

**FLIGHT ACTIVITY AND POPULATION FLUCTUATIONS OF  
*Liriomyza trifolii* (BURGESS) ADULTS (DIPTERA:  
AGROMYZIDAE) INFESTING BROAD BEAN**

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**ABSTRACT**

The flight activity and the population fluctuations of broad bean leaf miner, *Liriomyza trifolii* (Burgess) were investigated throughout the growing season of broad bean *Vicia faba* L. by using yellow sticky traps at Qualiubia governorate in 2001 and 2002 seasons. Traps were positioned at five different heights above the ground; 25, 50, 75, 100 and 125 cm. The yellow sticky trap was an effective tool for monitoring the adults of *L. trifolii*. Yellow traps placed 25 cm above the ground caught significantly more adults than the other trap heights overall the growing season. Thus, this leaf miner has a limited vertical range of flight activity. The correlation between trap heights and the number of adults trapped was negative. The males and females were equally responsive to yellow traps at any height. In both seasons, the highest number of seized adults occurred in February and March, while, the lowest adult populations were obtained in April. Two peaks for *L. trifolii* adults on broad bean season were recorded.

**INTRODUCTION**

The broad bean leaf miner, *Liriomyza trifolii* (Burgess) has become cosmopolitan and it occurs regularly on numerous ornamental and vegetable crops (Parrella and Keil, 1984, Ozawa *et al.* 1999) particularly in the Mediterranean area (Minkenberg, 1988). Grain legumes, e.g. broad bean (*Vicia faba* L.) are grown for their seeds which are rich in protein, sufficiently rich to be a meat substitute. In Egypt, number of studies has been conducted to determine the population fluctuations of the broad bean leaf miner on different leguminous hosts (Assem, 1966; Mowafy, 1988; Attia, 1989; and Metwally, 1989). Those previous authors utilized the number of mines per leaf as an indication to its population fluctuations and generations.

No study was found investigating the population density of the adults of this leaf miner throughout broad bean season. *Liriomyza* adults have long been known to be attracted to yellow cards coated with adhesive (Musgrave *et al.*, 1975; Chandler, 1981; Affeldt *et al.*, 1983; Zehnder and Trumble, 1984; Chandler, 1985; Parrella and Jones, 1985; Chavez and Raman, 1987; Robin and Mitchell, 1987; Zoebisch and Schuster, 1990). Subsequently, the present work was originated to monitor the flight activity and population fluctuations of *L. trifolii* adults infesting broad bean by yellow sticky traps at Qualiubia governorate.

**MATERIALS AND METHODS**

This study was carried out at Qualiubia Governorate in a broad bean field during two successive seasons; 2000/2001 and 2001/2002. The broad bean variety was Giza 2, and in both seasons it was seeded during the 1st

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week of December. A randomized complete block design (RCBD) was used in this experiment, where four blocks were employed and each one was divided into 5 plots, with a total of twenty plots. The size of each plot was 7 by 30 meters = 1/20 feddan. All plots received the usual agricultural treatments.

The used yellow sticky trap consisted of a yellow wooden board (10 by 18 cm) attached to a wooden pole (130 cm tall). The size of the yellow board was recommended by Chandler (1981) for trapping *L. trifolii* adults. The yellow boards were positioned on the wooden poles at five heights; 25, 50, 75, 100 and 125 cm above the ground. The starting height of 25 cm was manipulated because Schuster and Beck (1981) reported that the differences in the number of *Liriomyza* adults captured on sticky traps in tomatoes at 10, 20 and 30 cm heights were not significant. Each trap height was replicated four times and all trap heights were randomly allocated in the middle of the plots of each block.

Trapping was started one month after cultivation and continued on weekly basis for 16 weeks until harvest date (1st week in May). Weekly, one day before the sampling date at 9:00 a.m., every yellow wooden board was covered with 10 x 18 cm transparent-film TF 80 (Pelikan AG.D-3000 Hannover 1, Germany) coated with a thin film of Vaseline (pure petroleum jelly) as a sticky substance, and fixed on the yellow wooden board by drawing pins. These transparent films were removed on the next day at the same time and the trapped adults on them were immediately counted and sexed. The removal of transparent-films occurred after 24 h. to avoid the prevailing winds influence.

The percentages of total seized adults/height during the season were calculated in relation to the total trapped adults by 25 cm trap where the highest adult population was caught. Also, the percentages of adult distribution on different trap heights were calculated by dividing the sum number of adults caught / height / month by the total number of adults caught/month. Data were statistically analyzed by analysis of variance (ANOVA), and Duncan's multiple range test (Steel and Torrie, 1980).

## RESULTS

### Flight Activity:

Tables (1 & 2) present the average density of *L. trifolii* adults trapped at five different heights above the ground in a broad bean field in 2001 and 2002, respectively. Weekly samples which started in January and ended in April revealed that the average number of adults trapped by 25 cm trap height was higher than the corresponding numbers seized by the other heights. The adult numbers captured by 50, 75, 100 and 125 cm traps were declining in a descending order. The analysis of variance showed a significant difference ( $P = 0.05$ ) between the number of adults trapped by 25cm traps and the other trap heights. The only exception was in April where the leaf miner population was very low. Through out broad bean season, the number of adults caught by 100 and 125 cm traps were not significantly different, while, the numbers caught by 25, 50, and 75 cm were significantly different from one another. The sex ratio of captured *L. trifolii* adults was 1: 1 at any trap height.

Table (1): Average weekly numbers of *L. trifolii* adults trapped at different heights in broad bean during 2001.

Sampling Date	Average no. of adults caught / trap ± Sd at selected trap heights (cm) *					Total / Month
	25	50	75	100	125	
01-يناير	2.7 ± 1.3 a	0.8 ± 0.3 b	0.5 ± 0.1 b	0.2 ± 0.1 b	0.1 ± 0.1 b	4.3
08-يناير	4.6 ± 2.7 a	1.5 ± 0.8 b	0.6 ± 0.2 c	0.3 ± 0.1 c	0.1 ± 0.1 c	7.1
15-يناير	6.1 ± 3.2 a	2.3 ± 0.1 b	1.1 ± 0.6 c	0.6 ± 0.3 c	0.1 ± 0.1 c	10.2
22-يناير	11.7 ± 4.1 a	5.2 ± 1.5 b	2.3 ± 1.1 d	0.9 ± 0.4 d	0.2 ± 0.1 d	20.3
29-يناير	15.2 ± 7.3 a	7.2 ± 2.7 b	3.4 ± 1.7 c	1.1 ± 0.8 d	0.4 ± 0.2 d	27.3
Total / Height	40.3	17	7.9	3.1	0.9	69.2
05-فبراير	12.4 ± 5.2 a	5.3 ± 2.3 b	2.1 ± 1.2 c	0.8 ± 0.4 d	0.3 ± 0.1 d	20.9
12-فبراير	5.7 ± 2.7 a	2.4 ± 1.3 b	1.3 ± 0.8 c	0.5 ± 0.2 cd	0.3 ± 0.2 d	10.2
19-فبراير	13.2 ± 6.1 a	6.7 ± 2.4 b	3.6 ± 1.7 c	1.2 ± 0.9 d	0.6 ± 0.2 d	25.3
26-فبراير	20.1 ± 8.3 a	10.3 ± 4.6 b	4.7 ± 2.1 c	1.5 ± 0.8 d	0.8 ± 0.3 d	37.4
Total / Height	51.4	24.7	11.7	4	2	93.8
05-مارس	12.2 ± 5.4 a	5.2 ± 2.8 b	2.3 ± 1.2 c	0.8 ± 0.4 d	0.3 ± 0.1 d	20.8
12-مارس	8.8 ± 2.4 a	4.6 ± 1.6 b	1.7 ± 0.9 c	0.6 ± 0.3 d	0.2 ± 0.1 d	15.9
19-مارس	6.1 ± 1.9 a	2.6 ± 1.2 b	1.1 ± 0.7 c	0.7 ± 0.3 c	0.5 ± 0.2 c	11
26-مارس	4.3 ± 1.8 a	1.9 ± 0.9 b	0.9 ± 0.6 c	0.4 ± 0.2 c	0.2 ± 0.1 c	7.7
Total / Height	31.4	14.3	6	2.5	1.2	55.4
02-أبريل	0.8 ± 0.3 a	0.5 ± 0.3 a	0.2 ± 0.1 ab	0.0 b	0.0 b	1.5
09-أبريل	0.3 ± 0.1 a	0.2 ± 0.2 a	0.1 ± 0.1 ab	0.0 b	0.0 b	0.6
16-أبريل	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0
Total / Height	1.1	0.7	0.3	0	0	2.1
Total / Season	124.2	56.7	25.9	9.6	4.1	220.5

\* Means followed by the same letter per row per sampling date are not significantly different (p = 0.05; Duncan's multiple range test).

Table (2): Average weekly numbers of *L. trifolii* adults trapped at different heights in broad bean during 2002.

Sampling Date	Average no. of adults caught / trap ± Sd at selected trap heights (cm) *					Total / Month
	25	50	75	100	125	
05-يناير	3.8 ± 1.2 a	1.4 ± 0.6 b	0.7 ± 0.3 c	0.3 ± 0.1 c	0.2 ± 0.1 c	6.4
12-يناير	5.3 ± 2.1 a	2.3 ± 0.6 b	1.1 ± 0.6 c	0.6 ± 0.3 cd	0.3 ± 0.1 d	9.6
19-يناير	6.5 ± 2.1 a	3.1 ± 0.8 b	1.8 ± 0.7 c	0.9 ± 0.4 d	0.6 ± 0.1 d	12.9
26-يناير	8.7 ± 3.6 a	4.2 ± 1.4 b	2.1 ± 1.1 c	0.8 ± 0.3 d	0.6 ± 0.2 d	16.4
Total / Height	24.3	11	5.7	2.6	1.7	45.3
02-فبراير	14.3 ± 7.4 a	7.8 ± 2.3 b	3.5 ± 1.3 c	1.3 ± 0.6 d	0.8 ± 0.3 d	27.7
09-فبراير	10.8 ± 4.7 a	4.7 ± 1.6 b	1.9 ± 0.8 c	0.8 ± 0.5 d	0.4 ± 0.1 d	18.6
16-فبراير	7.6 ± 3.2 a	3.2 ± 1.1 b	1.5 ± 0.7 c	0.7 ± 0.3 d	0.6 ± 0.2 d	13.6
23-فبراير	10.2 ± 2.9 a	4.9 ± 2.3 b	2.4 ± 0.8 c	1.4 ± 0.6 cd	0.7 ± 0.3 d	19.6
Total / Height	42.9	20.6	9.3	4.2	2.5	79.5
02-مارس	19.4 ± 6.5 a	8.7 ± 2.8 b	1.9 ± 0.9 c	0.8 ± 0.3 d	0.8 ± 0.3 d	31.6
09-مارس	11.7 ± 3.9 a	5.3 ± 1.7 b	2.4 ± 1.1 c	0.5 ± 0.2 d	0.5 ± 0.2 d	20.4
16-مارس	7.6 ± 2.6 a	3.9 ± 1.2 b	1.2 ± 0.7 c	0.7 ± 0.3 cd	0.2 ± 0.1 d	13.6
23-مارس	5.2 ± 1.8 a	2.1 ± 0.9 b	0.7 ± 0.2 c	0.4 ± 0.2 c	0.3 ± 0.1 c	8.7
30-مارس	3.3 ± 1.2 a	1.7 ± 0.6 b	0.5 ± 0.2 c	0.4 ± 0.2 c	0.2 ± 0.1 c	6.1
Total / Height	47.2	21.7	6.7	2.8	2	80.4
06-أبريل	1.3 ± 0.8 a a	0.6 ± 0.2 b	0.2 ± 0.2 b	0.3 ± 0.1 b	0.1 ± 0.1 b	2.5
13-أبريل	0.6 ± 0.5 a	0.3 ± 0.1 ab	0.1 ± 0.1 ab	0.0 b	0.0 b	1
20-أبريل	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0
Total / Height	1.9	0.9	0.3	0.3	0.1	3.5
Total / Season	116.3	54.2	22	9.9	6.3	208.7

\* Means followed by the same letter per row per sampling date are not significantly different (p = 0.05; Duncan's multiple range)

In 2001, the percentages of adults trapped during the season by 50, 75, 100, and 125 cm traps were 46.3, 21.2, 7.9, and 3.4 %, respectively, and in 2002, the corresponding percentages were 46.6 % at 50 cm trap height, 18.9% at 75 cm, 8.5 % at 100 cm and 5.4 % at 125 cm traps. It was obvious that the relationship between trap height and the numbers of seized adults was negative.

Figure (1) illustrates the percentages of the average distribution of adults *L. trifolii* caught/trap height/ month in 2001 and 2002. Yellow sticky trap at height 25 cm caught more than half of the adult population in every month during the season. The percentages of the adult distribution at this height ranged between 52.4 % in April and 58.2 % in January 2001, and between 53.6 % in January and 61.3 % in April 2002. At 50 cm trap height the percentages varied from 24.6 % in January to 33.3% in April and from 24.3 % in January to 29.0 % in April 2001 and 2002, respectively. In case of 75 cm trap height the percentages of adult distribution were between 11.3% in March and 14.3 % in April and 8.3 % in March and 12.6% in January 2001 and 2002, in that order. In the two seasons, the captured adults at 100 and 125 cm trap heights represented about 5 % of the whole population. It was obvious that in April 2001 and 2002 when the population density of the adults was the lowest, the percentages caught by 25 cm trap height was the highest (Fig. 1).

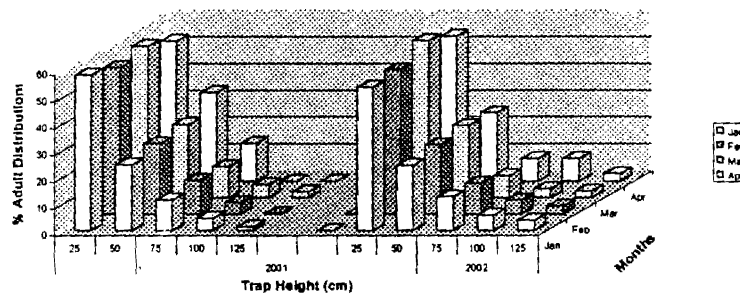
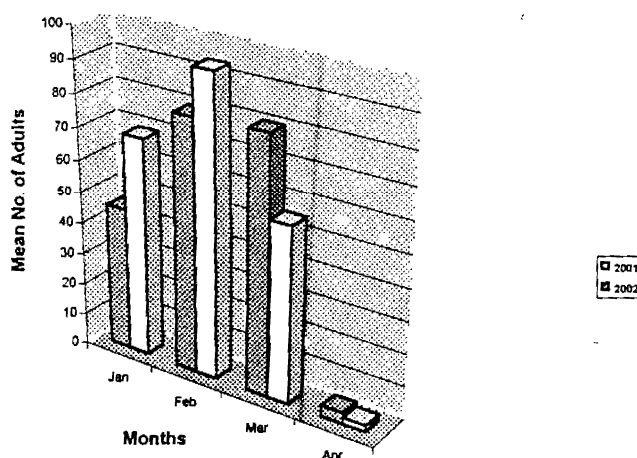


Fig 1: Percentages of average distribution of adults caught/ trap height / month on bean in 2001 and 2002

**Population Fluctuations:**

Figure (2) illustrates the mean number of *L. trifolii* adults caught/month on broad bean in 2001 and 2002. Generally, there was no significant difference in the population density of adults during the two seasons. In 2001, the highest catch/month occurred in February [the mean number of adults (x) was 93.8] and it was higher than the catches of January (x = 69.2 adults), March (x = 55.4 adults), and April (x = 2.1 adults) by 26.2, 40.9, and 97.8 %, respectively. However, in 2002, the highest catch/month occurred in March (x

= 80.4 adults) and it was 43.7 % higher than the catch of January ( $X = 45.3$  adults), 1.1 % higher than the catch of February ( $x = 79.5$  adults) and 95.6 % higher than the catch of April ( $x = 3.5$  adults). In both growing seasons, the lowest population density of adults was obtained during April where broad bean was close to harvest, and by mid-April the adults vanished. Apparently, there are two peaks for *L. trifolii* on each broad bean season. In table (1), the 1st and the 2<sup>nd</sup> peaks occurred on January 29 ( $x = 27.3$  adults) and on February 26 ( $x = 37.4$  adults), respectively. Also, in table (2), two peaks occurred; the 1st was on February the 2nd ( $x = 27.7$  adults) and the 2nd on March the 2nd ( $x = 31.6$  adults).



**Fig. 2:** Mean number of *L. trifolii* adults caught / month on broad bean in 2001 and 2002.

### DISCUSSION

The 25 cm trap height which caught more than half of the total adult populations during each season was the optimal height to trap *L. trifolii* adults. Thus, this leaf miner seems to have a limited vertical range of flight activity. This statement was in agreement with Chandler (1985) who ascertained that the height of 30 cm yellow sticky trap in a bell pepper field was the best height to elevate the catch of *L. trifolii*. In this study, the increase of broad bean height or size over a given period of time did not affect the catch of this optimal trap height. Subsequently, there is no need to use higher trap heights; to save time and money, or to adjust trap height for the changes in plant size.

Under field conditions, the sex ratio was 1:1 at any trap height, so the males and females were equally responsive to yellow traps. The same sex ratio was obtained under field conditions (Chandler, 1985) and under laboratory conditions (Dimetry, 1971).

In this study, two peaks were recorded for *L. trifolii* adults on broad bean. Attia (1989) reported three peaks for this leaf miner in January, February and March 1988 and 1989 at Sharkia and Menoufia governorates,

whereas, Metwally (1989) stated three peaks at Qualiubia governorate in January, February and March 1984, and only two peaks in January and February 1985. Furthermore, both studies determined the peaks by counting the number of mines/100 leaflets. The expected justification for having two adult peaks in this study is that the resulting pupae from the 2nd peak over summer or diapause in the soil, so no more adults emerge during the same season. The diapause of the pupae of *L. trifolii* was cited by Suss *et al.* (1984) at 16°C in Italy.

The punctures of female adults for oviposition and feeding and the larval mines cause a reduction in leaf photosynthesis (Bethke and Parrella, 1985, and Parrella *et al.*, 1985) and kill young plants and/or dramatically slow growth (Elmore and Ranney, 1954). Accordingly, it is very important to base any control measure on accurate damage thresholds.

The control of this insect is complicated due to its biology, e.g. fast development time, smallness and high mobility of adults, a relatively long pupal stage in the soil, high reproductive capability, and egg and larval stages within and protected by leaf tissue; larvae have a completely parasitic mode of life (Dimetry, 1971; Parrella *et al.*, 1983). Consequently, any chemical control should be aimed at the adult stage which is the only free and mobile stage. Besides, chemical control may have no / or little effect if it is focused on larvae that are well protected inside the leaf tissue. Evidently, counting the number of mines is improper because when mines become visible, already the infestation and the severe damage have been occurred. Hence, it makes sense to sample the population density of the adult of this pest instead of sampling the number of mines.

Finally, no doubt that yellow stick traps are very effective tools in assessing *L. trifolii* adult population changes over time and in evaluating control procedures. In addition, they have advantages over other sampling techniques e.g. foliage samples, primarily in handling and rapid assessment.

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### النشاط الطيراني والتذبذب في أعداد ذبابة أوراق الفول التي تصيب الفول البلدى في محافظة القليوبية

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درس النشاط الطيراني والتذبذب في أعداد ذبابة أوراق الفول على الفول البلدى بواسطة مصائد لاصقة صفراء. وقد تمت هذه الدراسة في محافظة القليوبية في عامي ٢٠٠١ و ٢٠٠٢ حيث استخدمت المصائد على خمسة ارتفاعات من سطح الارض وهى ٢٥ ، ٥٠ ، ٧٥ ، ١٠٠ ، ١٢٥ سم .

أثبتت المصائد اللاصقة الصفراء أنها أداة فعالة لمراقبة ذبابة أوراق الفول . كانت أعداد ذبابة أوراق الفول على المصائد ذات ارتفاع ٢٥ سم عالية ومعنوية بالمقارنة ببقية ارتفاعات المصائد، وبذلك ثبت أن النشاط الطيراني الراسي لذبابة أوراق الفول محدود. كانت العلاقة بين ارتفاعات المصائد وأعداد الذباب الموجود عليها علاقة سالبة في عامي ٢٠٠١ ، ٢٠٠٢ . قدرت النسب المئوية للذباب على كل ارتفاع من ارتفاعات المصائد خلال موسمي الفول البلدى ، كما تم تقدير النسب المئوية لمتوسط توزيع الحشرات على كل ارتفاع بالنسبة لكل شهر خلال الموسمين . كانت استجابة ذكور واثان ذبابة اوراق الفول للمصائد متساوية ، لذلك كانت النسبة الجنسية ١:١ على كل ارتفاعات المصائد . سجل أعلى تعداد للذبابة على المصائد فى شهرى فبراير ٢٠٠١ و مارس ٢٠٠٢، كما سجل أقل تعداد لها فى شهر ابريل فى عامى الدراسة . سجل جيلين لذبابة اوراق الفول فى كل موسم من موسمي نمو الفول البلدى . تمت مناقشة أفضلية حصر اعداد الحشرات الكاملة للذبابة بدلاً من حصر اعداد انفاق اليرقات عند اجراء عملية المكافحة .