

**STUDIES ON THE LEAFMINERS:
LIRIOMYZA SATIVAE (BLANCHARD) AND LIRIOMYZA
CONGESTA (BECKER) (DIPTERA: AGROMYZIDAE)
AND THEIR PARASITOIDS IN EGYPTIAN CLOVER FIELDS**

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Abstract

Liriomyza sativae (Blanchard) is a new recorded pest species attacking Egyptian clover, *Trifolium alexandrinum* L., with *Liriomyza congesta* (Becker) and *Chromatomyia* (= *Phytomyza*) *horticola* Goureau caused linear mines as well as the blister leafminer *Agromyza nana* Meigen in Egypt. Incidence and intensity of infestation as well as parasitism were studied on untreated clover plants at Al-Aiat (40 km south Cairo) during 2002- 2003 and 2003- 2004 seasons. Infestation rate and number of mined leaflets per leaf not varied in both seasons with general means of about 10% and ranged between 43%-43.7%, respectively. The highest infestation rate about 22% was recorded by late January and February in 2004 and 2003, respectively. Larval or pupal parasitism not varied in each season, but reached higher rates of 38.1 and 37.2% (2002-2003) opposed to 29.2 and 29.9% (2003- 2004). Its highest rates coincided with lower infestation by early March, in both seasons. Synchronization was found between the time of host emergence and larval parasitoids, which were the abundant species *Diglyphus isaea* (Walker), *Hemiptarsenus zilahisebossi* (Erdös), "*Chrysonotomia* (*Achrysocharella*) sp." and *Pnigalio* sp. (Eulophidae) in active seasons. Majority of flies and the dominant larval- pupal parasitoid species *Opius* sp. (Braconidae) as well as *Chrysocharis* sp. (Eulophidae) were emerged from active pupae. Asynchrony was observed in their timing of emergencies in active or diapause seasons, but not in the second diapause one. Parasitic activity by larval and larval-pupal parasitoids resulted in an obvious decrease about 34% of the leafminers population. Clover can be used as a banker crop to conserve and promote the natural enemies against the leafminers.

INTRODUCTION

The Egyptian clover or Berseem, *Trifolium alexandrinum* L., planting for feeding farm animals in Egypt. Willcocks (1922) observed larvae of three Agromyzid flies feed on berseem. Few authors contributed to survey and taxonomy of Agromyzidae species in clover fields (Hammad, 1955 and Tawfik *et al*, 1976). This study adds information on the infestation and parasitism of the leafminers in clover fields at Al-Aiat region.

MATERIALS AND METHODS

Two untreated clover fields were selected at Al-Aiat, Giza governorate. Five hundred trifoliolate leaves varied in numbers of infested leaflets were randomly collected from December 2, 2002 and 2003 to April 7 and 28, 2003 and 2004, respectively. In each weekly sampling date, leaflets of each leaf were visually examined and classified as infested and non infested. Number of linear and broad mines resulted from feeding larvae of *Liriomyza sativae*, *Liriomyza congesta* and *Chromatomyia horticola* as well as *Agromyza nana* were counted. Mined leaflets were taken on a paper sheet in the laboratory. Healthy larvae (pupated) were collected and recorded daily then placed in a petri dishes (10 cm in diameter). Emerged flies and larval- pupal parasitoids were also collected classified and counted. Dried leaflets were placed into glass containers and daily emerged larval parasitoids were collected classified and counted. After two months, puparia of emerged flies or pupal parasitoids were excluded and the remained pupae are considered to be in diapause. They were collected and counted and placed in new petri dishes. Also, the dried leaflets were placed into new glass containers. Daily inspection resumed again on September 1, 2003 and 2004. Emerged flies and pupal parasitoid adults were collected classified and recorded.

Larval or pupal parasitism rate was calculated by applying the following formulas on each collection date:

$$\text{Rate of larval parasitism} = \frac{L}{L + A} \times 100.$$

$$\text{Rate of larval- pupal parasitism} = \frac{P}{P + B} \times 100.$$

L = Total no. of emerged larval Parasitoids.

P = Total no. of emerged larval- pupal parasitoids.

A = Total no. of alive host larvae (pupated- parasitized pupae).

B = Total no. of emerged flies.

To assess the infestation rate and distribution number of mines on the infested leaflets, 50 plants were randomly collected every week from January 27, to April 7, 2003 and 2004. On each collection date, leaflets were visually examined and classed as infested and non infested on the lower to the upwards of each plant. Number of linear or broad mines per infested leaflet were also recorded.

RESULTS AND DISCUSSION

1- Incidence of Infestation

Infestation by the leafminers on clover, *T. alexandrinum*, not varied in both seasons with a general mean about 10%. It started in a low and high rates 7.1 and 22.3% by late January which reached 17.3% and lowered to 12.7% on early February, then drastically declined to 6.2 after a week (Fig. 1). It continued until early April, reached 22.6 and 8.5% at late February and registered a similar rate (12.3%) on the second and third weeks of March 2003 and 2004, respectively. Infestation proved to appear first on the leaflets at the lower leaves and extends upwards on the grown plants after cuttings during the growing season. Feeding larvae of *L. sativae*, *L. congesta* and *C. horticola* as well as *A. nana* species resulting in linear and blister mines in ratio about 12: 1 and 17: 1 in 2003 and 2004, respectively (Table 1). The highest number of linear mines was found on the second leaf which represented 30.8 and 34.4% of the total mines in 2003 and 2004, respectively. Such values of the broad mines reached about 30.3 and 35.8% at the fourth and fifth leaves, during the two successive seasons, respectively.

2- Intensity of Infestation

It can be expressed by the number of infested leaflets per leaf or mines per infested leaflet. Infested leaflets not varied in both seasons and represented about 44 and 43% of the total infested and non infested leaflets in 2002- 2003 and 2003- 2004 seasons, respectively (Table 2). The infested leaflets started at rates of 42.4 and 37.5% on early December and continued until mid and late April, respectively (Fig. 2). Two peaks of 49.4 and 60.6% as well as 57.9 and 46.2% were attained on the third and fourth weeks of January also at early March and late February in 2003 and 2004, respectively. Majority of leaves had an infested leaflet when compared to those 2 and 3 infested leaflets act in a ratio about 6: 3: 1, respectively, in both seasons. Whereas 98 and 99% of infested leaflets had one mine per leaflet while linear mines represented about 87% of the total number of linear and broad mines in both seasons.

3- Rate of parasitism

Rate of parasitism on the leafminers larvae or pupae was generally higher (38.1% and 37.2%) in 2002- 2003 than that (29.2% and 29.9%) in 2003- 2004. Larval parasitism started with high and low rates of 43.6 and 27.3% by early December and declined to 12.9 and 11.6% after two weeks in the second and first seasons, sequentially, (Fig. 3). It increased gradually to reach 50 and 55.9% on mid

January. Parasitism continued until early and late April in 2003 and 2004, respectively. Three peaks of 61.6, 72.2 and 78.8% were attained by late January as well as early and late March in 2003. Such values were 50, 57.3 and 77.8% at mid January as well as early and late March in 2004.

Pupal parasitism appeared in high and low rates of 25 and 6.3% on early December and increased gradually to reach 42.9 and 33.3% after three weeks in 2003 and 2002, respectively (Fig. 4). After two weeks it drastically lowered to 10.3 and 7.7%, but increased again to reach 44.4 and 23.6% on mid January during both seasons, respectively. Then, declined to 8.5 and 15.9% after a week. Parasitic activity continued till the first and the third weeks of April and reach a maximum of 100 and 88% on early April and March in 2003 and 2004.

In conclusion, incidence of larval and larval- pupal parasitism followed the same trend and continued until the first and third weeks of April in 2003 and 2004, except larval parasitism which prolonged a week in 2004. Higher larval and larval-pupal parasitism occupied with lower infestation at late January and March as well as early March in the first and both seasons, respectively..

4. Adult emergence

4-1 Flies : Emerged flies during the active season represented 99.2 and 96.4% of the total number of emerged flies in active and diapause seasons during 2002- 2003 and 2003- 2004, respectively. In both seasons, flies emerged from active pupae during the third week of December and continued until early May (Fig. 5). Three peaks of 129, 241 and 186 as well as 268, 58 and 54 were recorded on late January, the third week of February as well as the first and the second weeks of March in 2004 and 2003, respectively. However, it emerged from diapaused pupae in few numbers during October in 2003, but emergence period prolonged from the third week of September till mid December reached a peak of 21 at the third week of October in 2004. The abundant agromyzid species *Liriomyza congesta* (Becker) emerged with *Agromyza nana* Meigen from active and diapause pupae. However, *Liriomyza sativae* (Blanchard) and *Chromatomyia horticola* Goureau (= *Phytomyza atricornis* Mg.) were emerged from active one only. *L. sativae* has never been previously been recorded attacking the Egyptian clover, but it is a highly polyphagous species reared from (*Medicago sativa*) in Argentina and (*Vicia faba*) in Egypt (Spencer, 1990 and El-Serwy, 2003), It was previously reported with the polyphagous species *L. congesta* and *C. horticola* as well as the oligophagous species *A. nana* on host plant species belonging to: *Medicago*, *Melilotus*, *Trifolium* and *Trigonella* (*Trifolieae*) (Spencer,

1990). Whereas, the two first species were recorded on (*T. alexandrinum*) (Hammad, 1955).

4- 2 Parasitoid species: Larval parasitoids followed the same pattern of the flies emergence in the active seasons. Synchronization was found between the time of host emergence and occurrence of larval parasitoids during the two seasons, but it was a week earlier than the host in 2003- 2004 season (Fig. 6). Parasitoids had no an obvious trend which increased gradually to reach a peak of 68 and 107 on early February and March in 2003 and 2004, respectively. Then, it was drastically lowered to 14 and 38 at early March and mid April, but increased again to 99 and 78 after 2 and 1 weeks. Four hymenopterous parasitoid species: namely *Diglyphus isaea* (Walker), *Hemiptarsenus zilahisebossi* (Erdös), "*Chrysonotomia (Achrysocharella)* sp." and *Prigalio* sp. (Eulophidae) had emerged from parasitised larvae during the active seasons. Majority of emerging pupal parasitoids were emerged from active pupae. It represented 80.4 and 69.6% of the total number of emerged parasitoids from active and diapause pupae in 2002- 2003 and 2003- 2004, respectively. Asynchronous emerging was observed between parasitoids and flies emerged from active and diapause pupae in both seasons, except in the second diapause season. Wasps emerged from active pupae a week earlier and two weeks later than flies in 2003-2004 and 2002- 2003, respectively (Fig. 7). In both seasons, emergencies continued till early May and reached 78 and 65 at mid March. It emerged from diapause by the third week of September till mid and late December reached the highest numbers of 32 and 49 on early October and late September in 2003 and 2004 (Fig. 8). The dominant larval- pupal parasitoid species *Opius* sp. (Braconidae) as well as *Chrysocharis* sp. (Eulophidae) were emerged from active and diapause pupae.

In conclusion, infestation rate and number of mined leaflets per leaf not varied in both seasons with general means of about 10% and ranged between 43-43.7%. The highest infestation rate about 22% was recorded by late January and February in 2004 and 2003, respectively. Larval or larval- pupal parasitism were markedly higher (38.1% and 37.2%) in 2002- 2003 opposed to (29.2% and 29.9%) in 2003- 2004. Synchronization was found between the timing of the host emergence and occurrence of larval parasitoids during the active seasons. Majority of flies and larval- pupal parasitoids were emerged from active pupae and wasps emerged a week earlier and two weeks later than flies in 2003- 2004 and 2002- 2003 seasons. Asynchrony was observed between that in the first diapause season, but were emerged at the same time in the second one. The parasitic activities by larval or larval- pupal parasitoids of the leafminers on clover reached a general mean rate of about 34%. Parasitism on the leafminers attacking *Vicia faba* ranged between 19-

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24% at the different sites in Egypt (El-Serwy, 2003). To conserve and promote these parasitoids insecticides must be entirely avoided.

ACKNOWLEDGMENT

The author wishes to thank Dr John C. Deeming (Natural Museums & Galleries of Wales Cardiff, UK) for identification of Agromyzidae species.

Table 1. Distribution numbers of linear and blotch mines on the leaflets of the seven leaves of the clover plant during January - April in 2003 and 2004 years.

No. of leaves on plant *	Total no. of mines in 1154 and 943 infested leaflets during:							
	2003				2004			
	Linear mines		Blotch mines		Linear mines		Blotch mines	
	No.	%	No.	%	No.	%	No.	%
1	216	20.0	2	2.2	288	32.3	1	1.9
2	333	30.8	10	11.2	307	34.4	5	9.4
3	304	28.1	20	22.6	178	20.0	2	3.8
4	155	14.4	27	30.3	81	9.1	13	24.6
5	50	4.6	21	23.6	33	3.7	19	35.8
6	16	1.5	4	4.5	4	0.4	7	13.2
7	6	0.6	5	5.6	1	0.1	6	11.3
Total	1080		89		892		53	
%		(92.4)		(7.6)		(94.4)		(5.6)

* From lower leaves to upper ones.

Numbers between brackets represent % related to the total no. of the type of mines.

Table 2. Percentage of infested leaflets and distribution no. of mines on one, two and three infested leaflets per leaf during December- April in 2002- 2003 and 2003- 2004 seasons.

Season	Total no. of collected leaflets			Infested leaflets per leaf	Total no. of				Total	
	Non infested	Infested	%		Linear mines		Blotch mines			
					No.	%	No.	%	No.	%
2002-2003	16890	13110	43.7	1	5870	50.8	1572	88.7	7442	55.8
				2	4557	39.4	182	10.3	4739	35.6
				3	1181	9.8	19	1.0	1150	8.6
Total	30000				11558		1773		13331	
%						(86.7)		(13.3)		
2003-2004	18810	14190	43.0	1	6985	55.8	1458	80.0	8443	58.8
				2	4219	33.7	266	14.6	4485	31.3
				3	1322	10.5	98	5.4	1420	9.9
Total	33000				12526		1822		14348	
%						(87.3)		(12.7)		

Numbers between brackets represent % related to the total no. of the type of mines.

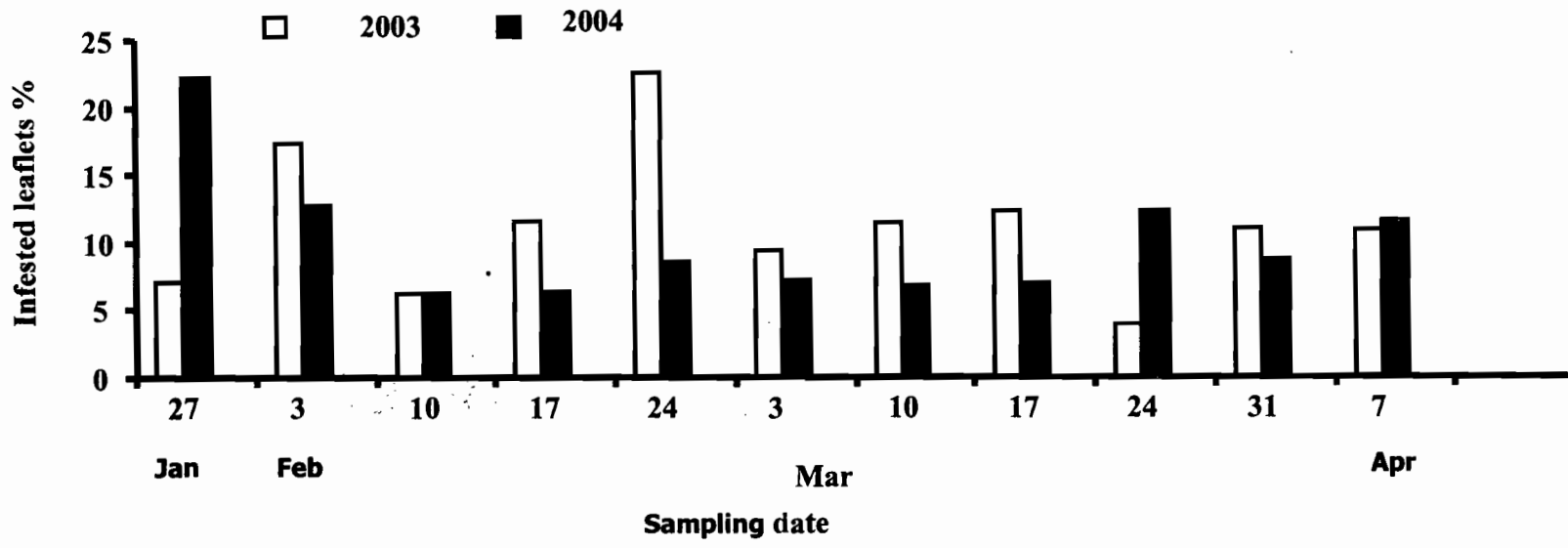


Fig. 1. Incidence of infestation by linear and blotch leaf miners during January- April, 2003 and 2004.

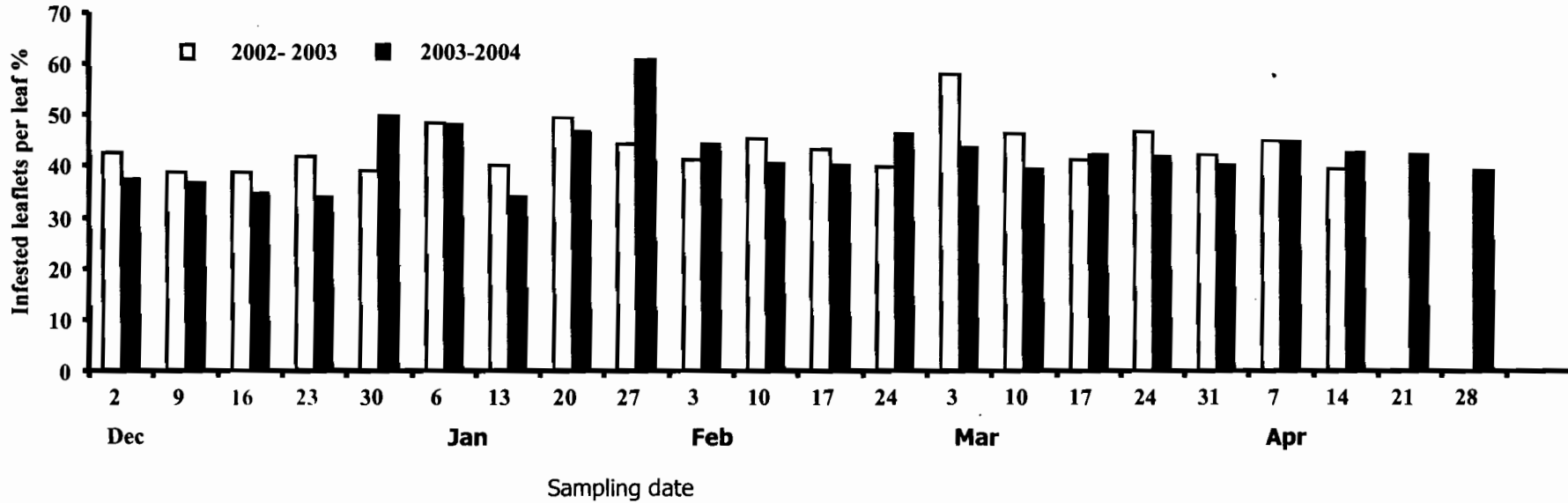


Fig. 2. Percentage of infested leaflets by leafminers during December- April, 2002- 2003 and 2003- 2004 seasons

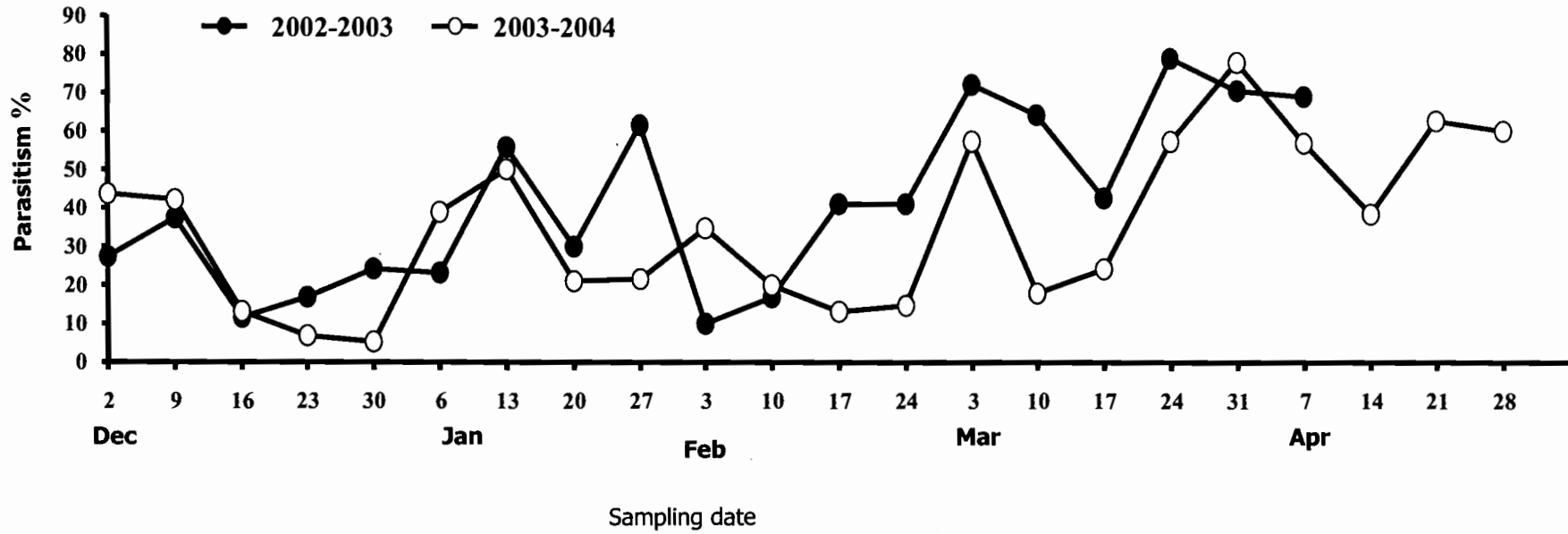


Fig. 3. Percentage of larval parasitism on the leafminers during December- April, 2002- 2003 and 2003- 2004 seasons.

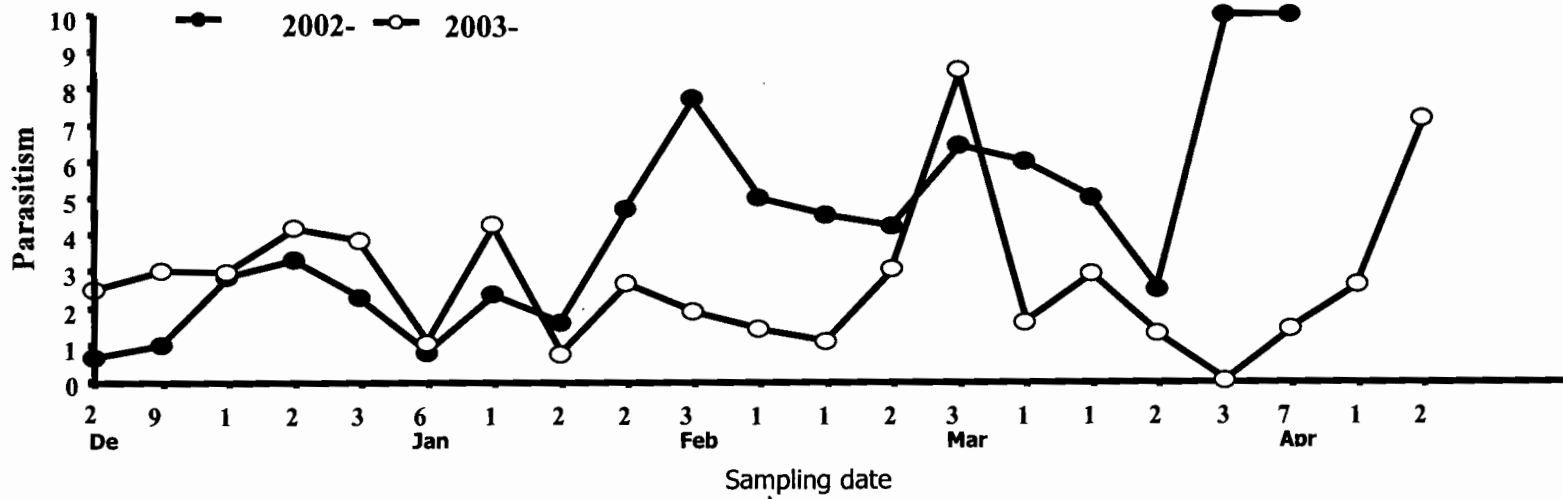


Fig. 4. Percentage of pupal parasitism on the leafminers during December- April, 2002- 2003 and 2003- 2004 seasons.

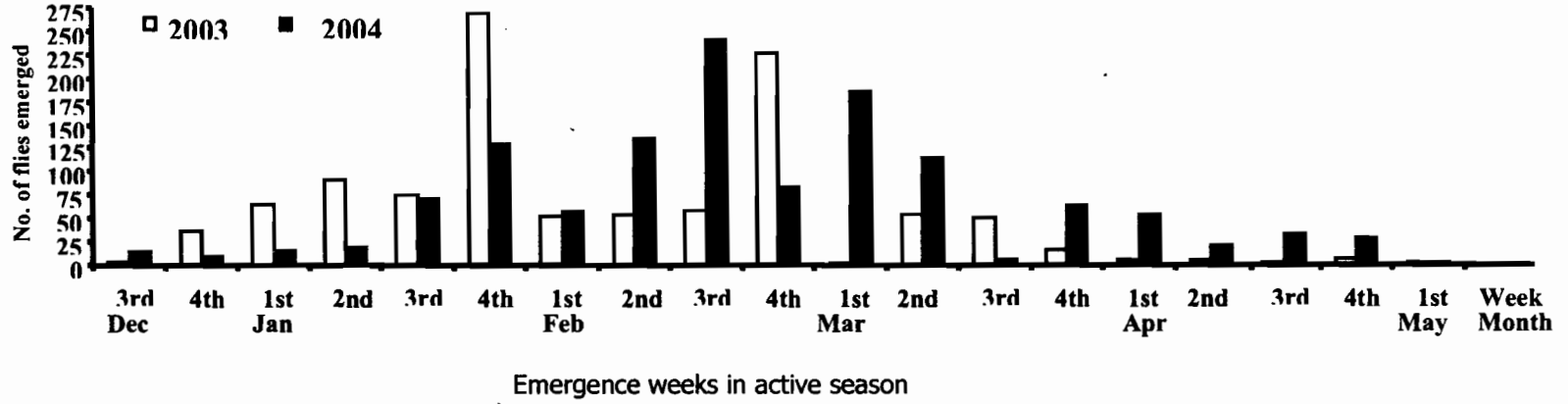


Fig. 5. Distribution no. of emerged flies during December- May, 2003 and 2004.

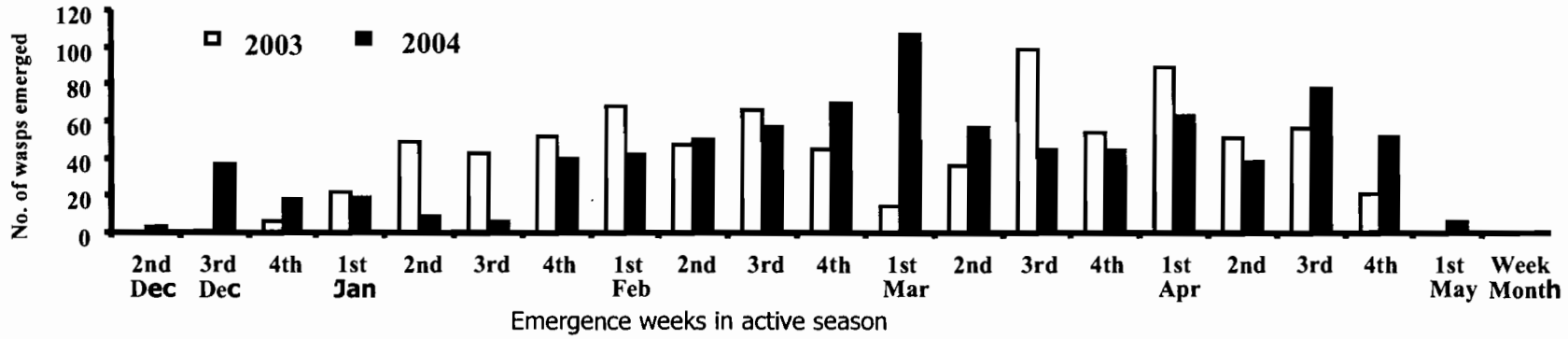


Fig. 6. Distribution no. of emerged larval parasitoids during December- May, 2003 and 2004.

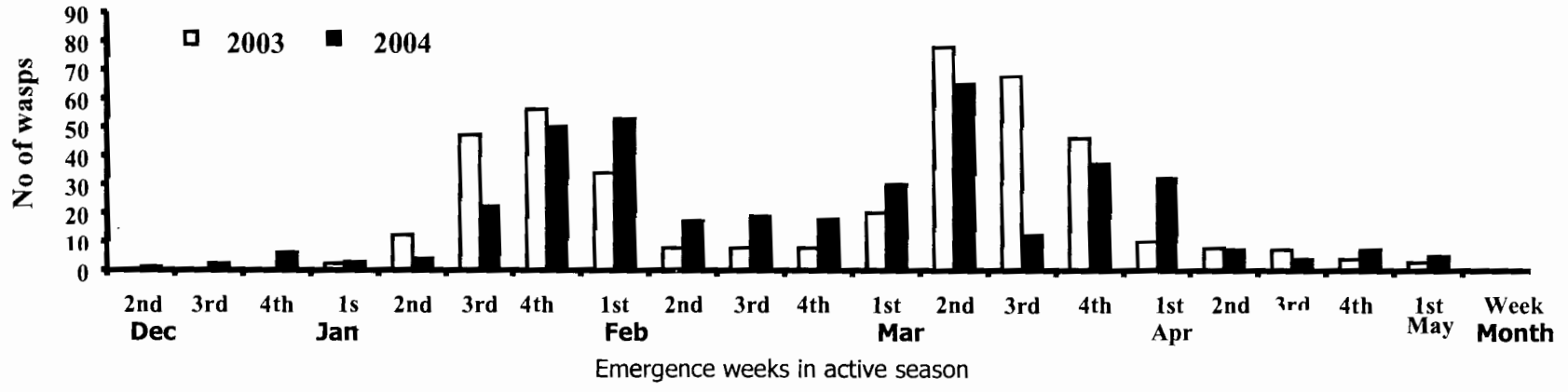


Fig. 7. Distribution no. of emerged pupal parasitoids during December- May, 2003 and 2004.

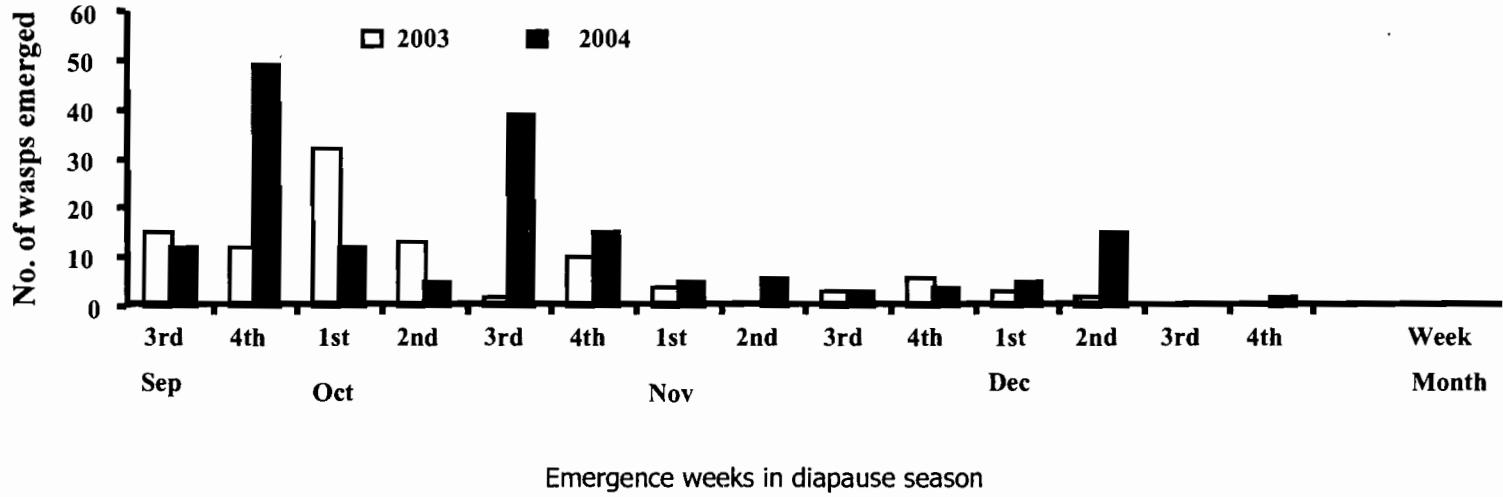


Fig. 8. Distribution no. of emerged pupal parasitoids during September- December, 2003 and 2004.

REFERENCES

1. El-Serwy, S. A. 2003. Studies on the leafminers: *Liriomyza cicerina* (Rondani) and *Liriomyza bryoniae* (Kaltenbach) (Diptera: Agromyzidae) and their parasitoids in Faba bean in Egypt. Egypt. J. Agric. Res., 81 (4): 1581- 1593.
2. Hammad, S. M. 1955. On some Dipterous leaf- miners from Egypt. Bull. Soc. Entom. Egypt, 39: 391- 394.
3. Spencer, K. A. 1990. Host specialization in the World Agromyzidae (Diptera). Dordrech Boston London. Kluwer Aca. Pub. : x + 444 pp.
4. Tawfic, F. S., S. I. El- Sherif and A. H. El-Heneidy. 1976. Insect Fauna of Egyptian clover in the Giza region, Egypt. Bull. Soc. Ent. Egypt, 60: 171- 178.
5. Willcocks, F. C. 1922. A survey of the more important economic insects and mites of Egypt. Bull. Sult. Agric. Soc., Tech. Sect., No. 1, Cairo.

دراسات على صانعتى أنفاق الأوراق

Liriomyza sativae (Blanchard) و *Liriomyza congesta* (Becker)

وظفيلياتها فى حقول البرسيم المصرى

سمير عوض السروى

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقى - الجيزة .

سجلت صانعة أنفاق الأوراق *Liriomyza sativae* (Blanchard) من عائلة صانعات الأنفاق ورتبة ذات الجناحين لأول مرة على البرسيم المصرى *Trifolium alexandrinum* L. النوعان *Liriomyza congesta* (Becker) ، *Chromatomyia (= Phytomyza) horticola* Goureau ، محدثة أنفاقا طولية بالإضافة لصانعة الأنفاق العريضة *Agromyza nana* Meigen فى مصر . تم دراسة سيروشدة الاصابة بهذه الآفات وكذلك التطفل عليها فى حقول برسيم غير معاملة بالمبيدات فى العياط (٤٠ كم جنوب القاهرة) خلال موسمى ٢٠٠٢-٢٠٠٣ و ٢٠٠٣-٢٠٠٤ . وجد أن معدل الاصابة وعدد اليرقات المصابة لكل ورقة لا يختلفا وبمتوسط عام حوالى ١٠% و تراوح مداها ما بين ٤٣-٤٣,٧% فى كلا الموسمين . سجلت أعلى معدلات الاصابة حوالى ٢٢% فى نهاية يناير وفبراير فى عامى ٢٠٠٤ و ٢٠٠٣ ، على التوالي . فى كل موسم ، لا يختلف التطفل على اليرقات أو العذارى ويصلا أعلا معدلاتها ٣٨,١% و ٣٧,٢% فى موسم ٢٠٠٢-٢٠٠٣ فى مقابل ٢٩,٢% و ٢٩,٩% فى موسم ٢٠٠٣-٢٠٠٤ . وتتوافق مستوياتها المرتفعة مع انخفاض الاصابة فى أوائل مارس وفى كلا الموسمين . وجد تزامن بين وقت خروج العائل وطفيليات اليرقات وهى النوع السائد *Diglyphus isaea* (Walker) ، *Hemiptarsenus zilahisebossi* (Erdös) ، *Chrysonotomia Achrysocharella* و *Prigalio* sp. من عائلة (Eulophidae) فى موسمى النشاط . ويخرج غالبية الذباب وطفيليات اليرقات - العذارى السائد *Opius* sp. من عائلة (Braconidae) و *Chrysocharis* sp. من عائلة (Eulophidae) من العذارى النشطة . كما لا يتزامن وقت خروجها فى كلا من موسمى النشاط والسكون وفى كلا الموسمين ، باستثناء الموسم الثانى للسكون . يؤدى نشاط الطفيليات بصفة عامة الى نقص حوالى ٣٤% فى أعداد صانعات الأنفاق . يمكن أستخدام البرسيم كمحصول أساسى لحفظ وادامة الاعداء الطبيعية ضد صانعات الأنفاق .