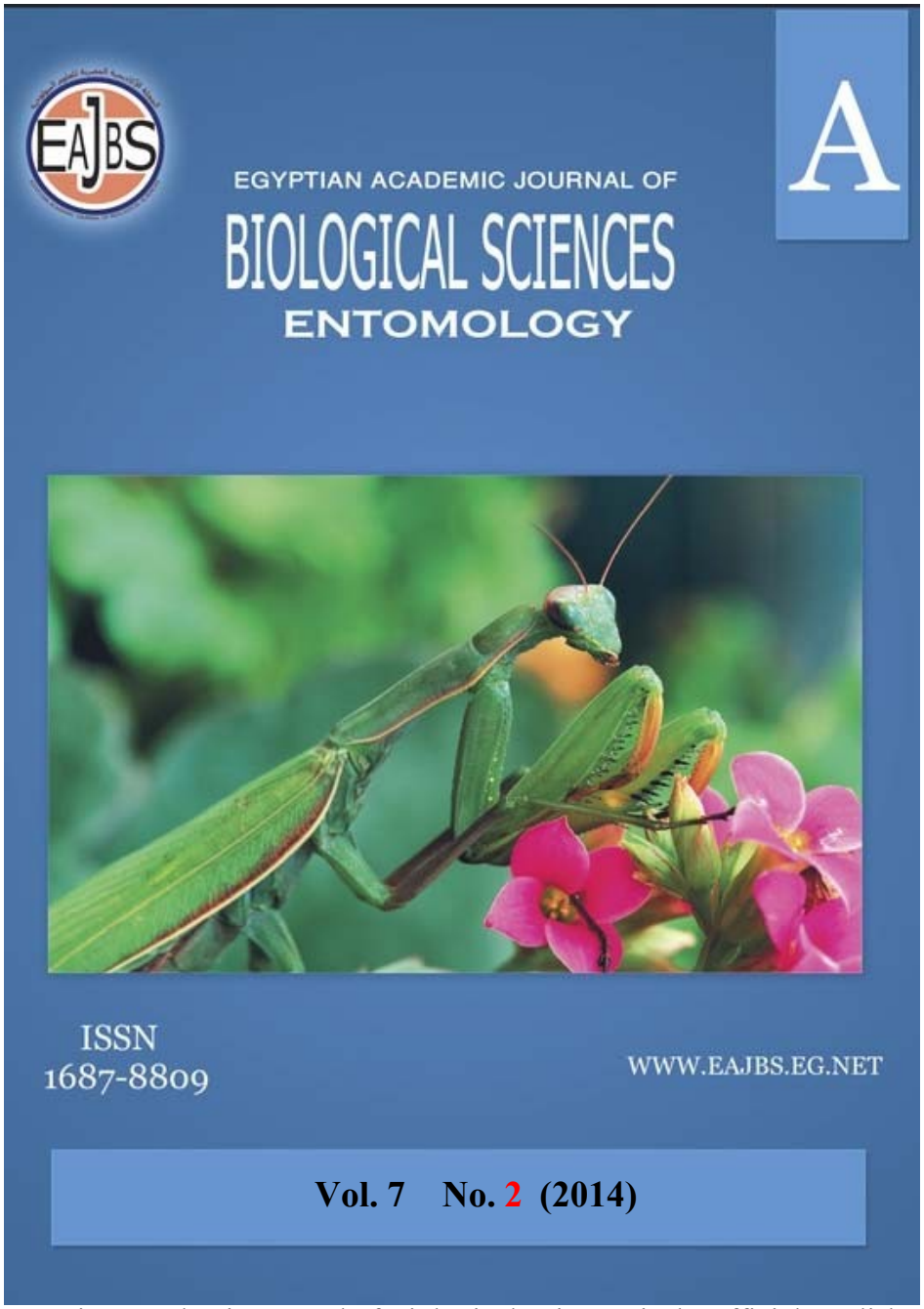

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Effect of certain climatic factors and plant age on the population density of leafminers , *Liriomyza* spp. infesting Fenugreek plants, *Trigonella foenum-graecum* L. in different planting dates.

Afsah, A. F. E.; Hanafy, A.R.I. and Hussein, S.H.A.
Plant Protection Research Institute, (A.R.C), Giza, Egypt.

ABSTRACT

An experiment was carried out to study the effect of planting date, climatic factors and plant age on the population density of Leafminers, *Liriomyza* spp. infesting fenugreek plants in Plant Protection Research Station at Kaha region during two successive seasons 2010-2011 and 2011-2012.

The obtained results revealed that the population density of *Liriomyza* spp larvae on fenugreek plants differed significantly according to the planting dates (Oct.,31st, Nov., 15thand Nov.,30th) during the two studied seasons. Planting of fenugreek seeds in the early planting date (Oct., 31st) lead to plants suffered from the highest infestation by *Liriomyza* spp. larvae. On the contrary, sowing the fenugreek at the second date (Nov., 15th) can be reduced the infestation rate of this insect pest.

The population density of leafminers, *Liriomyza* spp increases by increasing the plant age. The lightest population was recorded during the vegetative stage. While the fenugreek plants infested by the heaviest population during flowering and fruiting stages.

Statistical analysis of correlation coefficient values showed that the effect of climatic factors on the population density of *Liriomyza* spp. was differed positive or negative correlation according to plant stages (vegetative, flowering and fruiting stages) during two studied seasons. The population density of *Liriomyza* spp. correlated positively with plant age except for the early planting date (Oct., 31st) in the second season, as the calculated (r) values were 0.15, 0.68 and 0.48 for the three planting dates in the first season and -0.05,0.43 and 0.62 in the second season, respectively.

The climatic factors were more effective on leafminers population when comparing with plant age, as the explained variance (E.V. %) were 55.73, 70.83 and 42.93% for the three planting dates in the first season and 69.72, 78.59 and 39.40% in the second season, respectively.

The combined effect of the tested weather factors (maximum & minimum temperature maximum & minimum RH% and average wind speed) and plant age together on *Liriomyza* spp. population in the tested planting dates on different stages of fenugreek plants were 59.90, 73.15 and 66.82% at the three planting dates during first season and 72.74, 79.51 and55.82% during second season, respectively.

Keywords: climatic factors , leafminers, Fenugreek plants

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INTRODUCTION

Fenugreek plants, *Trigonella foenum-graecum* L. is an annual plant in the family Fabaceae with leaves consisting of three leaflets. It is cultivated worldwide as a semi-arid crop. It is used in different forms either eaten directly as leaves or boiled as drinks. It is extensively used as a spice in India and the Mediterranean region and is known to possess a number of medicinal properties. Steroidal sapogenins and mucilaginous fibers present in the seed and leaves of this plant contribute to anti-diabetic and hypocholesterolaemic properties attributed to the plant (Acharya *et al.,* 2008).

Fenugreek plants are infested by several insect pests such as aphids (*Aphis craccivora* Koch and *Myzus persicae* Sulz); thrips, including *Thrips tabaci* Lind and *Scirtothrips dorsalis*; alfalfa leaf weevil (*Phytonomus brunneipennis* Both) and leaf miner *Liriomyza* spp, which cause a serious damage to forage yield in fenugreek (Kalra *et al.,* 2002; Kalra *et al.,* 2004 and Aryaand Perello, 2010).

The aim of the present study to determine the suitable planting date of fenugreek seeds to escape from the infestation of leafminers, *Liriomyza* spp. which causes a serious damage of leaves and study the effect of climatic factors and plant age in three tested planting dates.

Many researchers on the role of planting dates, climatic factors and plant age on the infestation of certain insects infesting leguminous plants has been done previously, Kumar *et al.* (1991); Sheoran*et al.* (2000); Meena and Bhargava (2001); Mishra *et al.* (2001); Wale (2002); Shalaby (2004); Mittal and Ujagir (2005); Arif *et al.* (2006); Maha A.M Tantawy (2006); Hanafy A.R.I (2007); Deshwal (2007); Afsah (2009); Elkhayat*et al.* (2010); Hussein *et al*., (2010); Abdel Hamed *et al.* (2012) and Omaprakash and Raju (2014).

MATERIALS AND METHODS

Field experiments were carried out to study the effect of planting date, climatic factors and plant age on the population density of Leafminers, *Liriomyza* spp. infesting fenugreek plants. The Fenugreek seeds (cultivar Giza 30) were obtained from Department of Medicinal and aromatic plants, Horticulture Research Institute (A.R.C.). An area of about 1575 $m^2$was cultivated in three planting date at 15 days intervals, Oct., 31st , Nov., 15th and Nov., 30th in Plant Protection Research Station at Kaha region, Qalubia Governorate throughout two successive seasons, 2010-2011 and 2011-2012. In both seasons, the experimental area was divided into 9 replicates (each replicate was 175 m^2). Each planting date was represented by three replicates). All replicates were arranged in Randomized Complete Block Design. All agricultural practices were done and no pesticide treatments were applied.

Weekly randomized samples of fenugreek leaves (20 of each replicate) were taken after foliage appearance and continue for 17 weeks. Each sample from each replicate were kept in tightly closed paper bags and transferred to the laboratory where all samples were thoroughly examined by the aid of stereomicroscope to count the number of leafminers, *Liriomyza* spp. larvae.

Climate factors for both studied seasons were obtained from the Central Laboratory for Agriculture Climate and recorded as the daily maximum & minimum temperature; maximum & minimum relative humidity and wind speed. Three periods of plant age (first, vegetative stage from planting till 49 days later; the second, flowering stage from 50 to 91 days and the third one, fruiting stage from 92 to the end

of the growing season) were also recorded for each planting date to determine the relationship between these factors and infestation of *Liriomyza* spp. larvae on fenugreek plants.

The mean numbers of leafminers, *Liriomyza* spp. larvae between the three tested planting dates were compared statistically. The simple correlation and partial regression were adopted to show the average rate of changes in population due to changes in the two mentioned factors. Data were analyzed according to SAS program (1988) and mean separation was conducted by using Duncan's multiple range test in this program.

RESULTS AND DISCUSION

Effect of planting dates on the population density of *Liriomyza* spp. infesting fenugreek plants.

Results in Table (1&2) revealed that the population density of *Liriomyza* spp. larvae on fenugreek plants was significantly differed according to the planting date during the two studied seasons 2010-2011 and 2011-2012.

In the first season, data in Table (1) showed that that the population density of *Liriomyza* spp. larvae increased by the early planting date. The fenugreek plants were sown in the earliest planting date (Oct., 31st) infested by the significantly highest numbers of *Liriomyza* spp. larvae (22.63 larvae/ 20 leaves) followed significantly by fenugreek plants planted at the second planting date (Nov., 15th)which infested by 12.73 larvae/ 20 leaves. On the contrary, fenugreek plants of the latest planting date (Nov., 30th) harbored the lightest seasonal mean numbers of *Liriomyza* spp larvae (5.79 larvae/ 20 leaves).

Table 1: Effect of three different planting dates on population density of *Liriomyza* spp. Infesting fenugreek plants during first season 2010-2011.

Inspection date	Planting dates			Climatic Factors				
	Oct., 31st	Nov.,15th	Nov.,30th	Max. Temp.	Mini. Temp.	Max. RH%	Mini. RH%	Average speed
Nov.,15th	3.00			29.16	18.69	81.44	38.10	4.64
22nd	12.67			27.21	18.76	84.26	48.10	6.04
29th	13.33	2.33		26.33	15.24	82.66	38.90	5.53
Dec.,06th	12.67	3.33		28.04	14.91	75.04	26.63	5.49
13rd	24.00	5.67	0.00	20.29	12.83	81.51	51.06	8.26
20th	29.33	5.00	9.67	21.13	11.66	72.39	35.20	6.99
27th	32.00	4.00	11.00	23.17	13.11	84.87	44.37	7.07
Jan.,03rd	54.00	3.67	2.67	17.73	14.74	69.39	56.68	4.24
10th	33.67	5.00	2.00	18.14	5.46	87.39	47.86	2.68
17th	19.67	9.00	2.67	19.24	5.93	85.79	45.83	2.79
24th	31.00	7.67	4.67	17.90	6.01	88.25	52.46	2.89
31st	28.33	31.00	3.00	20.06	7.04	82.76	36.92	4.18
Feb., 07th	13.33	31.33	2.00	19.73	9.79	84.95	48.71	4.08
14th	28.33	14.67	3.00	16.81	6.11	68.71	34.22	2.20
21st	19.67	11.67	4.33	23.12	7.47	76.63	28.76	2.68
28th	10.33	11.67	4.67	22.56	6.93	74.48	29.90	3.42
March.,07th	19.33	8.00	5.67	22.50	8.56	84.59	41.56	3.99
14th		31.33	7.00	19.91	5.54	83.06	39.39	5.06
21st		31.00	8.67	23.58	8.21	78.62	37.26	4.97
28th			15.67	23.32	10.04	83.54	43.40	3.95
April., 4th			11.67	24.39	8.72	83.81	39.09	3.63
Mean ± SE	22.63±2.92[a]	12.73±2.68[b]	5.78±1.00 [c]	22.11	10.27	80.67	41.16	4.51
F value	12.85							
L.S.D	6.71							

Table 2: Effect of three different planting dates on population density of Liriomyza spp. Infesting fenugreek during second season 2011-2012.

Inspection date	Planting dates			Climatic Factors				
	Oct., 31st	Nov.,15th	Nov.,30th	Max. Temp.	Mini. Temp.	Max. RH%	Mini. RH%	Average speed
Nov.,15th	1.33			25.03	12.29	83.95	46.58	2.52
22nd	6.67			26.81	13.39	84.09	41.85	1.99
29th	7.33	1.00		25.12	12.52	84.00	43.22	2.64
Dec.,06th	7.33	4.33		20.91	8.73	84.81	46.68	2.18
13rd	19.33	5.00	2.67	19.56	6.46	84.45	47.30	2.64
20th	14.67	4.67	2.67	20.34	7.86	83.99	47.49	2.11
27th	11.33	6.67	18.00	18.96	7.81	81.26	44.24	2.26
Jan.,03rd	18.33	6.33	12.67	18.16	6.29	82.14	44.71	3.07
10th	27.67	6.67	11.67	17.18	5.56	82.79	48.73	2.82
17th	19.00	7.67	12.00	16.52	5.21	74.84	39.43	3.81
24th	15.00	16.67	12.33	16.20	4.14	85.05	45.99	2.89
31st	16.33	8.00	13.67	17.90	7.19	80.16	45.99	2.72
Feb., 07th	11.00	8.33	12.67	18.58	5.84	76.38	38.10	3.28
14th	6.00	11.33	14.00	18.46	5.92	73.01	29.55	2.38
21st	7.33	12.33	21.00	18.69	6.90	79.84	39.51	3.16
28th	3.00	10.00	14.00	20.64	6.61	81.93	37.36	2.99
March.,06th	3.67	18.00	15.33	18.83	7.23	80.43	41.81	4.26
13rd		3.33	20.00	24.79	11.00	77.13	33.46	3.29
20th		3.67	16.00	20.42	7.54	80.09	40.86	4.02
27th			18.67	21.97	6.70	84.54	42.77	3.40
April., 03st			12.00	23.85	9.25	84.60	38.43	3.25
Mean ± SE	11.49±1.73[a]	7.88±1.12[ab]	13.49±1.21	20.42	7.83	81.40	42.10	2.94
F value	4.24							
L.S.D	3.92							

In the second season 2012, statistical analysis of the obtained data in Table (2) indicated that there was significant differences between the mean numbers of Liriomyza spp. larvae at the three tested planting dates, as the calculated LSD value was 3.92 and the results took the same trend obtained in the first season except the 3rd planting date. The highest infestation rate was recorded on fenugreek plants planted at the third and first planting dates (Nov., 30th and Oct., 31st), as the seasonal mean counts were 13.49 and 11.49 larvae/ 20 leaves, respectively without significant differences between them . On the other hand, the lowest general mean number of the studied insect was recorded on fenugreek leaves at the intermediate planting date, 2 nd planting date (Nov., 15th), being 7.88 larvae/ 20 leaves.

The obtained data in the two studied seasons clearly showed that planting of fenugreek seeds in the early planting date (Oct., 31st) lead to plants suffered from the highest infestation by Liriomyza spp. larvae. On the contrary, sowing the fenugreek at the second date (Nov., 15th) can be reduced the infestation of this insect pest.

The obtained results partially agree with Kumar *et al*. (1991) in India, found that the population density of leafminer, *Chromatomyia horticola* infesting sweetpea plants increased in the early planting date (Oct., 4th) while, decreased by delaying planting date (Nov., 21st). Mishra *et al.* (2001) showed that the incidence of Mustard aphids, *Lipaphis erysimi* (Kalt.) on fenugreek plants was low in the early planting date (Oct.,5th), while the population was high in the delaying planting date (Oct., 15th and 25th). Wale (2002) on field peain Ethiopia, recorded that the seasonal total number of aphids, *Acyrthosiphon pisum* increased as planting date was delayed. Mittal and Ujagir (2005) stated that late sown of common bean, *Phaseolus vulgaris*(2nd week of November) were almost free of stem fly *Melanoagromyza phaseoli*, but showed high

leafminer, (*Chromatomyia horticola*) incidence when compared with the earliest planting date (1st week of October). Maha A.M Tantawy (2006) in Egypt on sweetpea plants recorded that the highest mean number of leafminer, *(Liriomyza trifolii* and *Chromatomyia horticola)* was recorded on leave of plants planted at the latest planting dates, (Dec., 1st and Nov., 15th). While, the lowest general mean was recorded on leave of plants planted at the earliest planting date (Oct., 30th). Hanafy (2007) in Egypt stated that the degree of infestation by *T. tabaci* increased by delaying planting date, as sweet pea plants cultivated in the earliest planting date(Oct.,15th) were attacked by the fewest numbers, while the plants of the latest planting date (,Nov.,26th) were more liable to insect infestation. *Elkhayat et al.* (2010) found that the infestation rate of *T. tabaci* on cowpea plants increased on the early planting date compared with the latest planting dates.

Effect of climatic factors and plant age on the *Liriomyza* spp. infestation rate on fenugreek plants.

With regard to the effect of climatic factors and plant age on the population density of leafminers infesting fenugreek plants in three planting dates during 2010-2011 and 2011-2012 seasons at Qalubia Governorate, each of the correlation coefficient values and the explained variance % were calculated and tabulated in Tables 3 and 4.

Data arranged in Table (3) showed that, in the vegetative stage the simple correlation coefficient "r" indicated significant negative correlations between leafminers population and each of the maximum (r= -0.93, -0.89 and 0.52) and minimum temperature (r= -0.82, -0.86 and -0.50 for the three planting dates respectively) while, minimum RH% had a positive effect in the first two planting dates and a negative in the third date (r= 0.50, 0.51 and -0.61, respectively). Wind speed and planting age showed a positive effect on the pest population during the first and second planting dates, while in the third date plant age showed a weak negative effect as the calculated (r) value was -0.10 during the first season.

In the flowering stage, the population density of *Liriomyza* spp. was increased and the calculated correlation coefficient values were insignificantly positive in case of the tested maximum temperature and maximum RH% and wind speed (0.34, 0.36 and 0.07, respectively) while for minimum temperature & minimum RH% and plant age, the relationship were negative (-0.30, -0.26 and -0.23, respectively) for the first planting date. Statistical analysis of the obtained data in the second and third planting dates revealed that the similar relationship between infestation rate of *Liriomyza* spp. and the all studied factors except for wind speed, as the calculated (r) values were 0.59 and -0.45 to the second and third planting dates, respectively.

With respect to the fruiting stage, data in Table (3) showed a negative effective of the five climatic factors and the plant age on the population density of leafminers infesting fenugreek plants in the first planting date (Oct., 31st). While in the third planting date, the effect were positive for maximum & minimum temperature and maximum & minimum RH% and plant age, However, wind speed showed a negative effect (r value =-0.08). In the intermediate tested planting date only maximum and minimum temperature had slight negative correlation coefficient values (r= -0.31 and -0.04, respectively).

Concerning the all over correlation coefficient values for the three studied stages together (vegetative, flowering and fruiting) in the three tested planting dates, statistical analysis of the obtained data in the first and second planting dates gave the same results of relationship, as the relationship were negative with maximum temperature, maximum RH% and average wind speed. On the other hand, these

relations were positive with minimum RH% and plant age. While the relationship with minimum temperature was differed, as r values were -0.39 and 0.57 for first and second planting dates, respectively. In the third planting date, the allover (r) values of the effect of the three planting stages were insignificantly positive except for minimum temperature (r=-0.10).

The average rate of changes in the pest activity due to the changes in the combined effect of the tested five climatic factors were 55.73, 70.83 and 42.93%, while for the three planting age the EV% values were 2.34, 46.89 and 22.77% during the 1st ,2nd and 3rd planting dates, respectively, (Table, 3). The all over E.V.% for the climatic factors and planting dates together were 59.90, 73.15 and 66.82%, in the previously mentioned three planting dates, respectively.

Table 3: Effect of climatic factors and plant age on the population density of leafminers infesting fenugreek plants in three planting dates during 2010-2011 season.

Planting dates	Planting stage	Pest count/ 20 leaves	Correlation coefficient values						Explained variance %		
			Max. Temp.	Mini. Temp.	Max. RH%	Mini. RH%	Wind	Plant age	Climatic factors	Plant age	Overall
1st planting date	vegetative	13.13	-0.93	-0.82	0.03	0.50	0.95	0.89	55.73	2.34	59.90
	Flowering	33.27	0.34	-0.30	0.36	-0.26	0.07	-0.23			
	Fruiting	19.89	-0.52	-0.57	-0.12	-0.22	-0.27	-0.44			
	Allover r value	22.10	-0.27	-0.39	-0.47	0.18	-0.06	0.15			
2nd planting date	vegetative	4.07	-0.89	-0.86	-0.21	0.51	0.92	0.60	70.83	46.89	73.15
	Flowering	14.61	-0.14	0.72	-0.61	0.28	0.59	0.89			
	Fruiting	18.06	-0.31	-0.04	0.36	0.24	0.74	0.71			
	Allover r value	12.25	-0.54	0.57	-0.59	0.54	-0.17	0.68			
3rd planting date	vegetative	5.07	0.52	-0.50	0.39	-0.61	0.30	-0.10	42.93	22.77	66.82
	Flowering	3.28	-0.47	0.18	-0.14	0.01	-0.45	0.12			
	Fruiting	8.89	0.72	0.48	0.62	0.46	-0.08	0.86			
	Allover r value	5.75	0.17	0.26	0.01	-0.10	0.18	0.48			

In the subsequent season, 2011-2012, data arranged in Table (4) indicated that in the first planting date the maximum and the minimum temperature had a significantly negative effect on the occurrence of the studied pest during the vegetative stage (r= -0.79 and -0.72) while, maximum & minimum RH% and average wind speed had insignificant positive effect, however plant age affected the population of the leafminers (r=0.88). In the next planting date, the same relationships were confirmed expect with minimum RH% and average wind speed which had a negative relationship (r= -0.52 and-0.50). For the third planting date, each of the maximum & minimum temperature and maximum & minimum RH% showed a negative correlation coefficient values (r= -0.02, -0.61, -0.62 and -0.98, respectively) and both of average wind speed and plant age were positive (0.20 and 0.66, respectively).

The flowering stage of the first planting date affected by a negative effect with maximum& minimum temperature and minimum RH% (r=-0.42, -0.41 and -0.11, respectively) while maximum RH%, average wind speed and plant age factors affected positively on the population of *Liriomyza* spp. In the second planting date, the negative relationship was recorded with maximum & minimum temperature and average wind speed, the positive relationship were detected with minimum RH% and plant age. Concerning the third planting date, the statistical analysis showed that the (r) values were 0.58, 0.57,-011, 0.12, -0.08 and 0.77 for the relation between

maximum & minimum temperature, maximum & minimum RH%, average wind speed and planting age and the population of leafminers during the flowering period of the plant, respectively.

With regard to the fruiting stage, the most of the effect of the tested climatic factors was changed between negative and positive from planting date to the other. However, the plant age had a negative effect and decreased by delaying of plantation (r= -0.91, -0.55 and -0.07 in the three planting dates, respectively).

Table 4: Effect of climatic factors and plant age on the population density of leafminiers infesting fenugreek plants in three planting dates during 2011-2012 season.

Planting dates	Planting stage	Pest count/ 20 leaves	Correlation coefficient values						Explained variance %		
			Max. Temp	Mini. Temp.	Max. RH%	Mini. RH%	Wind	Plant age	Climatic factors	Plant age	Overall
1st planting date	Vegetative	8.40	-0.79	-0.72	0.30	0.44	0.32	0.88	69.72	0.35	72.74
	Flowering	17.67	-0.42	-0.41	0.27	-0.11	0.41	0.32			
	Fruiting	7.89	0.07	-0.71	0.51	-0.09	-0.35	-0.91			
	Allover r value	11.32	-0.52	-0.57	0.44	0.03	0.06	-0.05			
2nd planting date	Vegetative	4.33	-0.87	-0.98	0.41	-0.52	-0.50	0.89	78.59	18.61	79.51
	Flowering	8.95	-0.71	-0.59	0.13	0.47	-0.20	0.32			
	Fruiting	9.78	-0.58	-0.73	0.26	0.12	0.09	-0.55			
	Allover r value	7.69	-0.61	-0.6	-0.16	-0.15	0.32	0.43			
3rd planting date	Vegetative	9.54	-0.02	-061	-0.62	-0.98	0.20	0.66	39.4	38.1	55.82
	Flowering	14.28	0.58	0.57	-0.11	0.12	-0.08	0.77			
	Fruiting	16.00	0.27	0.26	-0.17	-0.52	0.06	-0.07			
	Allover r value	13.27	0.25	0.19	-0.47	-0.32	0.39	0.62			

The accumulated effect of the three planting stages in the first planting date were negative with maximum & minimum temperature and plant age (-0.52 -0.57 and -0.05, respectively) and positive with the other tested factors (0.44, 0.03 and 0.06 for maximum & minimum RH% and average wind speed, respectively. In the second planting date, the increasing of the temperature and RH% decreased the population of the studied pest. While the increasing of wind speed and the planting age increased the population, as the (r) values were 0.32 and 0.43 for the last two factors, respectively. The allover (r) value of the simple correlation between maximum & minimum temperature, average wind speed and plant age were positively affected, as the calculated (r) values were 0.25, 0.19, 0.39 and 0.62, respectively. On the contrary, the relationship was a negative with maximum & minimum RH% as (r) values were -0.47 and -0.32, respectively in third planting dates.

The amount of variability that could be attributed to the combined effect of the tested climatic factors on the different stages of leafminers population was 69.72, 78.59 and 39.40%for the three planting dates, respectively. For the plant age in the first date at the three planting stages, the E.V.% was 0.35, this percentage was increased in the second and third planting dates (E.V.% were 18.61 and 38.10%, respectively), while in the third planting date, the planting age effected on the population being 22.77%. While, the overall explained variance (E.V. %) was 72.74, 79.51 and55.82 for the three planting dates, respectively.

Generally, it could be concluded that the population density of leafminers,

Liriomyza spp. increases by increasing the plant age. The lightest population was recorded during the vegetative stage. While, the fenugreek plants infested by the heaviest population during flowering and fruiting stages.

In a similar work of the studied the effect of climatic factors and plant age on the population density of different insect pests infesting many crops had been done in different countries. Meena and Bhargava (2001) in India on fenugreek plants stated that the population density of aphid, *Acyrthosiphon pisum* correlated significantly negative correlation with temperature and had a positive correlation with relative humidity. Shalaby (2004) in Egypt on common bean found a significant correlation between minimum temperature and numbers of *L. trifolii*, while, an insignificant correlation was found between relative humidity and the population of *L. trifolii*. Arif *et al.* (2006) found that rainfall and temperature were significantly positive relationship with the population density of *T. tabaci,* Jassid and whitefly infesting cotton plants, while the relative humidity showed non- significant effect. Hanafy (2007) in Egypt on sweetpea plants stated that the population density of *T. tabaci* was affected by climatic factors and plant age in three planting dates. Afsah (2009) in Egypt on fenugreek plants stated that the population density of *Liriomyza* spp. was positively correlated with temperature and wind velocity, while it was negatively correlated with relative humidity. Hussein *et al*.(2010) in Egypt on garlic plants recorded that there are a Positive relationships between the population density of *T. tabaci* and the developmental stages of plant, and negatively correlated with maximum and minimum temperatures, while, the mean of R.H was affected positively on the population this pest. Abdel Hamed *et al.* (2012) in Egypt on okra plants found that the weather factors (maximum, minimum, mean temperature) and plant age had significantly positive effect on population of *B. tabaci*, *T. tabaci*, *L. trifolii* and *T. urtica,*while the relative humidity had significantly negative effect. Omaprakash and Raju (2014) in India on brinjal plants, *Sollanum melongena* L. stated that *B.tabaci* population was significant and negative correlation with temperature and insignificantly negative with humidity.

DISCUSSION AND CONCLUTION

Field experiment was carried out on heavy infested area with cotton leafworm larvae at early season on cotton plants. For evaluation the field performance of Low-Volume spraying machines; Knapsack Motor sprayer (Agromondo) (20 L/fed.), Hand-held compression sprayer (Kwazar) (94 L/fed.) and a High-Volume spraying equipment Conventional Motor Sprayer (Wisconson) (600 L/fed.); to spray Profenofos (OP compound), Bio agent (Spinosad) and Pyriproxyfen (IGR) with full recommended dose and 3/4 recommended dose.

A satisfactory coverage was obtained on cotton plants, the droplet spectrum was obtained in field experiment was agreed with the optimum droplet sizes which mentioned by Himel (1969). The best obtained result was 20 L/fed. as spray volume, 154 μm and 163 droplets/cm^2, these results agreed with (Himel *et al.*, 1969) in the optimum droplet size to control cotton leafworm in cotton fields by ground equipment. Profenofos revealed the best bioefficiacy results with the three tested sprayers (Agromondo) Motor sprayer (20 L/fed.), Kwazar sprayer (94 L/fed.) and Wisconson Motor sprayer (600 L/fed.). Also, Pyriproxyfen revealed the best bioefficiacy results with motor sprayer Agromondo (20 L/fed.) followed by Spinosad with the same sprayer, and these results agreed with Hindy *et al*. (2004) and Genidy *et al.* (2005) which recommended KZ oil and Pyriproxyfen followed by Agerin using

low volume spraying because of reducing the time lost in process filling the machines, improve the homogeneity of the spray solution on the plant leaves and saving the lost spray on the ground. Also, there was no significant difference between recommended dose rate and 3/4 recommended dose with low volume spraying.

The data showed that, Agromondo Motor sprayer (20L/fed.) is the best equipment to control cotton leafworm on cotton plants. Also, the lowest spray volume and the lowest percentage of lost spraying between plants, this results was agreed with Hindy *et al*. (1997), who mentioned that, there was a positive relationship between rate of application and spray lost on ground.

Generally, Spinosad, and Pyriproxyfen are recent insecticides avoid the activity of cotton leafworm on cotton plants, and safe the children who were picked manually egg masses during hot days, and safing also the traditional insecticides which injures the human body and the agricultural environment.

It could be recommended to use Profenofos and Pyriproxyfen followed by Spinosad with low volume (LV) spraying equipment with not less than (20L./fed.) and use ¾ recommended dose which revealed successful results. There was a negative complete correlation between (VMD) and the mean residual of mortality of *S. littoralis* while there was a positive complete correlate between N/cm² and the mean residual of mortality of *S. littoralis* in all treatments.

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ARABIC SUMMERY

تأثير بعض العوامل المناخية وعمر النبات على الكثافة العددية لصانعات الأنفاق *Liriomyza* spp. التى تصيب نباتات الحلبة *Trigonella foenum-graecum* L. المزروعة فى مواعيد مختلفة.

عبدالجابر فتوح السيد عفصه، أحمد رمضان إبراهيم حنفى و سيد حسين أحمد حسين
معهد بحوث وقاية النباتات- مركز البحوث الزراعيه- الجيزة- مصر

تم إجراء تجربة حقلية في محطة بحوث وقاية النباتات في منطقة قها- محافظة القليوبية خلال موسمين متتاليين ٢٠١٠-٢٠١١ و٢٠١١- ٢٠١٢ وذلك لدراسة تأثير بعض العوامل المناخية وعمر النبات على الكثافة العددية ليرقات صانعات الأنفاق *Liriomyza* spp. التى تصيب نباتات الحلبة فى ثلاث مواعيد زراعة مختلفه (٣١ أكتوبر، ١٥ نوفمبر و ٣٠ نوفمبر).

وقد أظهرت الدراسة أن ميعاد الزراعة له تأثير كبير فى معدلات الإصابة بهذه الآفة حيث تبين أن نباتات الحلبة في تاريخ الزراعة المبكرة (٣١ أكتوبر) قد تعرضت لأعلى معدل إصابة بصانعات الأنفاق *Liriomyza* spp. وعلى العكس من ذلك وجد أن زراعة الحلبة في الميعاد الثاني (١٥ نوفمبر) قد قلل من الإصابة بهذه الآفة.

كما بينت النتائج أن الكثافة العددية لصانعات الأنفاق *Liriomyza* spp. تزيد بزيادة عمر النبات حيث سجلت أعلى معدلات لها خلال مرحلتى الإزهار والإثمار. فى حين أن النباتات فى طور النمو الخضرى قد أصيبت بأقل أعداد من هذه الحشرة. وأظهرت نتائج التحليل الإحصائى أن الكثافه العدديه لهذه الأفه قد إرتبطت إرتباطا موجباً أو سالباً حسب مراحل نمو النبات المختلفة خلال موسمى الدراسة فى حين أرتبطت إرتباطا موجباً مع عمر النبات فى كل مواعيد الزراعة المختبرة إلا فى الميعاد المبكر حيث إرتبطت إرتباطاً سالباً خلال الموسم الثانى.

وكان معامل الإرتباط هو ٠.١٥ ، ٠.٦٨ و٠.٤٨ لمواعيد الزراعة الثلاث فى الموسم الأول وكان -٠.٠٥ ، ٠.٤٣ و٠.٦٢ خلال الموسم الثانى على التوالى. وبينت نتائج الدراسة أن العوامل الجوية قد أثرت تأثيراً عالياً على الكثافة العددية لصانعات الأنفاق *Liriomyza* spp. بالمقارنة بتأثير عمر النبات وكان التاثير المشترك للعوامل المناخية هو ٥٥.٧٣، ٧٠.٨٣ و٤٢.٩٣% لمواعيد الزراعة الثلاث فى الموسم الأول و ٦٩.٧٢ ،٧٨.٥٩ و٣٩.٤٠% خلال الموسم الثانى لمواعيد الزراعة الثلاث على التوالى. وكما أوضحت النتائج أن تأثير العوامل المناخية وعمر النبات معاً على الكثافة العددية لصانعات الأنفاق *Liriomyza* spp. خلال مراحل النمو المختلفة داخل الثلاث مواعيد الزراعة المختبرة لنباتات الحلبة هو ٥٩.٩٠، ٧٣.١٥ و ٦٦.٨٢% خلال الموسم الأول و ٧٢.٧٤، ٧٩.٥١ و ٥٥.٨٢% خلال الموسم الثانى لثلاث مواعيد الزراعة المختبرة على الترتيب.