it peaked at 2 p.m. (Table 4) .

Regarding coleopterous insects 306 and 371 insects were swept , forming 22.46 and 26.48 % of the total insect count in the two years of study , respectively. *Tropinota squalia* was the most common species , recording 182 represented 178 insects and 13.36 and 12.71 % of the total insect visitors in the two years of study , respectively. The daily peak activity was noticed between 12 noon – 2 p.m. On the other hand, the lowest abundant species was *Bruchidus trifolii*.

Dipterous insects were the most abundant in general , recording 534 and 503 insects and representing 39.21 and 35.90 % of the total insect count in the two years of study , respectively. The most common dipterous insect visitor was *Liriomyza congesta* in the first year (16.08 % of the total insects catch) and *Musca domestica* in the second year of the study . Daily peak activities of dipterous insects were detected between 12 noon and 2 p.m. Although flies had a high occurrence , yet they are of less importance as pollinators.

The total numbers of hymenopterous insects were 408 and 418 individuals , representing 29.96 and 29.84 % of the total insect visitors in the two years, respectively . Honeybees (*Apis mellifera* L.) were the most abundant hymenopterous insect in both seasons, forming 11.01 and 11.21 % of the total insect catch in the two seasons, respectively.

Honeybees were most active during the period between 12 noon and 2 p.m. *Philanthus abdelkader* occupied the second rank of Hymenopterous insects in the second year (88 insects) but,

Table (3) : Faba bean insect visitors collected a day weekly during the flowering seasons of 2000 and 2001 at Ismallia region.

Year Date of observation	2000									2001								
	13/1	20/1	27/1	3/2	10/2	17/2	24/2	Total	%	12/1	19/1	26/1	2/2	9/2	16/2	23/2	Total	%
Order: Hemiptera																		
<i>Oxycarenus hyalinipennis</i> Costa	3	7	5	8	2	5	6	36	2.64	1	2	6	6	7	5	7	34	2.43
<i>Nezara viridula</i> L.	2	4	3	4	1	3	5	22	1.62	1	3	2	3	1	1	2	13	0.92
Total Hemipterous insects	5	11	8	12	3	8	11	58	4.26	2	5	8	9	8	6	9	47	3.35
Order: Lepidoptera																		
<i>Pieris rapae</i> L.	4	4	6	7	3	5	4	33	2.42	5	5	6	7	5	4	3	35	2.50
<i>Polymmatous baeticus</i> L.	2	3	6	3	2	4	3	23	1.69	3	2	4	5	7	4	2	27	1.93
Total Lepidopterous insects	6	7	12	10	5	9	7	56	4.11	8	7	10	12	12	8	5	62	4.43
Order: Coleoptera																		
<i>Coccinella undecimpunctata</i> L.	5	9	4	8	3	3	4	36	2.64	6	8	5	7	10	4	6	46	3.28
<i>Coccinella septempunctata</i>	7	3	6	4	2	2	3	27	1.98	7	6	9	11	10	6	7	56	4.00
<i>Bruchidus trifolii</i> Motsh.	2	1	2	1	4	4	5	19	1.40	1	2	4	6	3	5	2	23	1.64
<i>Trichodes longissimus</i>	3	5	8	10	4	5	7	42	3.08	4	9	11	13	8	16	7	68	4.85
<i>Tropinota squalida</i>	19	27	36	43	23	21	13	182	13.36	20	27	19	30	33	32	17	178	12.71
Total Coleopterous insects	36	45	56	66	36	35	32	306	22.46	38	52	48	67	64	63	39	371	26.48
Or: Diptera																		
<i>Syrphus corollae</i> F.	6	9	7	2	5	4	6	39	2.86	3	5	4	7	10	15	7	51	3.64
<i>Liriomyza congesta</i> Becker	33	29	52	43	17	21	24	219	16.08	20	25	33	27	17	22	35	179	12.77
<i>Musca domestica</i> L.	39	31	42	27	40	10	16	205	15.05	28	31	22	44	37	28	37	227	16.20
<i>Sarcophaga carnaria</i> Meig	4	6	5	9	2	3	3	32	2.35	1	3	2	5	4	3	1	19	1.36
<i>Lucelia sericata</i> Meig	2	2	3	1	1	1	4	14	1.03	2	2	1	2	1	4	1	13	0.93
<i>Tabanus taeniola</i> Pal. B.	3	5	4	3	6	2	2	25	1.84	1	1	4	3	2	1	2	14	1.00
Total Dipterous insects	87	82	113	85	71	41	55	534	39.21	55	67	66	88	71	73	83	503	35.90
Order: Hymenoptera																		
<i>Apis mellifera</i> L.	15	24	33	29	22	18	9	150	11.01	10	23	26	32	29	25	12	157	11.21
<i>Megachile submucida</i> Afk.	2	1	3	7	3	4	6	26	1.91	1	1	3	2	2	1	1	11	0.79
<i>Polistes gallicus</i> L.	7	5	10	12	8	5	7	54	3.97	7	10	9	8	6	5	2	47	3.35
<i>Philanthus abdelkader</i>	3	6	9	16	14	7	8	63	4.63	9	15	18	14	22	7	3	88	6.28
<i>Chalicodoma mucorea</i>	9	12	21	11	6	10	8	77	5.65	5	9	12	9	15	19	5	74	5.28
<i>Xylcopa aestuans</i>	-	2	2	3	2	1	1	11	0.81	1	1	1	2	1	1	1	8	0.52
<i>Anthophora</i> sp.	1	1	4	3	9	4	5	27	1.98	3	2	5	4	7	9	3	33	2.36
Total Hymenopterous insects	37	51	82	81	64	49	44	408	29.96	36	61	74	71	82	67	27	418	29.84
General Total	171	196	271	254	179	142	149	1362	-	139	192	206	247	237	217	163	1401	-
Mean temp C°	15.8	15.8	13.5	17.5	14.5	14.5	14.5	r ₁ =0.19	-	18.8	16.3	15.7	17.0	20.40	18.5	17.4	r ₁ =0.02	-
Mean RH(%)	60.0	65.0	62	54.0	60.0	61	63.0	r ₂ =-0.37	-	66.0	63.0	62	67.0	63.0	65	65	r ₂ =- 0.22	-

r₁ = Correlation coefficient value between air temperature (C°) and the number of insects.

r₂ = Correlation coefficient value between R. H. % and the number of insects.

Correlation coefficient value between air temperature & R.H. % and the number of honeybee were (0.10; - 0.29 and 0.07; - 0.20) in the two seasons respectively.

Chalicodoma mucorea occupied this rank in the first year, 77 insects forming 5.65 % of the total insect count. Other wild bees were noticed as *Megachile submucida*, *Anthophora* sp. and *Xylocopa aestuans* found at the lowest populations .

Generally, honeybees are the common insect pollinators to faba bean in the two locations. Similar results were reported by Voluzneva (1971); Stoddard (1991); Varis (1995) and Koltowski (1996a). In addition, there are some wild bees that play important role in faba bean pollination such as *Anthophora* sp. However these species of wild bees are not frequent. These results disagreed with El-Barry *et al.*, (1974) and Rashad (1985) who stated that *Anthophora* sp. was the commonest pollinators of broad bean, while *Xylocopa aestuans* was the lowest ones.

Regarding the effect of prevailing air temperature and RH % on the occurrence of insect pollinators, it is clear that the effect of the two factors was very slight in the first season while it was moderate in the second one. For instance, the correlation coefficient value between air temperature and number of collected insects recorded 0.08 and 0.6 in Kalubia; 0.19 and 0.02 in Kassasin in the two seasons, respectively. This variation could be attributed to the higher and more stable temperature during the first season which made this factor less effective. The inverse was noted in the second season.

Correlation coefficient values (r) between RH % and the number of insect visitors are nearly similar and negative as it recorded -0.35 and -0.51 in Kalubia; - 0.31 and - 0.22 in Kassasin in the two seasons, respectively. Also the correlation coefficient between air temperature (°C) & R.H. % and the number of honeybee showed the same trend.

3.2.Effect of insect pollination on the yield of faba bean in El-Kassasin – Ismailia Governorate

3.2.1. Mean percentage of pod set

Data in Table (5), indicate that mean percentages of pod set recorded 55.60, 59.15 ; 35.70, 33.58 and 53.80, 54.94 % for open pollination, insect exclusion and honeybee pollination in the two years, respectively. Insect exclusion indicated the least significant percentage of pod set. The differences between open pollination and honeybee pollination were insignificant in both seasons of the study.

Table (4): Daily activity of faba bean pollinators at two-hour intervals during the flowering seasons of 2000 and 2001 at Ismaelia.

Year	2000							2001							
	Time of the day	8p.m	10	12 noon	2 p.m	4	Total	%	8a.m	10	12 noon	2p.m	4	Total	%
Insect name															
Order: Hemiptera															
<i>Oxycarenus hyalinipennis</i> Costa	4	7	10	11			36	2.64	4	7	8	9	6	34	2.43
<i>Nezara viridula</i> L.	3	4	5	7	3		22	1.62	2	3	4	2	2	13	0.92
Total Hemipterous insects	7	11	15	18	7		58	4.26	6	10	12	11	8	47	3.35
Order: Lepidoptera															
<i>Pieris rapae</i> L.	2	4	11	13	3		33	2.42	3	6	8	10	8	35	2.50
<i>Polymatus baeticus</i> L.	1	4	8	7	3		23	1.69	2	5	9	8	3	27	1.93
Total Lepidopterous insects	3	8	19	20	6		56	4.11	5	11	17	18	11	62	4.43
Order: Coleoptera															
<i>Coccinella undecimpunctata</i> L.	4	7	13	8	4		36	2.64	6	9	14	13	4	46	3.28
<i>Coccinella septumpunctata</i>	2	5	10	7	3		27	1.98	5	9	18	19	5	56	4.00
<i>Bruchidus trifolli</i> Motsh.	1	2	7	7	2		19	1.40	4	5	6	7	1	23	1.64
<i>Trichodes ongissmus</i>	5	6	12	15	4		42	3.08	7	12	18	22	9	68	4.85
<i>Tropinota squalid</i>	27	34	49	47	25		182	13.36	23	38	42	51	25	179	12.71
Total Coleopterous insects	39	54	91	84	38		306	22.46	45	73	98	112	44	372	26.48
Order: Diptera															
<i>Syrphus Corollae</i> F.	3	6	13	12	5		39	2.82	4	8	15	18	6	51	3.64
<i>Liriomyza congesta</i> Becker	25	42	53	61	38		219	16.08	20	35	45	49	30	179	12.77
<i>Musca domestica</i> L.	30	38	51	54	32		205	15.05	24	45	56	65	37	227	16.20
<i>Sarcophage carnaria</i> Meig	6	6	8	7	5		32	2.35	2	3	5	6	3	19	1.36
<i>Lucelia sericata</i>	1	2	4	3	4		14	1.03	1	2	3	4	3	13	0.93
<i>Tabanus taeniola</i>	5	4	7	4	5		25	1.84	1	2	4	6	1	14	1.00
Total Dipterous insects	70	98	136	141	89		534	39.12	52	95	128	148	80	503	35.95
Order: Hymenoptera															
<i>Apis mellifera</i> L.	13	32	40	49	16		150	11.01	20	28	39	47	23	157	11.21
<i>Megachile submucida</i> Afk.	2	6	7	10	1		26	1.91	1	1	3	4	2	11	0.79
<i>Polistes gallicus</i>	6	8	17	14	9		54	3.96	4	8	14	14	7	47	3.35
<i>Philanthus abdelkader</i>	7	10	16	21	9		63	4.63	10	19	23	25	11	88	6.28
<i>Chalicodoma mucorea</i>	8	11	20	23	15		77	5.65	7	12	21	23	11	74	5.28
<i>Xylcopa aestuans</i>	1	2	3	3	2		11	0.81	1	2	2	2	1	8	0.57
<i>Anthophora</i> sp.	3	4	6	9	5		27	1.98	3	5	8	11	6	33	2.36
Total Hymenopterous insects	40	73	109	129	57		408	29.96	46	75	110	126	61	418	29.84
General Total	159	244	370	392	197		1362	100.00	154	264	365	415	204	1402	100.00

Similar results were reported by Kamler (1982) and Yousif-Khalil *et al.*, (1989) taking in consideration the varied leguminous crop.

3.2.2. Mean number of pods/plant

As shown in Table (5), it is clear that open pollination plots produced the highest significant value in both seasons (32.83 and 33.62 pods), whereas insect excluded plots yielded the least significant mean number of pods/plant (24.32 and 24.81 pods). On the other hand, the differences between honeybee provided plots and open pollinated plots were insignificant in both seasons. A similar conclusion was also reached by Koltowski (1996b) .

3.2.3. Mean number of seeds / pod

Results in Table (5) indicate that insect exclusion produced the least significant mean number of seeds/pod in the first season (1.71 seeds), but the differences between the three treatments were insignificant in the second season. These results partially agree with Koltowski (1996b) and Richards (1997).

3.2.4. Mean number of seeds/plant

Data presented in Table (5) indicate that open pollination yielded the highest significant mean number of seeds/plant recording 78.48 and 81.57 seeds in the two seasons, respectively. Insect prevention induced the least significant one (41.54 and 48.63 seeds) in both seasons. Obtained results are in accordance with those of Voluzneva (1971); Somerville (1994) and Koltowski (1996 a & b).

3.2.5. Mean weight of seeds/plant

Data given in Table (5) indicate that open pollination produced the heaviest significant mean weight of seeds/plant recording 31.82 and 34.52 g. in both seasons, respectively. While no differences were detected between honeybee pollination and insect exclusion in the two years. These results agree with Mesquida (1992).

3.2.6. Mean weight of 100 seeds

As shown in Table (5), the differences between open pollination, insect exclusion and honeybee pollination were insignificant in both seasons, the same conclusion was also reached by Yousif-Khalil *et al.*, (1992) with lentil.

Table (5): Yield of the faba bean cultivar Giza 9 as influenced by open –pollination (A) , insect –exclusion (B) and honeybee pollination (C) at Ismaelia during 2000 and 2001 seasons.

Year	2000					2001				
	A	B	C	L.S.D.		A	B	C	L.S.D.	
				5%	1%				5%	1%
Mean percentage of pod set	55.6	35.7	53.8	5.98	9.92	59.15	33.58	54.94	1.57	2.6
Mean number of pods /plant	32.83	24.32	28.12	5.87	9.71	33.62	24.81	29.39	7.54	12.65
Mean number of seeds /pod	2.39	1.71	2.35	0.51	0.83	2.43	1.96	2.28	—	—
Mean number of seeds /plant	78.48	41.54	65.95	14.05	23.29	81.57	48.63	67.0	16.88	27.91
Mean weight of seeds /plant (g)	31.82	16.61	22.59	8.47	14.06	34.52	19.37	26.09	6.67	11.06
Mean weight of 100 seeds (g)	74.67	66.56	71.08	—	—	76.67	67.16	74.7	—	—
Estimated seed yield/feddan(Kg.)	1069.15	558.01	759	201.11	333.47	1169.95	650.83	900.48	210.85	349.69
The two years mean seed yield / feddan (Kg.)										
Treatments	A		B		C					
	Wt.	Control	Wt.	Ratio %	Wt.	Ratio %				
Cultivar Giza 9	1119.55	100.0	604.42	53.99	829.74	74.11				

* Based on control plot as 100 %

3.2.7. Estimated seed yield/feddan

Data in Table 5 indicate that the estimated seed yield/feddan under open pollination, insect exclusion and honeybee pollination recorded (1069.15 and 1169.95) ; (558.01 and 650.83) and (759 and 900.48) Kg. in the two seasons, respectively. Open pollination induced the highest estimated seed yield/fed, but insect exclusion was the lowest. The two year mean seed yield/fed, recorded 1133.05, 604.42 and 829.7 Kg. for open pollination, insect exclusion and honeybee pollination, respectively.

Honeybee pollination yielded 74.11 % of the seed yield of the control (open pollination), whereas insect exclusion yielded 53.99 % as control. These results partially agree with Koltowski (1996b) and Svendsen and Brodsgaard (1997) who indicated that open pollination produced 25 – 30 % higher seed yield. In contrast Guen *et al.*, (1992) stated that insect pollination had no effect in seed production or abortion rate in some self fertile cultivars of faba bean.

Generally, it could be concluded that insect pollination is necessary for high yield production of crops and the presence of honeybee colonies is very important to ensure adequate pollination specially in the reclaimed lands.

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كفاءة نحل العسل وغيره من الحشرات الملقحة فى تلقيح الفول البلدي

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ملخص

تم إجراء هذه الدراسة بهدف التعرف على الحشرات الزائرة للفول البلدي (*Vicia faba* L.) أثناء فترة التزهير خلال موسمى ١٩٩٩/٢٠٠٠ ، ٢٠٠٠/٢٠٠١م فى منطقتين الأولى فى شلقان بمحافظة القليوبية التى تمثل أراضى الوادي القديم ، أما الثانية فى منطقة القصاصين بمحافظة الإسماعيلية التى تمثل الأراضى حديثة الاستصلاح.

وقد أظهرت النتائج أن الحشرات الزائرة لأزهار الفول البلدي تشمل ٢١ ، ٢٢ نوع حشري فى كل من منطقتي الدراسة على الترتيب خلال عامي الدراسة. تتبع هذه الأنواع خمس رتب هي نصفية الأجنحة (نوعان) ، حرشفية الأجنحة (نوعان) ، غمدية الأجنحة (أربعة أنواع فى المنطقة الأولى وخمسة أنواع فى المنطقة الثانية) ، ثنائية الأجنحة (ستة أنواع) ثم رتبة غشائية الأجنحة (سبعة أنواع). هذا وقد لوحظ أن هناك اختلافات فى أعداد وأنواع الحشرات الزائرة فى منطقتي الدراسة.

كان نحل العسل الأعلى تواجدا بالنسبة لأنواع النحل الأخرى حيث مثل نسبة (١٣,١٢ ، ١١,٨٤%) ، (١١,٠١ ، ١١,٢١%) من مجموع الحشرات الزائرة في عامي الدراسة في كل من المنطقتين على الترتيب. وكان أعلى تواجد للنحل خلال اليوم في الساعة الثانية بعد الظهر.

وقد لوحظ كثرة تواجد بعض الحشرات الزائرة خاصة في رتبة ثنائيات الأجنحة مثل الذباب المنزلي أو رتبة غمدية الأجنحة مثل جعل السورد الزغبى. تعتبر تلك الحشرات آفات أكثر منها ملقحات.

إتضح من الدراسة أن تأثير درجات الحرارة ونسبة الرطوبة على تعداد الحشرات الزائرة لأزهار الفول البلدي كان ضعيفا في السنة الأولى ومتوسطا في السنة الثانية.

تم دراسة تأثير التلقيح المفتوح والتلقيح بنحل العسل والعزل الحشري على محصول نبات الفول البلدي في منطقة القصاصين بمحافظة الاسماعيلية. وقد اتضح أن التلقيح المفتوح كان الأعلى معنويا بينما العزل الحشري كان الأقل معنويا. أما التلقيح بنحل العسل فكان محصول البذور للفدان وسط بين المعاملتين السابقتين حيث كان متوسط محصول البذور للفدان لسنتي الدراسة ١١١٩,٥٥ ، ٦٠٤,٤٢ كجم للمعاملات المفتوحة التلقيح والمعزولة حشريا والتلقيح بنحل العسل على الترتيب.

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