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THE CHANGES IN THE SEASONAL ABUNDANCE OF THE WHEAT LEAFMINER, *AGROMYZA NIGRELLA* (RONDANI) (DIPTERA: AGROMYZIDAE), AND RELATED PARASITES IN TWO DIFFERENT AGRO-ECOSYSTEMS

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Abstract

Sakha 69 wheat variety was sown on three successive planting dates at El- Gemmiza and Sids Agric. Res. Stations, representing lower and middle Egypt. The changes in the seasonal fluctuations and larval parasitism of *Agromyza nigrella* (Rondani) in 1995- 1996, 1996- 1997 and 1997- 1998 seasons was studied. Results obtained indicate that infested leaves, number of mines and live larvae were significantly higher in El- Gemmiza than in Sids. All considered parameters were significantly decreased by delaying sowing dates and markedly different from season to season. Multiple regression for the relationship existed between temperature and relative humidity and intensity of infestation, mine density and number of live larvae for the different seasons was worked out. Leaves and mines started in low numbers by late February, but increased gradually thus reaching its maximum levels by the third week of April, in both ecosystems. However, live larvae followed the same trend, but peaked early by the third and the fourth weeks of March in Sids and El-Gemmiza, respectively. Larval parasitism by eulophids *Diglyphus isaea* (Walk.) and *Pnigalio* spp. was 5.7% in Sids and 5.8% in El- Gemmiza. Under low larval parasitic activity, hot and dry weather conditions harbored an obvious decrease in infestation by wheat leafminer *A. nigrella* in Sids.

INTRODUCTION

The blotch or blister leafminer, *Agromyza nigrella =Agromyza* (Rondani) attacks wheat and barley in most wheat growing areas of Egypt (El- Serwy, 1994). Thus causing considerable damage for wheat plants United Kingdom (Duthoit, 1968) and Egypt (El- Serwy, 1999a), barley in France (Lescar, 1984). Less susceptible varieties, intercropping with barley and certain agriculture practices *i.e.* nitrogen and phosphorus fertilizers, sowing date and spacing reduce the population density of *A. nigrella* populations on wheat (El- Serwy; 1996, 1997, 1998 and 1999b). Pupae went into diapause by the end of wheat-growing season and the majority of flies and the braconid parasitoid *Dacnusa nipponica* Takada were emerged by the first diapause season (El- Serwy, 1999c).

The present study aimed to obtain new information on the seasonal fluctuations and larval parasitism of the leafminer *A. nigrella* at two different agroecosystems.

MATERIALS AND METHODS

Three field experiments were conducted at El- Gemmiza and Sids Agric. Res. Stations during 1995- 1998 wheat growing seasons. In each season, a field was divided into three equal plots each 1000 m^2. Wheat variety Sakha 69 was machine seeded in each treatment on December 1, 11 and 21 at Sids and after two days at El- Gemmiza in rows 20 cm apart. Normal recommended cultural practices were followed uniformly, and insecticides were entirely avoided.

At each sowing date, the upper four leaves on 50 random main shoots were collected at weekly intervals from 21 February to 19 April at Sids and 24 February- 21 April at EL- Gemmiza. The selected plants were visually examined and grouped as infested or sound-plants. Infested leaves were examined under the stereomicroscope and the numbers of mines and live larvae were recorded.

On every sampling date, the infested leaves were placed into a glass container of 6000 cm^3 in size, inspected daily and the emerged parasitoids of larvae were collected, identified and recorded.

Data were statistically analyzed and multiple correlation values were obtained for relationships between each of infestation, mines and live larvae and two variables *i.e.* temperature and R. H. % during the different seasons in each region.

RESULTS AND DISCUSSION

Data in Table 1 show that the percent of infested-leaves and number of mines and live larvae were significantly higher at El-Gemmiza than at Sids. At each agroecosystem, for the differences between the seasons it was significantly lower in 1996-1997 season than the two other seasons. There are significant differences between infested-leaves and mines at the different sowing dates in both regions. However, live larvae were positively higher and lower at the first and the third sowing dates than the corresponding two ones at El-Gemmiza and Sids, respectively. Significant interactions were existed between sowing date x year influenced on infested leaves, mines and live larvae. The highest values were 48.4% & 31% and 83 & 37 mines /100 leaves and 40 & 12 larvae/ 100 leaves at the 1st sowing date in 1995- 1996 at El- Gemmiza and Sids, respectively. But, was insignificantly different when compared to those obtained at the same sowing date in 1997-1998 season or mines and larvae at the 2 nd sowing date in the same season at El-Gemmiza.

1. Incidence of infestation and fluctuations in number of mines and live larvae: Percent of infested-leaves and number of mines and live larvae were varied greatly fluctuated between seasons at the different sowing dates in each region.

1.1. El-Gemmiza

At the 1st sowing date (Dec., 3); infested-leaves, mines and live larvae, Figs 1, 2 and 3 started in a relatively low rates *i.e.* 6%, 4% and 5%; 8, 6 and 5 mines / 100 leaves and 8, 8 and 6 larvae/ 100 leaves by late February at means of 17.1, 13.8 and 13.8 °C with 70.1%, 65.7% and 61.7% R. H. in 1995-1996, 1996-1997 and 1997-1998 seasons, respectively. It increased gradually and reach a maximum of 77%, 62% and 86% and high number of 135, 84 and 170 mines/ 100 leaves by the third week of April at means of 23.1, 20.9 and 21.2 °C with 59.1%, 62.2% and 56.3% R. H., accordingly. However, a peak of 89, 60 and 92 larvae/ 100 leaves was attained by late March at means of 17.1,16.2 and 22.1 °C and 69.8%, 54% and 59.1% R. H. which declined to 5, 3 and 12 by the third week of April in 1995-1996, 1996-1997 and 1997-1998 seasons, respectively.

For the 2 nd and the 3 rd sowing dates (Dec., 13 and 23); infestation, mines and live larvae were markedly reduced when delaying sowing date was considered, but followed the same trend for the 1st sowing date in all tested seasons and ranged between 3%- 68%, 2%-39% and 5%-65%; 4- 123, 4-59 and 5-127 mines/ 100 leaves and a peak of 87, 25 and 83 larvae/ 100 leaves at the 2nd sowing date in 1995-1996, 1996- 1997 and 1997- 1998 seasons, respectively, Figs 1, 2 and 3. Such values were in respective 2%- 53%, 2%- 43% and 2%- 61% and 2- 76, 3- 52 and 2- 109 mines/ 100 leaves and 42, 22 and 78 larvae/ 100 leaves at the 3 rd sowing date, Figs 1, 2 and 3.

1.2. Sids

At the 1st sowing date (Dec., 1), low infestation level rates of 5%, 2% and 2% with numbers of 6, 2 and 2 mines/ 100 leaves and 7, 3 and 3 larvae/ 100 leaves were observed by the 3 rd week of February at means of 18.3, 16 and 14.5 °C with 62.1%, 61.1% and 64% R. H. in 1995-1996, 1996- 1997 and 1997-1998 seasons, respectively; Figs 4, 5 and 6. It reached a maximum of 50%, 16% and 41% and 58, 19 and 46 mines/ 100 leaves by the 3 rd week of April at means of 27.9, 27.2 and 24.4 °C with 54.6%, 57% and 54.9% R. H., accordingly. A peak of 36, 19 and 29 larvae/ 100 leaves was recorded by the 3 rd week of March at means of 21.1, 19 and 21.9 °C with 61%, 61% and 62.3% R. H. which declined to 3, 1 and 2 on April 12 in 1995-1996, 1996-1997 and 1997- 1998 seasons, respectively.

For the 2nd sowing date (Dec., 11), infestation level were ranged between 2%- 37%, 1%- 12% and 2%- 35% and occupied a range of 2- 50, 1- 14 and 2- 40 mines/ 100 leaves from the 3 rd week of February to the 3 rd week of April in 1995- 1996, 1996-1997 and 1997-1998 seasons, respectively; Figs 4 and 5. Live larvae appeared in a low number of 2, 1 and 2/ 100 leaves by the 3 rd week of February and reached a peak of 28, 14 and 23 after a month in 1995-1996, 1996-1997 and 1997-1998 seasons, accordingly, Fig 6.

For the 3 rd sowing date (Dec., 21) it appeared that infestation, mines and live larvae followed the same trend for the early sowing dates in the different seasons. The corresponding ranges were in respective 2%- 31%, 1%- 9% and 1%- 25% and 2- 35, 1- 11 and 1- 26 mines/ 100 leaves with peaks of 21, 11 and 18 larvae/ 100 leaves, respectively, Figs 4, 5 and 6.

Previous results indicate that infested leaves, mine density and number of live larvae were markedly higher at El- Gemmiza than at Sids. The highest infestation values were obtained during the 1st sowing date in 1995- 1996 and 1997- 1998 at both eco-systems and El- Gemmiza, respectively. Undetected infestation was observed at the beginning of the wheat-growing season. Initial infestation rate was noticed by the 3rd week of February and increased gradually to reach a maximum after two months. Mines followed the same trend, but live larvae peaked early by the 3 rd and the 4th weeks of March at Sids and El- Gemmiza, accordingly. Such parameters varied greatly according to weather conditions in the different seasons at each region. Multiple correlations existed between temperature and relative humidity and each of infestation rate and number of mines and live larvae in the different seasons at each region. Multiple correlation coefficients (R^2) were 0.99, 0.91 and 0.95 in 1995- 1996, 1996- 1997 and 1997-1998 at El-Gemmiza, respectively. The corresponding multiple regression equations were in respective: $y = -101.55 + 1.53 X_1 + 1.75X_2$, $y = -231.98 + 4.9 X_1 + 3.2X_2$ and $y = -150 + 6.33 X_1 + 1.03X_2$. However, the R^2 values and the regression equations were 0.99, 0.99 and 0.99; $y = -186.7 + 7.6X_1 + 0.75X_2$, $y = -195.36 + 8.74X_1 + 0.54X_2$ and $y = -44.88 + 1.93X_1 + 0.21X_2$ at Sids.

Infestation, mines and live larvae were increased by increasing temperature and relative humidity in the different seasons. However, hot and dry conditions hastened the mature of the wheat plants which resulted in low infestation and mines, consequently live larvae peaked a week earlier at Sids when compared to moderate temperature and wet weather at El- Gemmiza. Thus, reflecting the vegetation and succulent leaves was highly preferred for oviposition and larval survival. Two generations were found in a year. El- Serwy (1999c), reported that 99% of *A. nigrella* went into diapause by the end of the wheat growing season. Emerged flies of the first generation from diapaused pupae in two periods from late November until the 3 rd week of January and during late February- late March. The main peak occurred by late December and a partial ones by early March. However, flies of the second generation emerged from active pupae during the wheat-growing season. Such result agrees with those on *A. nigrella* and *A. megaalopsis* Hering on barley, *Hordeum vulgare* L., (Scherney, 1965 and El- Serwy, 1991).

The abundant species *A. nigrella* with a few numbers of *Pseudonapomyza atra* Meigen and *Liriomyza orbona* (Meigen) (Agromyzidae) were found at both regions. However, the species *Hydrella griseol* (Fallen) (Ephydridae) was recorded at Sids.

Hammad (1956), recorded *P. atra* on maize (*Zea mays* L.), common wheat (*Triticum vulgare* Vill. and *Triticum pyramidale*) and common barley (*Hordeum vulgare* L.) in Egypt. However, *L. orbona* is a new record on wheat. It has been previously reported without unknown host plants in Egypt (Mohammed and Negm, 1989). It is a widespread species for which no host plant has been established and has not been found attacking wheat in Europe (J. C. Deeming, 1998, personal communication). *H. griseol*, is an important pest on cereals which infested the young and old leaves of wheat and barley (Hafez *et al.*, 1970 and Deeming, 2002).

2. Parasitism

Larval parasitism was generally lower in general rate of 5.7% and 5.8% at Sids and El-Gemmiza, respectively. Rates of 5.5%, 5.1% and 6.6% or 4.1%, 6.9% and 6.5% were recorded in 1995-1996, 1996-1997 and 1997-1998 wheat growing seasons, respectively.

It started in a low rate of 0.2% and 6.6% on March 10 in 1995-1996 and 1997-1998, but a rate of 0.6% was observed a week later in 1996-1997 season at El-Gemmiza Fig. 7 A. It increased gradually and reached a maximum of 22%, 50.9% and 16.6% by mid-April, respectively. At Sids, a rate of 6%, 1% and 1.4% was observed on March 1, 8 and 15 which reached a maximum of 56.3%, 11.4% and 7.2% by late March in 1997-1998, 1995-1996 and 1996-1997 seasons, respectively, Fig. 7 B. The larval parasitic activity continued a week later in 1996-1997.

The abundant larval parasitoid *Diglyphus iseae* (Walker) and small numbers of *Pnigalio* spp. (Eulophidae) had emerged in both regions. Such low number of larval parasitoids had no significant effect in biological control. However, the braconid parasitoid *Dacnusa nippoica* Takada has been found to attack the pupae of *A. nigrella* and the highest values of parasitism were 82.9% and 91% on the pupae collected from the third week of March from wheat plants growing in plots receiving 15 or 22.5 kg P/ Fed. (El-Serwy, 1999b and 1999c).

Previous results lead to the conclusion that, under low larval parasitic activities hot and dry conditions may be resulted in lower infestation of the leafminer *A. nigrella* in Sids when compared with the moderate temperature and wet conditions in El- Gemmiza.

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Table 1. The fluctuations in the number of infested leaves and the corresponding mines and live larvae of *A. nigrella* at different sowing date in 1995- 1996, 1996- 1997 and 1997- 1998 wheat growing seasons at El-Gemmiza and Sids.

Region	Sowing date	Percent of infested leaves in seasons:				No. of live larvae per 100 leaves in seasons:				No. of live larvae per 100 leaves in seasons:			
		1995-1996	1996-1997	1997-1998	General mean	1995-1996	1996-1997	1997-1998	General mean	1995-1996	1996-1997	1997-1998	General mean
El-Gemmiza	Dec.3	48.4**	34.8	42.2**	41.8a	83**	48	70**	67a	40**	21	39**	33a
	13	41.4	21.9	34.4	32.6b	72**	32	53	52b	34**	11	30	25b
	23	30.2	23.1	31.7	28.3c	41	28	51	40c	18	11	30	20b
General mean		40.0	26.6*	36.1	34.2	65	36*	58	53	31	15*	33	26
Sids	Dec.1	31.0	9.9	24.4	21.8a	37	12	28	26a	12	6	9	9a
	11	22.8	6.9	19.2	16.3b	31	8	22	20.6b	9	5	9	8a
	21	16.9	5.7	13.9	12.1c	20	7	15.7	14c	6	4	5	5b
General mean		23.5	7.8*	19.2	16.7	29	9*	22	20	9	5*	8	7

Means followed by the same letter in each column at each region are not significantly different at 0.01 % level.

* and ** indicates significant difference between years and interaction between sowing date x year for infested leaves, mines and live larvae in each region.

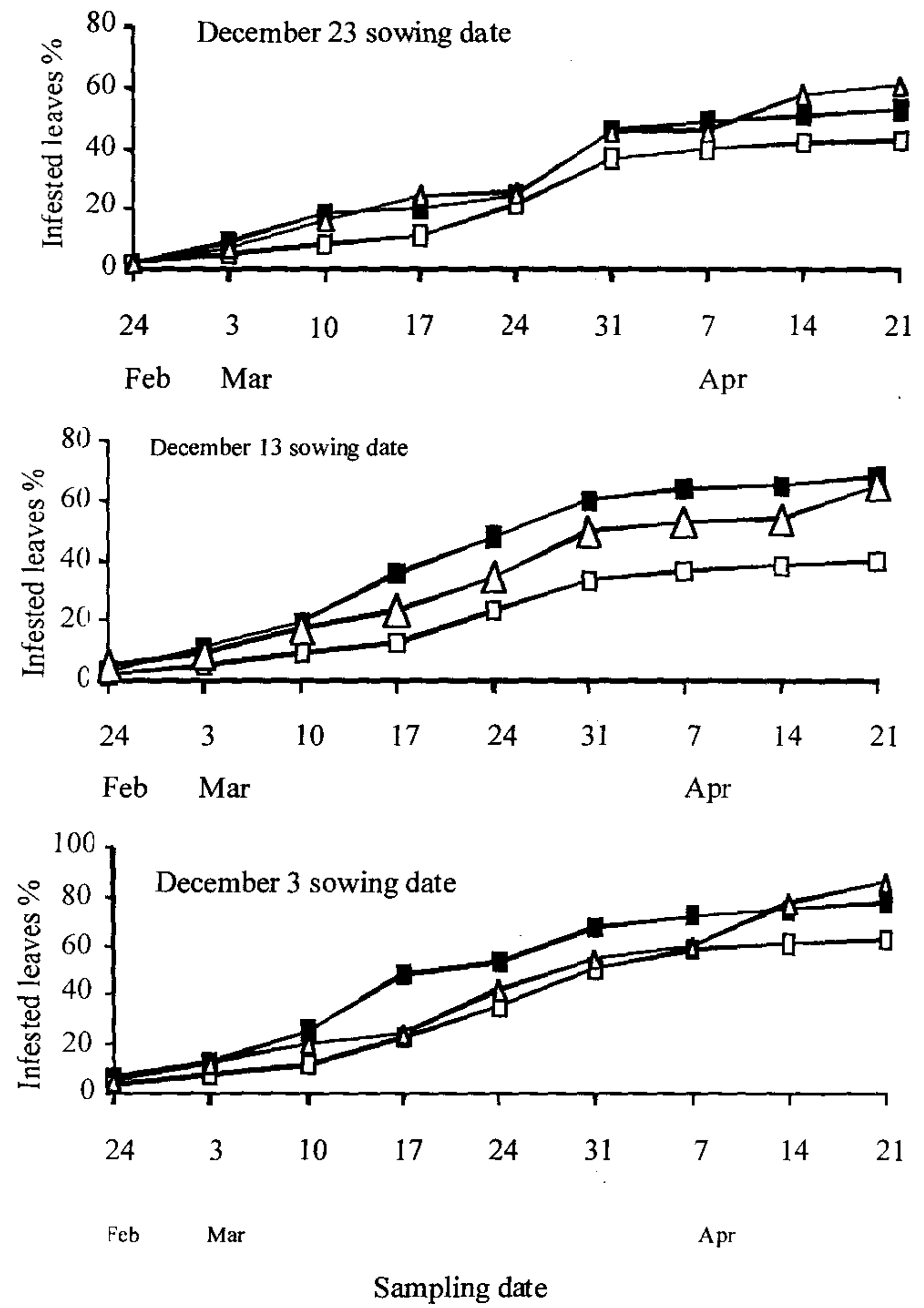

Fig. 1. Percent of infested leaves by *A. nigrella* at the different sowing dates in 1995-1996 -■- , 1996-1997 -□- and 1997-1998 -△- seasons at El- Gemmiza.

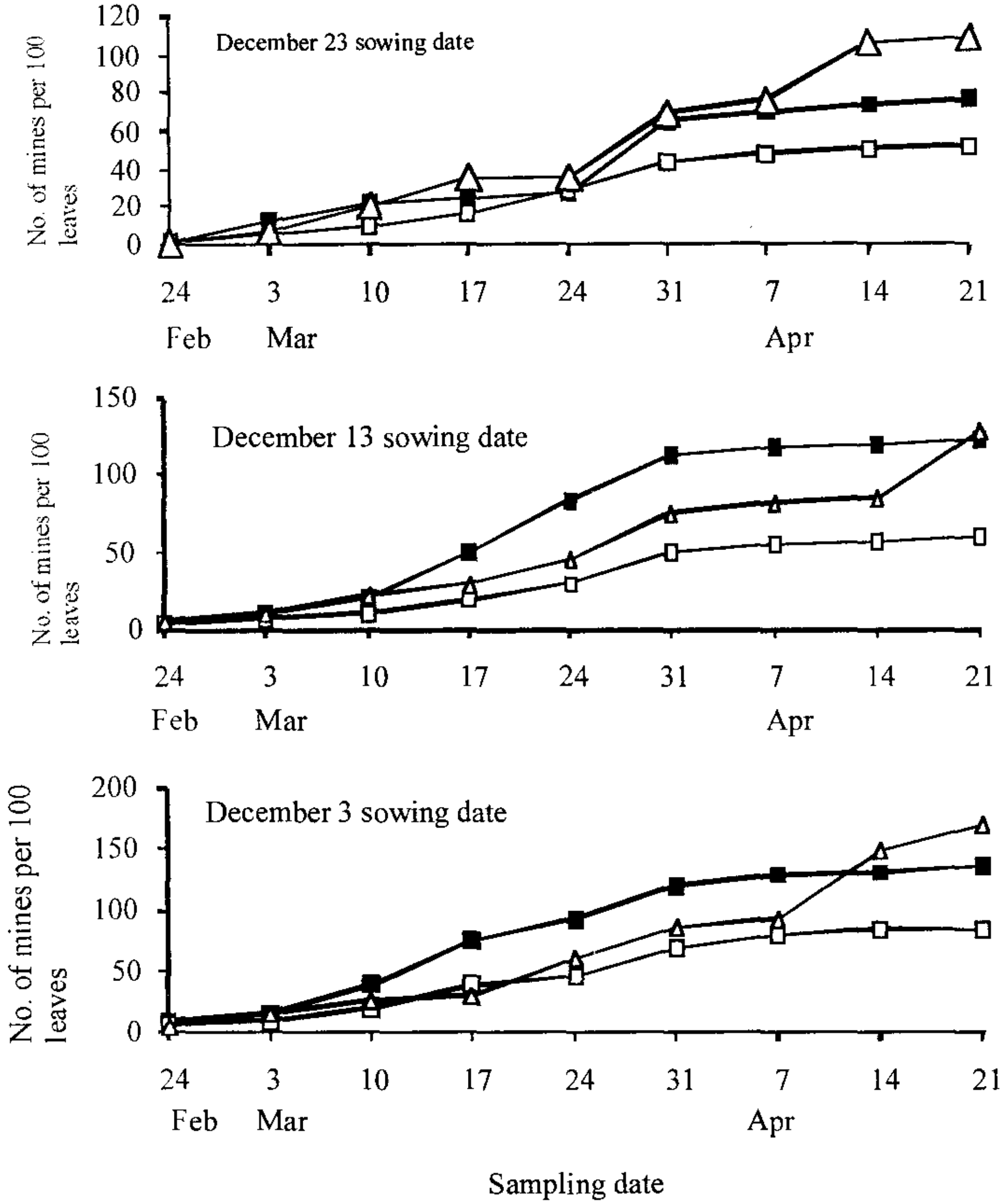

Fig. 2. No. of mines per 100 leaves by *A. nigrella* at the different sowing dates in 1995-1996 —■—, 1996-1997 —□— and 1997-1998 —△— seasons at El- Gemmiza.

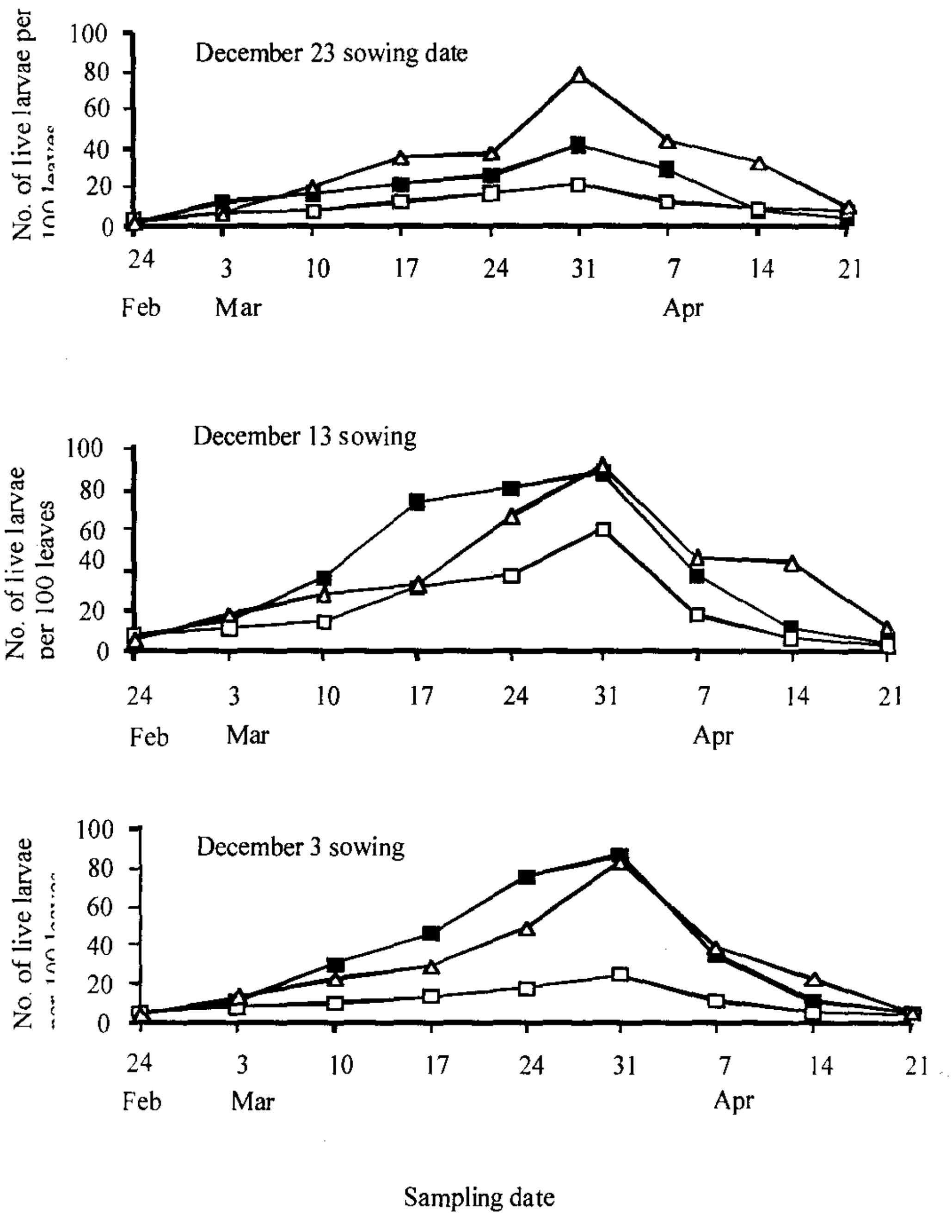

Fig.3. Mean no. of *A. nigrella* live larvae per 100 leaves at different sowing dates in 1995-1996 ■, 1996-1997 □ and 1997-1998 △ seasons at El- Gemmiza.

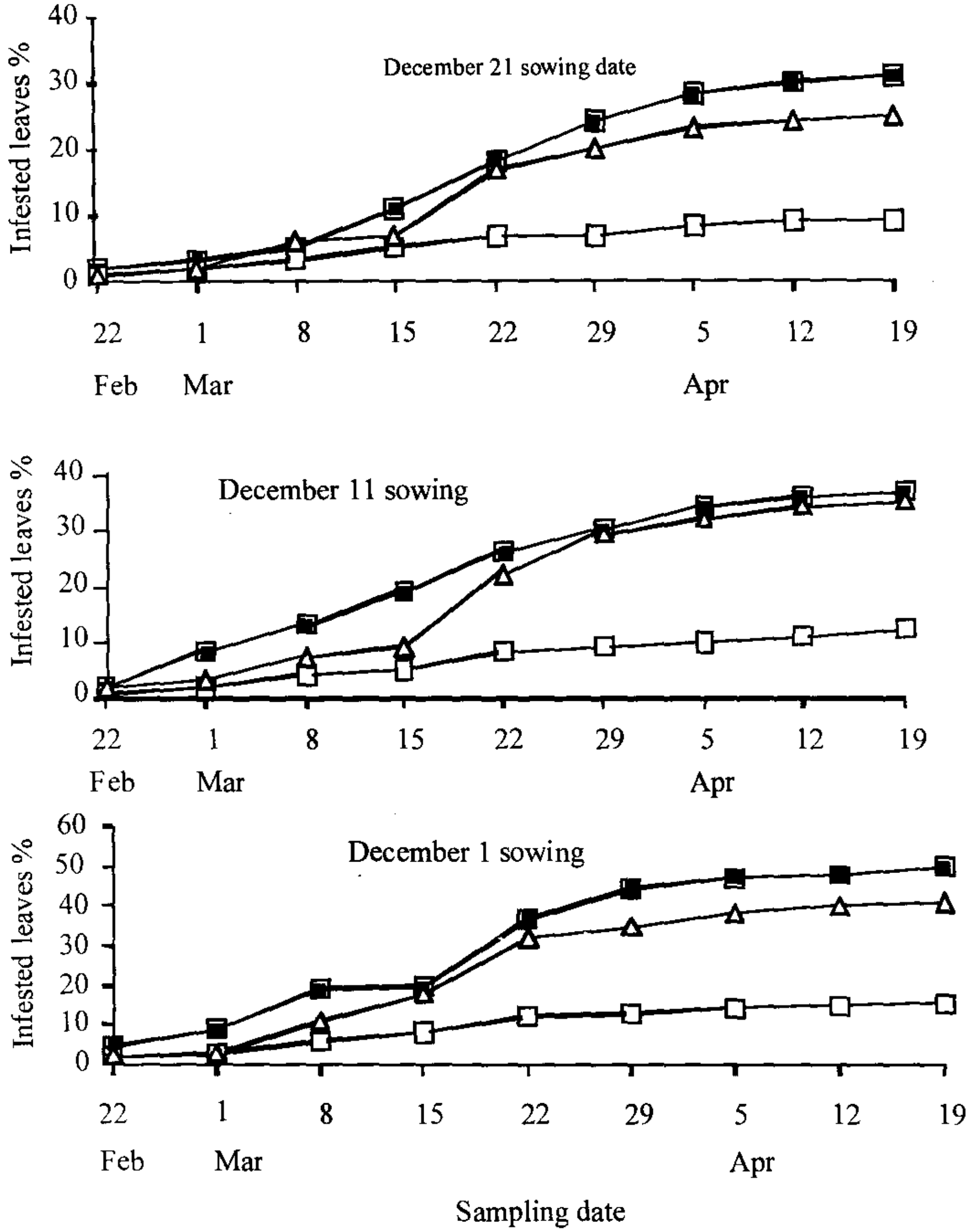

Fig.4. Percent of infested leaves by *A. nigrella* at the different sowing dates in 1995-1996 —■—, 1996- 1997 —□— and 1997- 1998 —△— at Sids.

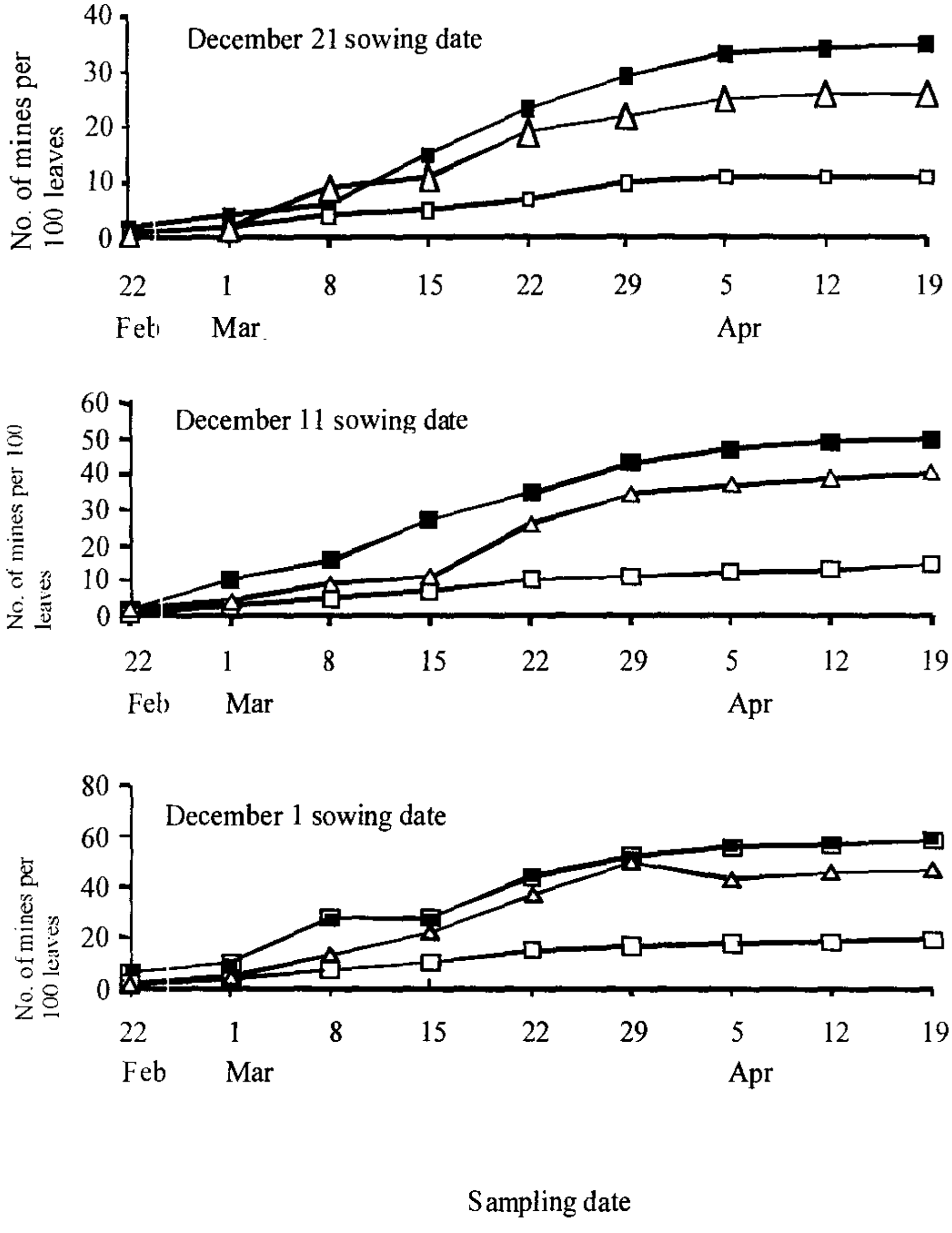

Fig.5. Mean no. of mines per 100 leaves by *A. nigrella* at different sowing dates in 1995- 1996 —■—, 1996- 1997 —□— and 1997- 1998 —△— seasons at Sids.

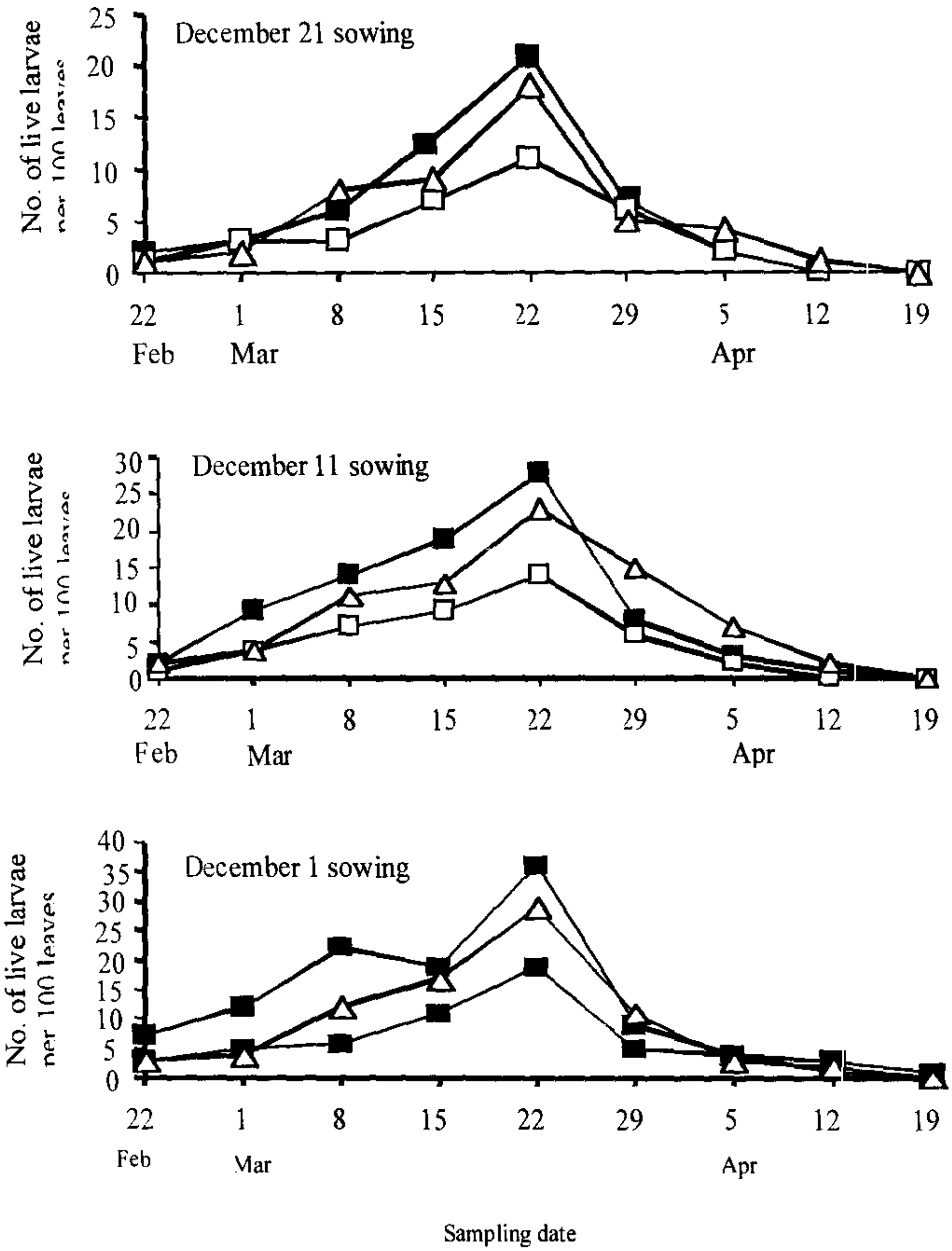

Fig.6. Mean no. of *A. nigrella* live larvae per 100 leaves at different sowing dates in 1995- 1996 -■-, 1996- 1997 -□-and 1997- 1998 -△-seasons at Sids.

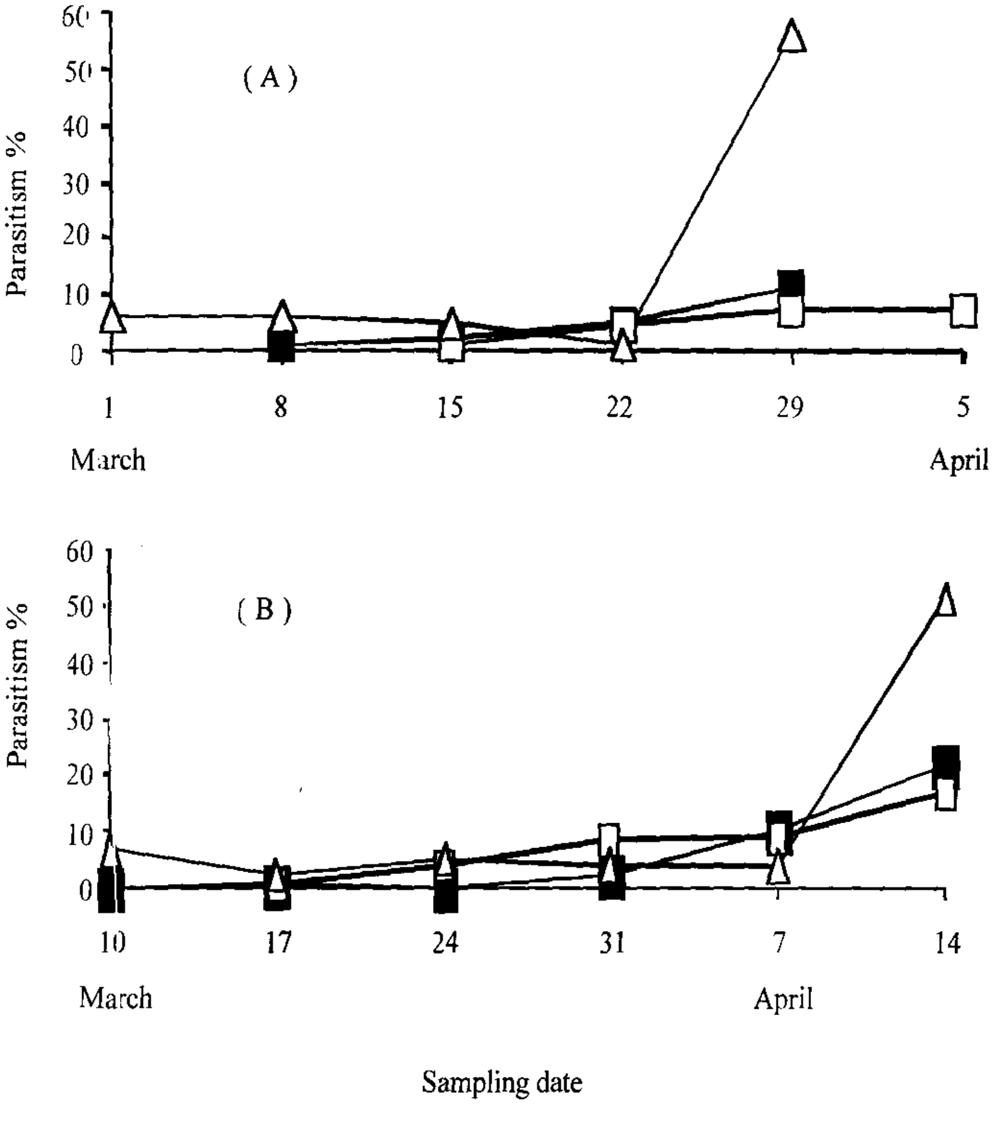

Fig. 7. Rate of parasitism on larvae of *A. nigrella* in 1995- 1996 -■- , 1996- 1997 -□- and 1997- 1998 -△-seasons at El- Gemmiza (A) and Sids (B) regions.

REFERENCES

1. Deeming, J. C. 2002. Some species of the genus *Hydrellia* Robineau- Desvoidy (Diptera, Ephydridae) in Africa and Arabia, with a special reference to species of economic importance. Mitt. Mus. Nat. Kd. Berl., Dtsch. entomol. Z. 49, 1 : 47-59.

2. Duthoit, C. M. G. 1968. Cereal leaf miner in the south- east region. Pl. Path., 17: 61-63.

3. El-Serwy, S. A. M. 1991. The barley leaf miner *Agromyza megalopsis* Hering (Diptera: Agromyzidae) biological and ecological studies in Abu-Ggraib region, Iraq. Unpublished Ph. D. Thesis, Faculty of Agriculture, Baghdad University, Iraq. (In Arabic) (English summary).

4. El-Serwy, S. A. 1994. Occurrence, parasitoids and host plants of the wheat leafminer, *Agromyza nigripes* (Meigen) (Diptera: Agromyzidae) in Egypt. Proc. 5th Conf. Agric. Dev. Res., Fac. Agric., Ain Shams Univ., Cairo, Egypt, 2: 831- 844.

5. El-Serwy, S. A.1996. Evaluation of certain wheat varieties for susceptibility to infestation with the leafminer, *Agromyza nigripes* (Meigen) (Diptera: Agromyzidae) and grain yield at El-Gemmeiza and Sids regions. Bull. Ent. Soc. Egypt, 74:139- 148.

6. El-Serwy, S. A. 1997. Effect of intercropping wheat with barley on wheat infestation with the leafminer, *Agromyza nigripes* (Meigen) (Diptera: Agromyzidae). Bull. Ent. Soc. Egypt, 75: 70- 75.

7. El-Serwy, S. A. 1998. Effect of nitrogen levels, sowing dates and spacings on infestation with the leafminer, *Agromyza nigripes* (Meigen) (Diptera: Agromyzidae). Egypt. J. Agric. Res., 76 (4): 1485- 1497.

8. El-Serwy, S. A. 1999a. Yield losses in wheat caused by the cereal leafminer *Agromyza nigrella* (Rondani) (Diptera: Agromyzidae). Bull. Ent. Soc. Egypt., Econ. Ser., 26: 13-26.

9. El-Serwy, S. A. 1999b. Effect of different rates of phosphorous fertilizer on the cereal leafminer *Agromyza nigrella* (Rondani) infestation and grain yield. Bull. Ent. Soc. Egypt, 77:155- 169.

10. El-Serwy, S. A.1999c. Studies on the diapause of the blotch leaf- miner of wheat, *Agromyza nigripes* (Meigen) and its braconid parasitoid, *Dacusa nipponica* Takada in Egypt. Egypt. J. Agric. Res., 77(4): 1519 - 1529.

11. Hafez, M., S. El-Ziady and N. Z. Dimetry 1970. Leaf mining Diptera of vegetables and crops in Egypt. Bull. Soc. Ent. Egypt, 54: 289- 413.

12. Hammad, S. M. 1956. Further additions to the knowledge of some leaf-miners from Egypt. Bull. Soc. Entom. Egypte, 40: 21-27.

13. Lescar, L. 1984. Development of the protection of cereal against pests and diseases in France. Proc. 1984 Brit. Crop Prot. Conf. Pests and diseases : 159-168.

14. Mohammed, S. K. and F. H. A., Negm 1989. Revision of family Agromyzidae (Diptera) in Egypt. 3 rd Nat. Con of Pests & Dis. of Veg. & Fruits in Egypt and Arab Count. Ismailia, Egypt: 379-392.

15. Scherney, V. F. 1965. Zur biologie der an Gerste minierenden Agromyzidenart*Agromyza nigrella* Rondani (Dip.). Z. Pflanazkr, u. Pflschutz, 73: 141-146.

التغيرات الموسمية لصانعة أنفاق الأوراق *Agromyza nigrella* (Rondani) والتطفل اليرقي في مصر السفلي والوسطى

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زرع القمح صنف سخا ٦٩ في ثلاثة مواعيد لدراسة المتغايرات الموسمية والتطفل اليرقى لصانعة الأنفاق *Agromyza nigrella* ومن عائلة Agromyzidae ورتبة ذات الجناحين وذلك بمحطتي البحوث الزراعية بالجميزة بمحافظة الغربية وسدس بمحافظة بنى سويف خلال مواسم ١٩٩٥- ١٩٩٦ و ١٩٩٦- ١٩٩٧ و ١٩٩٧- ١٩٩٨ . وقد بينت النتائج المتحصل عليها أن النسبة المئوية للأوراق المصابة وعدد الأنفاق واليرقات الحية ازدادت معنويا في الجميزة مقارنة في سدس. وأدى تأخير مواعيد الزراعة إلى انخفاض معنوي في قيم جميع المعايير المستخدمة لقياس الإصابة الحشرية، كما تتغاير تلك القيم بين المواسم المختلفة وفى كل منطقة. وجد ت علاقة ارتباط متعدد بين درجات الحرارة والرطوبة النسبية وكلا من شدة الإصابة، كثافة الأنفاق وعدد اليرقات الحية في المواسم المختلفة. وتظهر الإصابة بنسبة منخفضة في أواخر فبراير ثم تزداد تدريجيا لتصل أقصاها في الأسبوع الثالث من أبريل حيث تتوافق مع عدد الأنفاق واليرقات الحية ولكن اليرقات تصل ذروتها في الأسبوع الثالث والرابع من مارس في سدس والجميزة على التوالي .

بلغت نسبة التطفل بطفيليات اليرقات *Pnigalio* spp. و *Diglyphus isaea* (Walker) من عائلة Eulophidae ٥,٧٪ و ٥،٨٪ في سدس والجميزة على التوالي. وربما تؤدى الظروف المناخية الحارة والجافة إلى نقص الإصابة بصانعة أنفاق أوراق القمح في سدس مع انخفاض نشاط طفيليات اليرقات.