

Prediction of the cotton leafworm infestation in cotton fields using sex pheromone traps and some weather conditions at Kafr El-Sheikh and Dakahlia Governorates.

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ABSTRACT

The present work was carried out at Kafr El-Sheikh and Dakahlia Governorates, aimed to record populations of *Spodoptera littoralis* (Boisd.) for two years. The changes in population dynamics was studied by liquid pheromone traps during 2003 and 2004 of cotton growing seasons. Results indicated the occurrence of three annual peaks for *S. littoralis*. Multiple regression between the three tested weather factors (maximum-minimum temperature and relative humidity) and pest catch were calculated and the determination coefficient values were recorded. The combined effect of the prevailing temperature and relative humidity were accounted for 28.4 %, 47.9 % at Biala and 24 %, 38 % at Fowa, Kafr El-Sheikh Governorate of changes in male moths population during 2003 and 2004, meanwhile, Dakahlia Governorate, the effects were 5.9 %, 26.6 % at Aga and 12.8 %, 26.5 % at El Senbellaween during 2003 and 2004 of the changes of the population male moths, respectively. On the other hand, the combined effect of the three prevailing factors were affected for 16 %, 12.9 % at Biala and 6.5 %, 28.6 % at Fowa, Kafr El-Sheikh Governorate on the number deposited of egg- masses during 2003 and 2004, while, it's affected for 37 %, 18.2 % at Aga and 47.6 %, 42.5 % at El-Senbellaween, Dakahlia Governorate during 2003 and 2004 cotton seasons.

INTRODUCTION

The cotton leafworm, *Spodoptera littoralis* (Boisd.) is the major pest attacking several crops and vegetables in Egypt. This pest causes great damage to cotton especially in The Nile Delta regions including Kafr El-Sheikh and Dakahlia Governorates. Pheromone baited traps were

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considered to be quite reliable for forecasting the changes in the population of *S. littoralis*. Hosny *et al.* (1987); Flint *et al.* (1990) and El-Zanan and El-Hawary (1999) used pheromone traps to study the seasonal occurrence of *S. littoralis* during cotton growing seasons. Pheromone traps were used as a good indicator for best populations, particularly in early growing season (El-Zanan and El-Hawary, 1995).

Utilization of sex Phermones in monitoring and control insects populations and relating such levels to field infestations and damage has many advantages: (1) to provide an early warning of pest incidence particularly if pest occurs sporadically from year to year or where long-range migration is suspected (Campion, 1994). Naser *et al.* (1984) suggested that populations of *littoralis* (Boisd.) build up locally and some localized populations redistribute. They drew their conclusion from a 2-year study in the Nile Delta region in Egypt by pheromone traps, (2) To reduce insecticide treatments, by eliminating unnecessary applications (Toscano *et al.*, 1994) and (3) To conserve populations of beneficial arthropods in pheromone treated areas than those treated with broad spectrum insecticides (El- Adl *et al.*, 1998) and to increase honey production as it was noticed when incorporation of pheromone treatment in cotton pest management programme (Moawad *et al.*, 1991).

The present investigation was conducted to study the population density of this pest and effect of the three main weather factors, maximum, minimum temperature and relative humidity on them. The annual generations of this pest was also studied.

MATERIALS AND METHODS

The present study was based on determining the number of cotton leafworm, *S. littoralis* male moths caught nightly by pheromone traps, are fixed in Biala and Fowa districts, Kafr El-Sheikh Governorate, and Aga and El-Senbellaween districts, Dakahlia Governorate during two successive years 2003 and 2004 of cotton plantation. Planting cotton occurred on late March and first half of April in both Governorates in two seasons. cotton plants received normal agricultural practices.

Pheromone traps were placed in each field from first May till the mid of September in both seasons. Traps were fixed and distributed manually at the rate of 1 trap/5 feddans. The baited sex pheromone was fixed on metal bars just above cotton plants. The traps were baited with specific pheromone capsules and replaced every two weeks by fresh ones. The soaped water was also changed every three days and the number of trapped males was counted.

The sex pheromone traps were baited with synthetic pheromone formulation in poly ethylen vials. The vials contain 2mg of active ingredient of synthetic pheromone. The pheromone was cis- 9- trans- 11-tetra decadiene 1-yl-acetate (Kehat *et al.*, 1983), produced by Plant Protection Institute, Dokki, Giza.

According to the national control program applied on cotton leafworm in Egypt, the experimental areas in both seasons were cleaned by the hand collection of egg-masses as well as defoliated leaves every three days to minimize the deleterious effects of the coming generation.

One pheromone trap was distributed per 5 feddans in the treatment area. The experimental areas (5 feddans for each) in Fowa, Kafr El-Sheikh and El-Senbellaween, Dakahlia Governorates, were manually sprayed by using the recommended insecticides. While, the experimental area in Biala, Kafr El-Sheikh and Aga, Dakahlia Governorates was three feddans from each, did not receive insecticidal applications. The recommended insecticides sprayed in Fowa and El-Senbellaween was:

- 1- Agrain (*Bacillus thuringensis* 6.5 %W.P)
- 2- Atabron (chlorfluzuron 5 % E.C) at the rate of 400 ml/fed.
- 3- Pestban (chloropyrifos 48 % E.C) at the rate of 1 liter/fed.

The average of maximum, minimum temperature and relative humidity were obtained from the Metrological Department at both Governorates. Data were statistically analyzed and multiple regression values were calculated.

RESULTS AND DISCUSSION

Sex pheromone was used to collect male moths of *S. littoralis* in Kafr El-Sheikh (Biala and Fowa) and Dakahlia (Aga and El-Senbellawan) Governorates.

Generations of the cotton leafworm:

Kafr El-Sheikh Governorate: Data presented in Table (1) and Fig. (1, 2) show the fluctuation of the male moths of cotton leafworm during the period extend from the first week of May till the second week of September in 2003 and 2004 seasons from two districts Biala and Fowa, Kafr El-Sheikh Governorate.

As for 2003, there were three generations with three sharp peaks in Biala and Fowa districts. These peaks were found to be in first week of June, first week of July and August in Biala districts. The corresponding number of caught males was 10.16, 19.31 and 5.66 (male/trap/day) in the Biala district. While, in Fowa district this peaks appeared in second week of June, first week of July and second week of August and the caught males of trapped were 12.4, 24.15 and 13.0 (male/trap/ day).

In 2004 growing season , three generations were observed on Biala and Fowa districts, during a period extended from first of May till mid of September, reaching their peaks during the last week of May (5.15), second week of July (10.15) and first week of August (19.2), (mal/trap/ day) inBiala. In Fowa, the same peaks were observed during second week of June, second week of July and second week of August (12.3, 16.5 and 12.4), (male/trap/ day), respectively.

The obtained data assured that, peaks of cotton leafworm occurred during May, June, July and August during the two seasons. During two seasons, maximum number of moths caught was recorded during June and July in Biala and Fowa. The obtained results are parallel with those obtained by many authors. El- Zohairy *et al.*, (1994) studied the population density of cotton leafworm, *S.littoralis* (Boisd). He showed that the pest had three generations on cotton, the first started in the third week of May, the second appeared in the third week of June and the third one recorded in the first week of August.

Table (1): population size of the trapped male moths of the cotton leafworm, *spodoptera littoralis* by pheromone-baited traps together with average weather conditions in cotton fields at Kafr El-sheikh Governorate during 2003-2004 cotton seasons.

Period of inspection	2003					2004				
	Average No of male moths/ trap/day			Average of weather factor/day		Average No of male moths/ trap/day			Average of weather factor/day	
	Bath	No wa	Max	Min	R.H.%	Bath	No wa	Max	Min	R.H.%
May 3-8	442	32	30.14	13.4	70.91	12	43	27.18	10.71	37.83
8-14	543	41	29.74	15.31	65.03	245	52	29.71	13.44	55.44
15-20	629	55	30.41	14.02	61.33	31	61	30.34	15.44	61.0
21-24	73	59	30.03	14.44	61.35	435	61	33.88	17.34	44.33
25-1/6	899	74	30.14	14.5	60.03	515	84	32.83	17.83	43.43
June 2-7	1014	475	27.42	14.0	61.03	44	113	34.82	20.13	44.0
8-13	912	124	29.14	15.42	57.5	44	123	33.4	18.94	44.0
14-19	748	118	28.83	14.23	60.5	543	103	34.3	20.28	48.0
20-25	921	141	30.33	18.03	71.42	625	92	35.23	21.35	49.83
26-1/7	1771	1845	30.33	20.42	67.33	73	89	32.32	18.63	48.42
July 2-7	1931	3415	32.14	21.0	69.33	90	142	33.85	19.5	49.44
8-13	842	224	34.0	20.44	70.75	1015	145	33.42	21.33	74.25
14-19	420	120	34.25	20.33	68.83	915	44	33.9	20.92	74.75
20-25	449	47	34.0	20.03	73.42	745	75	35.33	20.7	73.14
26-31/8	415	725	35.83	22.03	73.92	92	84	33.7	20.94	73.5
August 1-4	544	1035	34.4	22.25	71.44	192	103	34.84	19.8	74.5
5-12	525	130	34.5	20.5	70.56	84	124	35.03	21.93	75.75
13-18	375	103	35.4	27.4	48.0	42	73	35.18	20.44	78.44
19-24	334	625	34.02	20.35	57.0	44	68	33.9	20.03	73.58
25-30	325	39	35.32	20.32	72.0	41	45	34.33	18.03	45.33
31-5	298	31	33.32	19.45	68.92	54	33	33.88	18.7	49.14
September										
6-11	352	30	31.97	20.74	72.14	38	30	32.2	17.5	45.44
12-17	299	27	32.45	18.48	59.03	33	34	31.45	14.34	49.03
Total	15942	218	758.99	437.98	153.33	1444	1749	744.1	430.33	177.3
Mean	4.94	9.78	32.11	19.04	64.43	4.28	7.4	33.34	18.72	48.59

1: Mean number of 2 traps at El Garaida Zone. (Biala district)
 2: Mean number of 16 traps at El Salmia Zone. (Fowa district)
 3: Mean number of 21 traps at El Salmia Zone. (Fowa district)

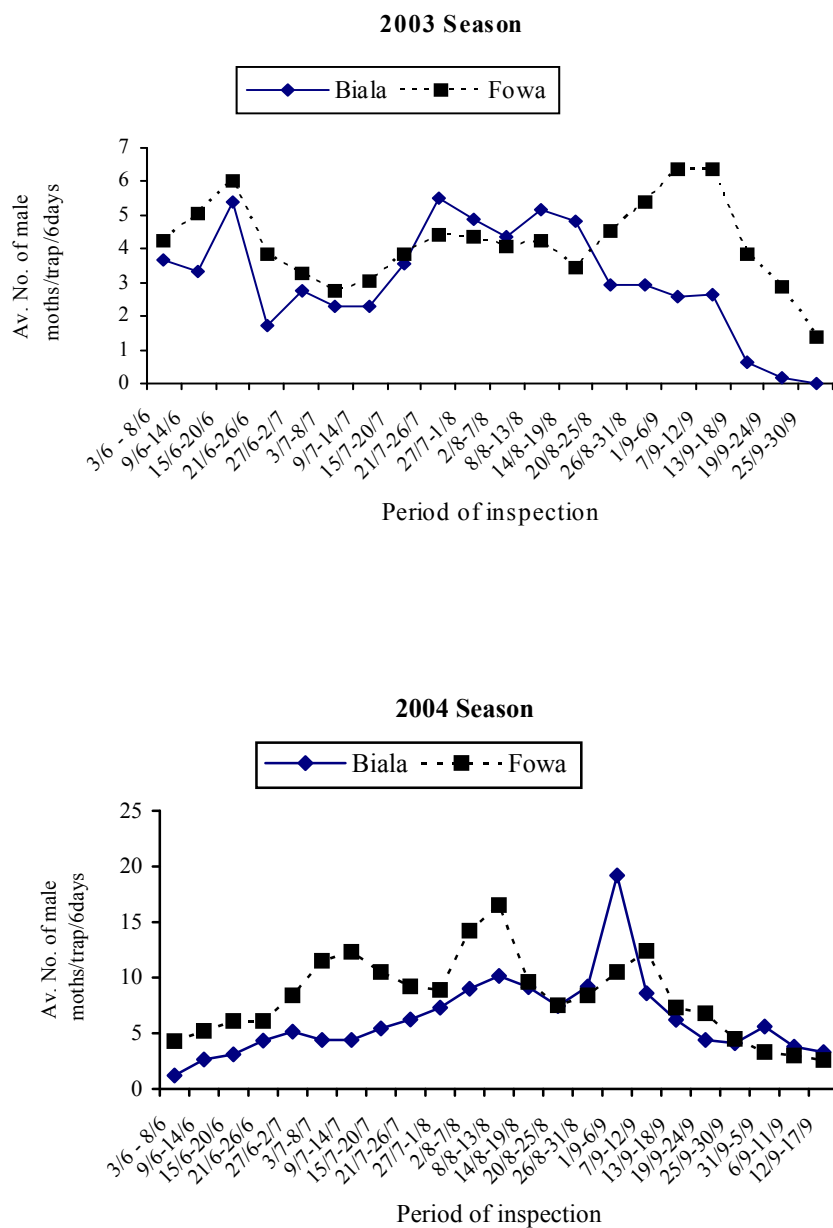


Fig. (1 & 2): Average number of cotton leafworm adult male moths caught using pheromone traps in the two districts Biala & Fowa, Kafr El-Sheikh Governorate during 2003 & 2004 seasons.

Dakahlia Governorate: Data presented in Table (2) and Fig. (3 , 4) show the fluctuation of the male moths of cotton leafworm during the period extended from the fourth week of April till the first week of September in 2003 and 2004 seasons on two districts (Aga and El-Senbellaween), Dakahlia Governorate.

As for 2003, there were three generations with three sharp peaks in Aga and El-Senbellaween in both seasons. Those peaks were found to be in second week of June, late of June and first week of August in Aga 2003 season. The corresponding number of caught males was 76.15, 78.5 and 25.55 in Aga, while it was 23.5 (in the late of May), 24.2 (late of June) and 1.77 in the first of August in case of El-Senbellaween district 2003 season.

During 2004, the male moths recorded 61.4, 26.21 in the fourth week of May, 98.45, 38.13 in the third week of July and 19.6, 3.6 in the third and fourth week of August in Aga and El-Senbellaween districts.

These results are in accordance with those of Abd El- Fattah *et al.* (1987) who indicated that four moth broods of *S. littoralis* of variable size could be detected with their peaks that occurred late in May and June, in mid-August and late in September. El-Mezayyen *et al.*, (1997) recorded three adult population peaks of *S. littoralis* in May, August and November in the first season and it occurred in April, July and November in the second one. El-Zanan and El-Hawary (1995) recorded five adult population peaks of *S. littoralis* in May, July, August and September during 1980 and 1990 seasons in Kafr El-Sheikh. Also, the obtained results were supported by Rizk *et al.*, (1990) who reported that the pheromone traps attracted more *S. littoralis*. However, careful investigation of the concurrent data presented in Tables 1 and 2, it could pointed out the following points:

1 - Concerning the first time of appeared the peaks there is no different variation between two districts on two Governorates except, some peaks appeared in one districts before other.

2- Fortunately, the population densities of both seasons are positively so low during the period extended from first May to mid September. This period is a critical period for cotton plants during which squares appeared, flowers and green bolls are progressively formed and thus be subjected to the attack of cotton leafworm larvae

Table (2): population size of the trapped male moths of the cotton leafworm, *Spodoptera littoralis* by pheromone-baited traps together with average weather conditions in cotton fields at Dakahlia Governorate during 2003-2004 cotton seasons.

Period of inspection	2003						2004					
	Average No. of male moths/ trap/day			Average of weather factor/ day			Average No. of male moths/ trap/day			Average of weather factor/ day		
	Aga ¹	Elsen ²	Max	Min	R.H%		Aga ¹	Elsen ²	Max	Min	R.H%	
April 24-29	4.37	4.1	27.71	13.33	69.5		8.2	3.49	30.66	14.16	59.8	
May 30-5	5.25	5.9	29.33	15.08	67.33		11.2	4.12	30.16	15.33	57.16	
6-11	5.5	6.15	30.6	16.0	69.5		13.55	4.49	31.25	15.66	65.4	
12-17	14.35	7.45	30.3	15.83	69.0		18.85	6.89	32.5	17.5	68.83	
18-23	18.3	10.15	31.5	17.25	70.83		20.05	9.33	33.16	18.5	61.3	
24-29	37.2	23.5	31.92	18.08	71.3		61.4	26.21	33.25	19.33	64.4	
June 30-5	64.75	14.35	32.25	18.25	72.0		56.9	18.13	35.58	20.83	64.0	
6-11	76.15	19.94	33.16	18.66	71.5		70.9	25.32	34.08	20.75	66.2	
12-17	55.5	21.8	34.58	20.5	72.7		98.45	38.13	32.25	21.25	68.8	
18-23	65.25	22.95	32.75	19.83	78.2		87.45	29.94	32.16	22.08	69.8	
24-29	78.5	24.2	33.5	20.75	81.5		36.15	14.60	34.25	22.85	67.6	
July 29-4	75.1	14.3	32.25	22.08	77.8		11.55	5.74	34.33	22.83	69.6	
5-10	31.1	6.6	36.0	22.83	83.7		11.5	3.2	35.5	24.1	74.3	
11-16	9.8	1.95	35.0	23.43	83.7		19.6	2.8	34.33	23.66	71.7	
17-22	2.6	1.06	34.65	22.74	78.3		19.0	3.6	34.83	22.25	74.8	
23-28	5.35	0.8	35.35	22.66	94.2		19.5	3.5	34.16	22.5	71.8	
29-3	13.3	1.45	34.58	23.5	85.7		13.2	3.3	35.61	22.63	76.5	
August 4-9	25.55	1.77	34.58	21.92	86.2		10.2	2.95	35.0	22.5	76.7	
10-15	25.2	1.6	34.61	22.63	77.2		7.5	1.7	35.16	21.83	78.7	
16-21	13.3	1.13	35.0	21.5	86.2		6.25	1.5	34.58	22.25	73.6	
22-27	9.5	0.8	35.16	22.25	80.3		5.75	1.97	34.5	21.83	66.2	
28-2	7.1	0.8	32.83	18.83	79.2		5.75	1.64	33.83	21.33	69.2	
September 3-8	4.49	0.68	83.58	21.33	74.3		4.35	0.95	34.5	20.83	65.7	
9-14	3.7	0.55	33.83	21.5	74.2		3.2	0.8	34.3	20.16	69.1	
Total	646.84	179.88	768.31	467.42	1789.86		590.25	200.81	779.27	482.26	1591.39	
Mean	26.95	7.5	32.01	19.48	74.58		24.59	8.37	32.47	20.09	66.31	

1: Mean number of 2 traps at Borg El Nore Zone. (Aga district)

2: Mean number of 22 traps at Kafr Saad Zone. (El-Senbellaween district)

3: Mean number of 26 traps at Kafr Saad Zone. (El-Senbellaween district)

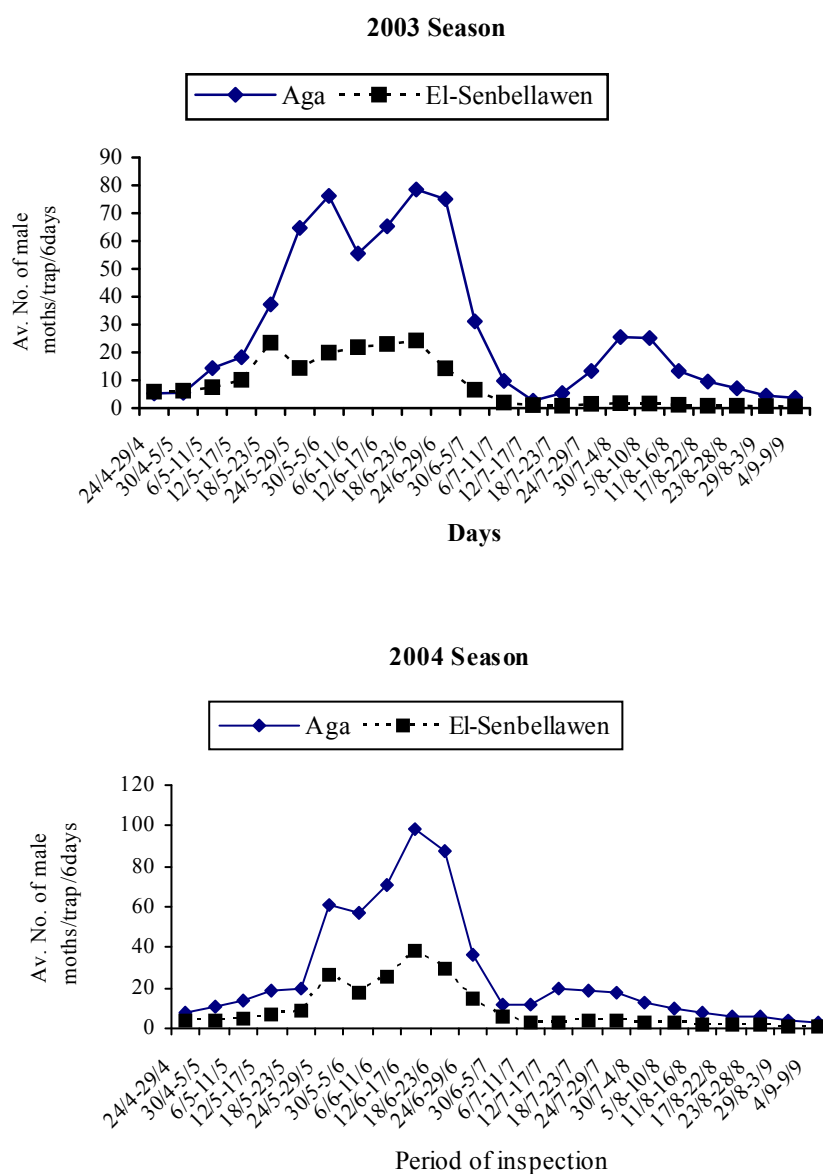


Fig. (3 & 4): Average number of cotton leafworm adult male moths caught using pheromone traps in the two districts Aga & El-Senbellaween\, Dakahlia Governorate during 2003 & 2004 seasons.

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3- Establishment of the relationships between adult population of the cotton leafworm *S. littoralis* (Boisd.) and its female egg deposition activity in the field.

Egg-masses in Kafr El-Sheikh Governorate :Data presented in Table (3) and Fig (5 , 6) show the fluctuation of the egg-masses during the period extended from the fourth week of May till the half of July in 2003 and 2004 season on two districts (Biala, Fowa) Kafr El-Sheikh Governorate.

In two seasons, there were three sharp peaks in the (4th week of May, 1st week of June and late of June (2003 season) and the 4th week of May, first of June and late of June (2004 season) in Biala district. Meanwhile, in Fowa district, these peaks were appeared in late of May, 4th week of June (2003 season) and in late of May, 2nd week of June and late of June (2004 season).

Egg-masses in Dakahlia Governorate: The obtained data in Table (4) and Fig. (7 , 8) reflected that , peaks of egg-masses occurred during May (24 and 26th) in Aga and El-Senbellaween, and June (8- 10th- and 26- 28th) in Aga while in El-Senbellaween district appeared in (5-7th and 29-1/7st) within 2003 in 2004 cotton seasons, these peaks appeared in May and June too. In Aga district, the peaks appeared in fourth weeks of May, second and last week of June. While, in El-Senbellaween district appeared in fourth week of May, first week of June and last week of June.

Combined effect of weather factors on the population fluctuations of cotton leafworm: The combined effect of the three weather factors, maximum, minimum temperature and relative humidity on the population of the cotton leafworm is shown in Tables 5 and 6, and was calculated by multiple correlation (R) and coefficient values (R^2).

The effect of multiple correlation for the previous weather factors was found to be positive and slightly significant ($p \leq 0.01$) with *S. littoralis* in 2003 and 2004. The R^2 values for the three weather factors were 0.284 and 0.479 for Biala and 0.240 and 0.380 for Fowa, in both seasons. Values of R^2 were 0.059 and 0.266 for Aga district and were 0.128 and 0.265 for El-Senbellaween district.

Moreover, the multiple regression analysis revealed that the joint effect between the three climatic factors were responsible for 28.4 %, 24 % and

Table (3): Average number of egg-masses of the cotton leafworm with average weather conditions in cotton fields at Kafr El-Sheikh Governorate during 2003-2004 cotton seasons.

Period of inspection	2003						2004					
	Average No. of Eggmasses/ Day/ feddan			Average of weather factor			Average No of Eggmasses/ Day/ feddan			Average of weather factor		
	Biala	Fowa	Max.	Min.	R.H%		Biala	Fowa	Max.	Min.	R.H%	
May 23-25	64	38.66	30.4	16.7	64.16		88.66	41.0	32.76	17.2	64.5	
26-29	224	152.33	30.7	16.9	60.33		52.33	32.33	33.63	17.8	63.66	
29-31	33.66	52.33	30.66	16.23	60.5		52.33	13.66	32.06	17.83	63.16	
June 01-03	43.33	46.33	27.06	16.3	62.33		57.33	3.66	34.6	19.93	64.5	
04-06	45	30.36	27.16	16.3	61.5		56.33	7.33	33.23	15.63	66.83	
07-09	38.33	32.66	29.2	15.9	57.16		47.33	10.0	33.0	18.86	66.83	
10-12	30.66	32.66	29.7	15.26	57.33		36.33	12.33	33.66	18.1	66.33	
13-15	24.33	33.0	28.36	16.13	60.16		18.0	10.66	34.53	20.66	68.16	
16-18	31.33	52.66	30.33	16.0	70.16		17.33	12.0	34.73	20.5	68.0	
19-21	90.33	83.0	28.93	18.23	67.33		35.33	20.33	35.4	20.96	69.66	
22-24	154.66	101	30.33	18.33	70.06		88.0	45.33	34.43	21.6	69.0	
25-27	203.66	112.66	30.33	19.23	66.83		98.33	87.33	33.4	18.6	68.83	
28-30	233.33	81.33	30.6	20.37	69.66		221.66	117.33	32.96	18.36	68.5	
July 1-3	81.33	66.33	32.66	21.17	69.83		42.33	92.33	33.3	19.0	69.33	
4-6	37.0	47.0	32.86	21.33	69.83		17.0	73.33	33.0	19.6	70.0	
7-9	13.33	15.66	33.96	20.33	69.66		9.66	39.66	33.2	20.36	74.0	
10-12	12.66	13.33	34.5	20.36	70.0		10.33	30.0	33.1	21.53	73.16	
Total	3460.94	991.60	517.74	305.34	1106.83		948.61	648.61	570.99	326.52	1154.45	
Mean	203.58	41.32	30.45	17.96	65.11		55.8	38.15	33.59	19.21	67.91	

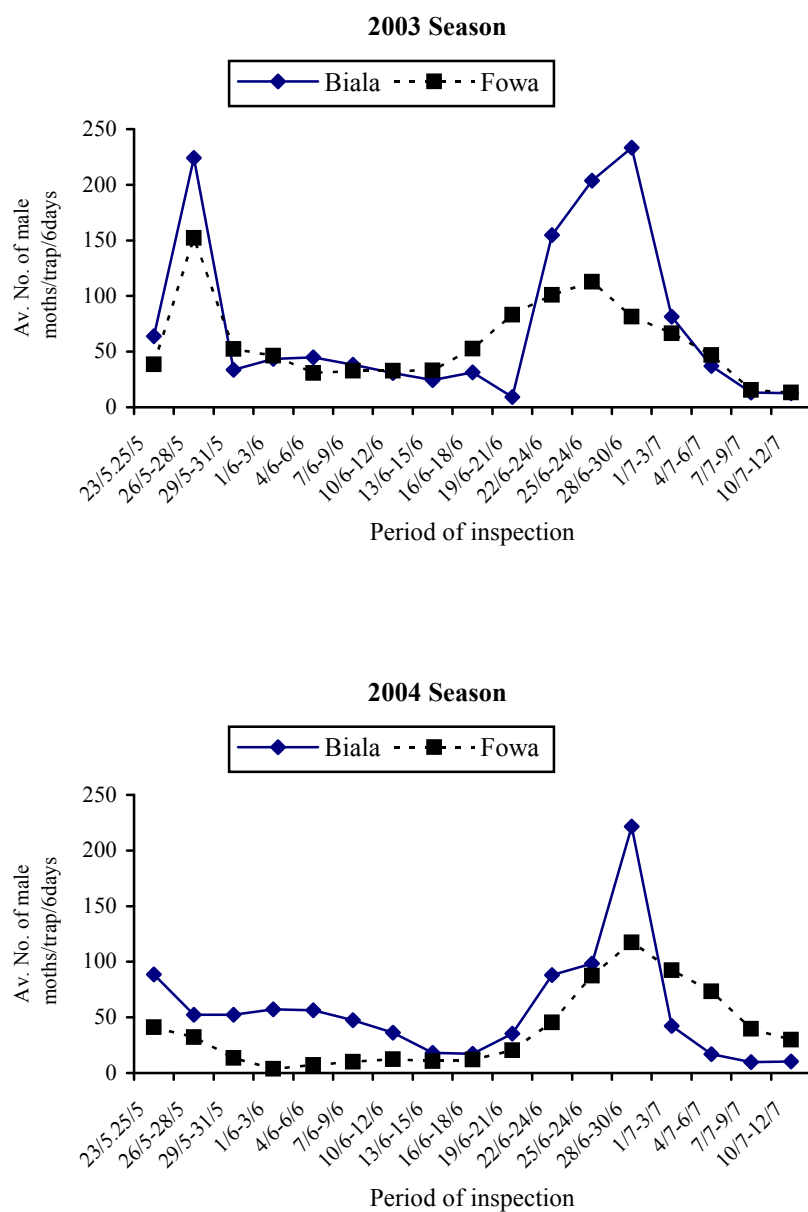


Fig. (5 & 6): Average number of Egg-masses of the cotton leafworm in cotton fields at two districts Biala & Fowa, Kafr El-Sheikh Governorate during 2003 & 2004 seasons.

Table (4): Average number of egg-masses of the cotton leafworm with average weather conditions in cotton fields at Dakahlia Governorate during 2003-2004 cotton seasons.

Period of inspection	2003					2004				
	Average No. of Egg masses/ Day/ feddan		Average of weather factor		Average No. of Egg masses/ Day/ feddan	Average of weather factor		Min.	Max.	R.H%
	Aga	ElSem*	Min.	Max.		Min.	Max.			
May 21-23	43.66	36.66	31.76	16.56	72.0	96.5	33.33	17.93	33.33	70.97
24-26	52.33	45.33	32.03	18.08	82.66	71.5	33.65	19.5	33.65	65.3
27-29	33.66	26.6	31.2	17.93	41.33	72.83	33.0	19.03	33.0	62.66
30-1/6	19.66	14.66	18.64	17.43	56.0	72.16	34.1	20.5	34.1	64.2
June 2-4	71.33	36.33	32.4	17.43	43.33	72.66	35.66	20.8	35.66	64.0
5-7	87.66	55.33	32.73	18.43	65.66	59.66	34.5	20.25	34.5	66.1
8-10	101.33	34.66	33.16	19.23	98.0	71.83	34.0	20.83	34.0	66.3
11-13	97.33	22.0	34.4	19.7	113.66	72.33	32.1	20.93	32.1	68.1
14-16	73.0	15.66	34.86	20.37	99.33	73.83	32.5	21.66	32.5	68.9
17-19	115.33	13.33	32.8	18.86	75.0	78.33	32.7	22.0	32.7	69.5
20-22	174.0	14.66	32.0	19.7	119.66	78.0	32.5	22.08	32.5	69.0
23-25	211.66	19.33	33.46	20.73	133.0	80.50	34.1	22.5	34.1	67.3
26-28	266.33	51.66	33.0	22.66	141.66	81.66	34.3	22.7	34.3	67.9
29-1/7	71.66	52.0	33.06	22.93	186.33	77.66	34.5	22.8	34.5	96.3
July 2-4	22.33	13.0	33.8	20.83	50.0	77.0	34.0	22.1	34.0	69.9
5-7	17.0	6.33	35.77	22.03	21.33	80.0	35.0	24.1	35.0	74.1
Total	1458.27	456.94	528.29	314.11	1398.95	1189.45	539.94	339.71	539.94	1083.63
Mean	91.14	28.56	33.02	19.63	87.43	74.34	33.75	21.23	33.75	67.73

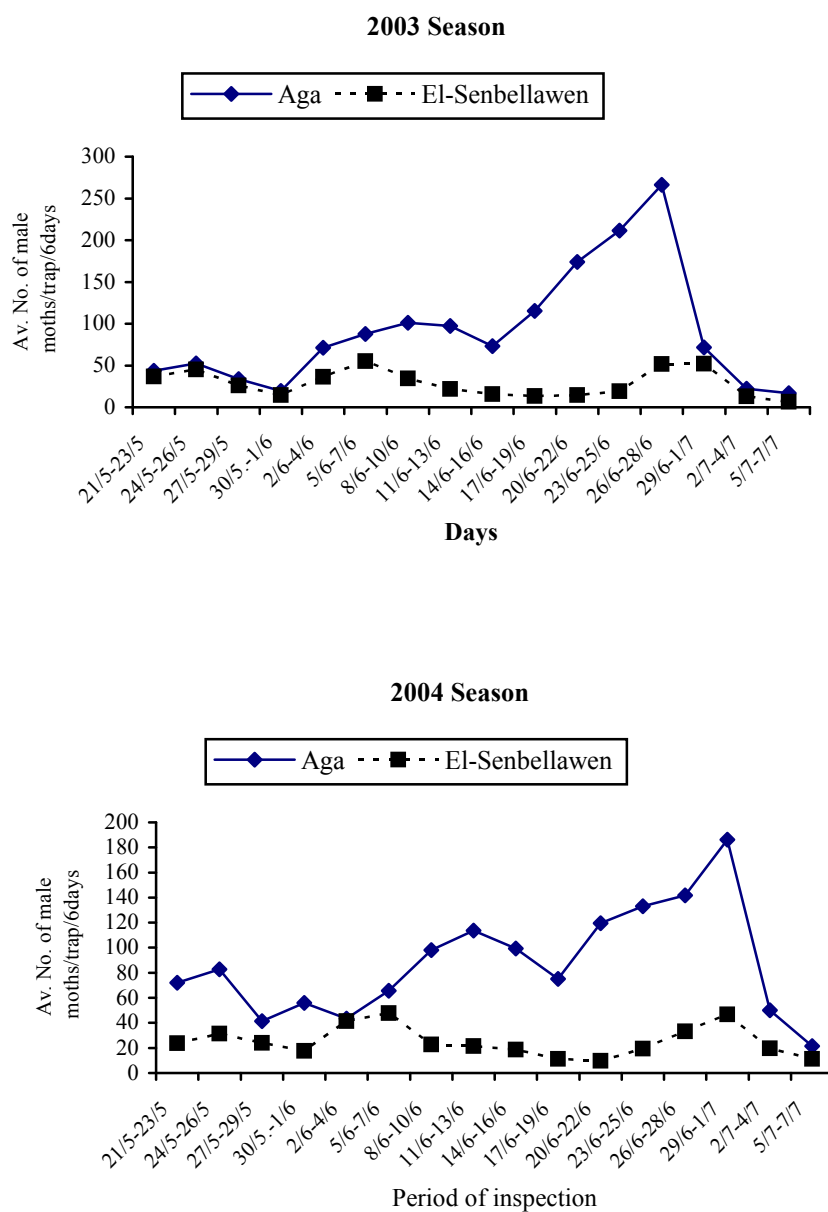


Fig. (7 & 8): Average number of Egg-masses of the cotton leafworm in cotton fields at two districts Aga & El-Senbellaween, Dakahlia Governorate during 2003 & 2004 seasons.

Table (5): Effect of temperature (maximum and minimum) and relative humidity on *S. littoralis* male moths population during 2003-2004 cotton seasons at Kafr El-Shikh and Dakahlia Governorates.

Season and district	Weather Factor	Mean of weather factor	Mean of male / Trap	B	S.E	2 R	E.V (%)	F
Kafr El-shikh governorate	Biala 2003	Max temp c Min temp c R.H%	32.11 19.04 66.63	6.94	-1.889 0.953 0.174	0.558 0.420 0.168	28.4%	** 3.909
	Fowa 2003	Max temp c Min temp c R.H%	32.11 19.04 66.63	9.78	-1.582 1.514 0.198	0.880 0.663 0.265	24%	** 2.002
	Biala 2004	Max temp c Min temp c R.H%	33.24 18.72 68.59	6.28	7.675 -3.026 0.419	0.842 0.700 0.178	47.9%	** 5.830
	Fowa 2004	Max temp c Min temp c R.H%	33.24 18.72 68.59	7.6	-0.936 1.512 -6.030	0.904 0.751 0.191	38%	** 3.879
	Aga 2003	Max temp c Min temp c R.H%	32.01 19.48 74.58	26.95	-0.290 3.405 -1.494	7.837 5.909 1.384	5.9%	0.415
	Elsen* 2003	Max temp c Min temp c R.H%	32.01 19.48 74.58	7.5	1.011 -0.361 -0.512	2.265 1.707 0.400	12.8%	* 0.976
	Aga 2004	Max temp c Min temp c R.H%	32.47 20.09 66.31	24.59	-12.665 9.213 -1.574	6.141 3.649 1.424	26.6%	** 2.421
	Elsen	Max temp c Min temp c R.H%	32.47 20.09 66.31	8.37	-4.845 3.274 -0.603	2.315 1.376 0.537	26.5%	** 2.408
Dakahlia governorate	B = Multiple regression.							
	S.E = Standard error of regression coefficient.							
	R ² = Determination coefficient.							
	E.V% = Percentages of explained variance.							
	* = Significant at 0.05 probability level.							
	** = Highly significant at 0.05 probability level.							

Table (6): Effect of temperature (maximum and minimum) and relative humidity on *L. littoralis* egg masses during 2003-2004 cotton seasons at Kafr El-Shikh and Dakahlia Governorates.

Season and district	Weather factor	Mean of weather factor	Mean of egg masses/ feddan	B	S.E	χ^2 R	E.V (%)	F
Kafr El-shikh governorate	Biala 2003	Max temp.c Min temp.c R.H%	203.58 17.96 65.11	-17.951 21.360 -0.158	13.676 17.890 6.466	0.160	16%	0.824*
	Fowa 2003	Max temp.c Min temp.c R.H%	41.32 17.96 65.11	-6.336 4.693 0.709	7.124 9.319 3.368	0.065	6.5%	n 0.302
	Biala 2004	Max temp.c Min temp.c R.H%	55.80 19.21 67.91	-6.138 -5.937 -0.311	10.778 11.614 5.499	0.129	12.9%	n 0.0640
	Fowa 2004	Max temp.c Min temp.c R.H%	38.15 19.21 67.91	-8.788 -2.976 6.740	6.630 7.144 3.383	0.286	28.6%	** 1.733
	Aga 2003	Max temp.c Min temp.c R.H%	91.14 19.63 74.34	-17.542 3.037 10.852	17.383 17.165 6.841	0.370	37%	** 2.334
	Elsen* 2003	Max temp.c Min temp.c R.H%	28.56 19.63 74.34	-9.368 9.500 -3.554	3.585 3.541 1.411	0.476	47.6%	** 3.632
Dakahlia governorate	Aga 2004	Max temp.c Min temp.c R.H%	87.43 21.23 67.73	-13.915 12.759 -2.585	12.197 8.961 4.725	0.182	18.2%	* 0.888
	Elsen	Max temp.c Min temp.c R.H%	24.97 21.23 67.73	6.823 -1.694 -0.893	2.804 2.060 1.086	0.425	42.5%	** 2.957

B = Multiple regression.

S.E = Standard error of regression coefficient.

R² = Determination coefficient.

E.V% = Percentages of explained variance.

* = Significant at 0.05 probability level.

** = Highly significant at 0.05 probability level.

47.9 %, 38 % of the population changes of the cotton leafworm in case of Biala and Fowa districts, in both seasons, respectively. In case of Aga and El-Senbellaween districts, the changes of population were 5.9 %, 12.8 % and 26.6 %, 26.5 % in both seasons, respectively. On the other hand, the multiple analysis revealed that the joint effect between the some factors and cotton leafworm egg-masses responsible for 16 %, 6.5 % and 12.9 %, 28.6 % in case of Biala and Fowa districts and it responsible for 37 %, 47.6 % and 18.2 % , 42.5 % in Aga and El-Senbellaween districts in 2003 and 2004 cotton seasons (Table 6). Results agree with those obtained by Champion *et al.* (1974) and Murlis *et al.* (1982). They indicated that the impact of relative humidity and temperature had a significant effect on *S. littoralis* catches in pheromone baited traps. El-Zanan and El-Hawary (1995) and El Mezayyen *et al.* (1997) attributed the differences of the recorded populations of *S. littoralis* moth in pheromone baited traps to the effect of temperature and relative humidity.

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