SEX PHEROMONE TRAPS AS A TOOL FOR SUPPRESSION OF INFESTATION WITH COTTON LEAFWORM, *SPODOPTERA LITTORALIS* IN COTTON FIELDS.

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Abstract

The effective number of pheromone traps used per feddan to keep the cotton leafworm *S.littoralis* infestation below its economic injury level was conducted using three rates of traps; one, two, and three traps/feddan for two successive seasons 1996 and 1997 in three Governorates; Sharkia, Menoufyia and Fayoum. Results could be summarized in the following:

1. In most cases there is a positive relationship between numbers of captured male moths and the numbers of pheromone traps set up in cotton fields.
2. The rate of 3 traps/feddan was significantly preferred than in the two other rates.
3. No significant relationship was found between population of egg-masses in cotton fields and numbers of attracted male moths.
4. Pheromone traps caused a decrease in hatchability percent of egg-masses. Rate of reduction was somewhat low in case of the high population of adult moths.
5. Pheromone traps cannot be used alone in controlling this insect on cotton in case of sever infestation, but it could be used within I.P.M. programme to apply insecticides in the suitable time.

INTRODUCTION

Many problems appeared as a result of using insecticides against the cotton leafworm *S.littoralis*. One of the most important is its highly expensive to the farmers, as well as its toxic effect to man, animals, plants and environment pollution. Few years ago, scientists began to formulate chemically the female mating odor. The synthetic pheromone was used as a biological control to avoid the above problems. The formulated pheromone was used in capsules hanged in different types of traps and/or a W.P. sprayed on plants. The formulated pheromone was synthesized by Nesbitt *et al* (1973) and Hall *et al.* (1975). These components have been field-tested in Cyprus, Crete by Campion (1972 and 1976) and Compion *et al.* (1974a). He

reported that sex pheromone may be used for the control of insect pests by causing communication disruption for long time enough to decrease mating and, therefore, diminish subsequent larval infestation. Kehat *et al.* (1976) tested a similar formulation in Israel.

Campion *et al.* (1980) and Kehat and Dunkelblum (1993) developed the minor sex pheromone component by adding some chemical compounds to modify its attractiveness. Catches were increased by the new pheromone component. The relationship between physical factors and the movement of *S.littoralis* moths depending on male catches in pheromone traps was studied by Campion *et al.* (1974b) and Nasr *et al.* (1984) whom used pheromone traps to investigate not only the seasonal variation of *S.littoralis* moth numbers as shown by catches, but also the possibility that migration occurs. El-Deeb (1988) proved that the attracted male moths increased in June and reached the maximum peak at 22-24 June followed by great depression due to the end of the 1st generation. Another peak, but in lower number occurred at 21-23 July. Ahmed (1988) in Iraq studied the seasonal flight of cotton leafworm, *S.littoralis* by using pheromone traps in vegetable crops. Data from moth catches indicated many peaks of adult flight during the study periods. Pheromone mass trapping in control insects was discussed by Ingram (1975) in Cyprus and Teich *et al.* (1979 and 1985) in Israel. In Egypt, Hosny *et al.* (1979) attempted to control the cotton leafworm *S.littoralis* by using pheromone traps with the rate of 3 traps/ha. The results they have obtained on the reduced egg mass counts were not conclusive enough to indicate a significant degree of control. Radwan (1985) presented that pheromone traps caused an average reduction of about 56% in the number of egg-masses collected. In this respect, El-Deeb (1988) found that field containing 3 pheromone traps/fed. gave overall reduction in the number of egg-masses collected compared with the control area without traps. He also added, that for every 21 male moths captured there is a reduction of about 10 egg-masses/fed. and the early trapping in clover plantations contributed much in reducing egg-masses population in cotton fields. Salem *et al.* (1995) used sex pheromone traps as an early warning and monitoring system of *S.littoralis* adult moth populations in soyabean cultivation and subsequent selection of the most appropriate time for *Bacillus thuringiensis* application to control the larvae.

Therefore, it became necessary to carry out experiments on the suitable number of pheromone traps which attract significantly more male moths and in the meantime suppress mating and reduce both of egg-mass counts and hatchability percent.

MATERIALS AND METHODS

Three cotton fields, one feddan each, were chosen in three different localities; Ibrahymia (Sharkia Gov.), Menouf (Meoufyia Gov.) and (Fayoum Gov.) to carry out this experiment during 1996 and 1997 cotton seasons.

Pheromone traps of the circular tray type were set up in the experimental area at the rate of: one trap, two traps and three traps/feddan. Every trap was mounted on a metal stand about 100-120 cm. length above the ground level. Each trap was provided with pheromone capsule to attract male moths and enough soapy water to use as a killing agent. Traps were examined every 3 days and the captured males were counted and the soapy water was renewed. Old capsules were replaced by fresh ones within 15-20 days. Pheromone traps were set up in the experimental area from June to September 1996 and from May to mid-September in Fayoum Gov. and till the end of September in the other Governorates in 1997 season.

To study the relationship between numbers of male moths attracted to different rates of traps per feddan and numbers of population of egg-masses laid on cotton plants and their vitality, an area of one feddan of cotton was left without any pheremone traps as a check besides the mentioned three tested fields in every Province. Through June and during the 1st generation of the cotton leafworm *S.littoralis* occurs, (Bishara 1934) cotton plants of the four tested fields were examined carefully every three days and the egg-masses were picked up, counted and transferred to the laboratory until hatching. About one hundred batches were selected at random to follow rate of hatchability. Records of counted egg-masses as well as hatched ones and population figures obtained from every Governorate were kept. Statistical analysis was conducted to find out any correlation between numbers of captured males and three days before collecting egg-masses. This period could be sufficient for males to copulate with the females before dropping in the traps taking into consideration the tested numbers of pheromone traps/feddan set up in each treatment.

RESULTS AND DISCUSSION

A. The suitable number of pheromone traps used per feddan.

1996 season

Data of various inspections as well as the daily average numbers of captured male moths/month by the three different rates of traps/feddan were represented in

Table 1. The initial observations indicated that a positive and significant relationship exists between the number of captured males and the number of traps used/feddan during the experimental season in all the tested localities. Also, it was found that the least daily average number of male catch was obtained in July and this may be due to insecticide application done during this month and/or due to the end of the 1st generation and the beginning of the 2nd one, but in lower numbers.

Sharkia Governorate: It appears from Table 1 that the daily average numbers of captured males at the rates of 1,2 and 3 traps/fed. were nearly the same in June and September. The means were 3.83, 8.23 and 12.77 males in June and 3.77,8.3 and 12.97 males in September for one, two and three traps/fed., respectively. The daily average number of captured males obtained in July (1.48,2.35 and 3.48) compared to that in June (3.83, 8.23 and 12.77) corresponded to 61.4%, 71.4% and 72.7% reduction in case of 1,2 and 3 traps/feddan. Regardless the number of traps used per feddan, no significaant differences were observed in male catch numbers during June, August and Septmber, while they differ significantly from those obtained in July taking into consideration the rates of traps/fed. Statistical analysis revealed highly significant differences (F = 38.6**) in the mean number of male catches.

Menoufyia Governorate: Generaly, during the whole seasons, the total number of male moths attracted to the pheromone traps tested with different rates are comparatively lower than that obtained in Sharkia Gov. As shown in Table 1, the increasing male catch alongside the increasing in number of traps/fed. were changeable from one month to another. This fluctation might be due to the size of population in the fields. June showed the highest daily average catch of 4.67, 7.3 and 12.33 males with the corresponding rates of 1,2 and 3 traps/feddan. The differences in total number of captured males in June on one hand and the three months; July, August and September on the other hand was highly significant from the statistical point of view.

Fayoum Governorate: The highest population of male moths attracted to the pheromone traps during 1996 season was obtained from this Province. A total of 4936 males were captured by all the testd traps. Out of these 705 (14.3%), 1724 (34.9%) and 2507 (50.8%) moths were attracted to the traps by the rates of 1,2 and 3 traps/fed., respectively. This means that half of the collective male moths was obtained by the highest rate of 3 traps/feddan.

Dancan's Multiple Range Test for data of the three Governorates indicate that June differ significantly from the other months in the numbers of trapped males and this perhaps is due to the size of dynamic population of the 1st generation of *S.littoralis* on cotton. This result is in agreement with the findings stated by El-Deeb (1988).

Inspite of the fact that using three traps/fed. attracted the largest numbers of males and one trap only/fed. caught the smallest numbers, while two traps/fed. ranked an intermediate position, yet results revealed insignificant differences between them in the catch during June. We could conclude that the relative efficiency of different rates of traps per feddan in attracting various numbers of male moths, depends on the abundance of *S.littoralis* moths in cotton fields.

1997 season

Number of male moths caught by different rates of traps/fed. every insepection and the dialy mean numbers per month during 1997 cotton season are shown in Table 2 for the three mentioned Governorates.

As recorded in 1996 season, using 3 traps/feddan revealed largest numbers of male moths, while two and one trap/fed. gave less numbers. The percentage of increasing varied from one locality to another and from month to another according to the size of population in the fields.

Sharkia Governorate: Statistical analysis showed significant differences between the tested rates of traps (F = 4.86**) and also between various months (F=17.35**) according to average numbers of trapped males. As to the mean number of male catch/month (regardless the rate of traps/fed.), the L.S.D. value put June in one group (116.47 males a), September (45.53 males b) and August (20.27 males bc) and at last both of July and May in another group (15.8 and 10.8 males, respectively c).

Menoufyia Governorate: Data in Table 2 indicate that the catch in the rate of one trap/fed. was relatively lower than that recorded in case of two traps/fed., but insignificantly different from one trap/fed. trial. The monthly catch in May, August and September wre 7.8,9.1 and 12.1, respectively without evident significant differences between them.

Fayoum Governorate: Although the size of population prevailing in cotton fields

during this season was noticeable low in comparison with the previous season, yet the three traps/fed. treatment caught the highest number of males (46.3 males a) followed by two traps/fed. (32.5 males b), then the catch in one trap/fed. (17.1 males c) which attracted the least number of males (F = 26.3**).

Reviewing the obtained results of the two successive seasons, it could be stated that captured male moths tended to increase as the number of sex pheromone traps increase. The trap density proved to have good role in minimizing the population of *S.littoralis*. Setting up three pheromone traps/fed. in cotton fields could certainly make some depression in the male moths population. The rate of depression could serve in keeping infestation of this insect below its economic injury level which lead to lessen to a reasonable extent using insecticides.

B. The relationship between population of egg-masses laid by *S.littoralis* females on cotton fields, rate of hatchability and numbers of attracted male moths in case of one, two and three pheromone traps/feddan.

As shown in Tables 3 & 4 during 1996 and 1997 seasons in the three tested Governorates, and from the statistical point of view "r" values for the correlation between captured male moths attracted to pheromone traps at the different rates of pheromone traps and number of collected egg-masses in the fields under test were changeable and sometimes positive and on the other hand negative and always insignificant except in case of Sharkia Gov. when one trap/fed. was used in 1997 season. This finding is on the contrary with the results obtained by Radwan (1985).

On the other hand, Table 5 showed the total number of egg-mass population in the experimental area during June and its hatchability percent with the corresponding reduction in hatchability rate in case of using various rates of pheromone trapes/fed. in comparison with untrapped area. Data revealed that the rates of reduction were almost low especially with high infestation. Using pheromone traps at the rate of 3 traps/fed. resulted in 1.28%, 8.46% and 25.17% reduction in hatchability percent in Sharkia, Fayoum and Menoufyia, respectively during June 1996, while these percentages reached 0.29, 7.39 and 29.2 in the next season.

These results clarify that captured male moths by three pheromone traps/fed. did not evidently influence on egg hatching especially in heavy infestation especially in open area, whereas males could easily came from outside the area and copulate with the females which lay fertilized eggs. In other words, it seems that spreading

sex pheromone traps allover cotton plantations and any other surrounding host plants in the locality (mass trapping) would serve in decreasing the population of the male moths in the fields, as a result the females would fail to meet with males and hence no mating could be achieved and the hatchability percent will decrease. On the other hand, the control of this insect by using pheromone mass trapping is, therefore, recommended as a possible approach to provide the basic information for large scale programs to avoid chemical control and to decrease environmental pollution.

Table 1. Total number of *S.littoralis* male moths attracted to different rates of traps/feddan in each inspection, in the three tested Governorates, 1996 season.

No. of traps / feddan	No. of males attracted to the traps														
	Sharkia Gov.				Grand total	Menoufyia Gov.				Grand total	Fayoum Gov.				Grand total
	June	July	Aug.	Septe.		June	July	Aug.	Septe.		June	July	Aug.	Septe.	
One trap	16	10	27	22		14	10	3	12		69	32	8	9	
	22	7	21	15		30	11	6	6		42	10	4	2	
	23	5	14	18		40	4	9	15		61	15	3	3	
	20	6	26	38		33	3	13	4		200	13	2	_	
	34	18	26	20		23	2	4	7		200	23	9	_	
Total	**115**	**46**	**114**	**113**	**388**	**140**	**30**	**35**	**44**	**249**	**572**	**93**	**26**	**14**	**705**
Daily av.	**3.83**	**1.48**	**3.68**	**3.77**		**4.67**	**0.97**	**1.13**	**1.47**		**19.07**	**3**	**0.84**	**0.74**	
Two traps	56	10	39	35		39	56	4	18		138	67	16	30	
	52	14	39	48		47	26	9	14		52	21	3	14	
	42	9	28	71		42	6	10	19		175	13	7	5	
	46	15	30	54		58	3	18	5		724	22	2	_	
	51	25	40	41		33	2	6	8		393	33	9	_	
Total	**247**	**73**	**176**	**249**	**745**	**219**	**93**	**47**	**64**	**423**	**1482**	**156**	**37**	**49**	**1724**
Daily av.	**8.23**	**2.35**	**5.68**	**8.3**		**7.3**	**3**	**1.52**	**2.13**		**49.4**	**5.03**	**1.19**	**2.58**	
Three traps	110	17	87	66		64	77	4	25		157	76	30	22	
	62	15	56	75		65	47	15	20		175	46	10	19	
	68	16	75	97		80	16	13	36		225	45	12	4	
	57	20	58	73		108	4	20	12		916	48	13	_	
	86	40	59	78		53	2	9	17		602	86	21	_	
Total	**383**	**108**	**335**	**389**	**1215**	**370**	**146**	**61**	**110**	**687**	**2075**	**301**	**86**	**45**	**2507**
Daily av.	**12.77**	**3.48**	**10.81**	**12.97**		**12.33**	**4.71**	**1.97**	**3.67**		**69.17**	**9.71**	**2.77**	**2.36**	
"F" values for traps	**38.6*****					**11.9*****					**10.2*****				
"F" values for months	**20.4*****					**22.8*****					**41.7*****				

– No traps were existed in this period of the month

Table 2. Total number of *S.littoralis* male moths attracted to different rates of traps/feddan in each inspection, in the three tested Goverorates, 1997 season.

No. of traps / feddan	Sharkia Gov.					Grand total	Menoufyia Gov.					Grand total	Fayoum Gov.					Grand total
	May	June	July	Aug.	Septe.		May	June	July	Aug.	Septe.		May	June	July	Aug.	Septe.	
One trap		18	0	10	45			7	13	4	10		15	23	20	22	9	
	17	90	17	7	33			16	11	10	8		11	30	13	17	11	
	10	135	12	6	21		7	12	2	4	7		15	29	8	25	3	
	3	48	6	8	12		6	14	8	3	15		18	18	16	17		
	6	20	5	24	20		11	3	0	7	12		34	24	29	20		
Total	**36**	**311**	**40**	**55**	**131**	573	**24**	**52**	**34**	**28**	**52**	190	**93**	**124**	**86**	**101**	**23**	427
Daily av.	**1.7**	**10**	**1.3**	**1.8**	**4.37**		**1.6**	**1.7**	**1.1**	**0.9**	**1.73**		**3**	**4.1**	**2.8**	**3.3**	**1.53**	
Two traps		77	3	13	63			4	10	6	16		26	61	53	40	10	
	10	145	19	11	50			22	2	15	5		27	31	47	27	16	
	9	226	28	22	42		9	17	0	10	7		49	29	17	25	13	
	8	118	17	12	46		11	17	4	7	9		60	48	32	16		
	20	20	19	40	31		18	6	7	6	16		66	62	37	21		
Total	**47**	**586**	**86**	**98**	**232**	1049	**38**	**66**	**23**	**44**	**53**	224	**228**	**231**	**186**	**129**	**39**	813
Daily av.	**2.2**	**20**	**2.8**	**3.2**	**7.73**		**2.5**	**2.2**	**0.7**	**1.4**	**1.77**		**7.4**	**7.7**	**6**	**4.2**	**2.6**	
Three traps		16	2	21	66			14	8	9	23		23	92	56	60	23	
	15	200	23	17	66			41	8	9	14		23	66	53	51	26	
	21	291	23	25	65		14	39	0	19	8		72	54	24	40	18	
	25	276	38	24	73		15	27	0	6	10		77	52	43	36		
	18	67	25	64	50		26	28	11	21	21		96	90	49	34		
Total	**79**	**850**	**111**	**151**	**320**	1511	**55**	**149**	**27**	**64**	**76**	371	**291**	**354**	**225**	**221**	**67**	1158
Daily av.	**3.8**	**28**	**3.6**	**4.9**	**10.67**		**3.7**	**5**	**0.9**	**2.1**	**2.53**		**9.4**	**12**	**7.3**	**7.1**	**4.47**	
"F" values for traps	**4.86****						**8.76****						**26.31****					
"F" values for months	**17.35****						**7.91****						**15.92****					

– No traps were existed in these periods of the months

Table 3. Correlation between numbers of *S.littoralis* male moths attracted to pheromone traps and numbers of egg-masses collected from cotton fields (1996 season).

No. of Inspections	No. of traps / feddan ·																	
	Sharkia Gov.						Menoufyia Gov.						Fayoum Gov.					
	1		2		3		1		2		3		1		2		3	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
1	8	39	35	48	69	36	20	3	37	5	45	2	54	37	111	269	84	200
2	8	36	21	33	41	28	25	7	24	2	47	1	58	13	97	120	111	62
3	10	43	25	26	32	42	15	2	18	0	33	0	11	245	41	312	46	190
4	12	35	27	42	30	23	13	6	30	4	65	0	24	133	18	286	91	151
5	10	39	20	27	37	41	20	4	28	2	43	3	18	391	34	263	84	235
6	13	44	22	42	31	41	15	4	28	7	40	5	33	211	39	224	78	188
7	10	36	20	41	18	16	8	3	5	2	13	1	28	111	136	198	147	145
8	10	35	26	28	39	24	8	3	19	5	30	2	42	15	490	107	547	208
9	20	28	25	18	47	15	1	2	35	2	45	3	158	34	234	65	369	110
Average	11.2	37.2	24.6	33.9	38.2	29.6	13.9	3.8	24.9	3.2	40.1	1.9	47.3	132.2	133.3	204.9	173	165.4
r-values	-0.5511		+ 0.3477		+ 0.1794		+ 0.5996		+ 0.4822		+ 0.1747		− 0.5078		− 0.5277		− 0.0184	

a = No. of captured males
b= No. of collected egg-masses

Table 4. Correlation between numbers of *S.littoralis* male moths attracted to pheromone traps and numbers of egg-masses collected from cotton fields (1997 season).

No. of Inspections	No. of traps / feddan																	
	Sharkia Gov.						Menoufyia Gov.						Fayoum Gov.					
	1		2		3		1		2		3		1		2		3	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
1	4	8	13	5	9	6	7	10	11	7	6	21	13	25	16	50	11	36
2	3	40	14	71	6	52	4	4	4	7	5	5	5	30	16	71	13	42
3	15	520	63	420	10	390	3	12	0	10	9	10	17	50	12	40	24	60
4	30	830	40	750	120	657	9	5	13	10	21	12	17	160	19	90	11	35
5	60	1275	105	1120	80	1300	7	7	9	8	20	10	14	350	15	105	19	75
6	90	1100	101	920	131	1120	5	10	12	12	15	12	9	120	16	125	23	130
7	45	1520	125	1450	160	1320	7	10	5	10	24	12	16	140	8	110	12	95
8	36	740	92	690	230	780	5	12	12	8	19	10	14	120	7	132	15	75
9	12	870	26	920	46	1100	9	8	5	5	8	10	16	300	9	150	12	200
10	8	520	10	450	38	510	3	3	3	3	16	5	13	258	11	125	6	117
Average	30.3	742.3	58.9	679.6	83	723.5	5.9	8.1	7.4	8	14.3	10.7	13.4	155.3	12.9	99.8	14.6	86.5
r-values	+ 0.7444*		+ 0.4354		+ 0.5881		− 0.0138		+ 0.3571		− 0.0698		+ 0.3315		− 0.4831		− 0.0301	

a = No. of captured males
b= No. of collected egg-masses

Table 5. Effect of using pheromone traps with different rates per feddan on the prcentage of egg hatchability during June 1996 and 1997 in the tested Governorats.

Gov.	No. of traps / feddan	1996			1997		
		Total no. of egg-masses	% Hatchabilily	% reduction in egg hatching	Total no. of egg-masses	% Hatchabilily	% reduction in egg hatching
Sharkia	1	335	95.18	0	7423	96.61	0.34
	2	305	92.9	0.62	6796	96.89	0.05
	3	266	92.28	1.28	7235	96.66	0.29
	Check (without traps)	316	93.48		7597	96.94	
Menoufyia	1	34	82.41	11.43	81	73.55	22.7
	2	29	80.71	13.26	80	73.98	22.2
	3	17	69.63	25.17	107	67.35	29.2
	Check (without traps)	40	93.05		146	95.13	
Fayoum	1	1190	90.18	5.91	1553	94.4	0.464
	2	1844	90.66	5.4	998	87.95	7.26
	3	1489	87.73	8.46	865	87.83	7 39
	Check (without traps)	2111	95.84		2237	94.84	

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استخدام مصائد الفرمون كوسيلة لخفض الاصابة بدودة ورق القطن في حقول القطن

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تناولت الدراسة استخدام ثلاث معدلات من المصايد الجاذبة الجنسية لذكور فراشات دودة ورق القطن في الفدان وهي : مصيدة ، مصيدتين ، ثلاثة مصايد / الفدان وذلك خلال موسمين ١٩٩٦ ، ١٩٩٧ في ثلاث محافظات : الشرقية والمنوفية والفيوم .

أوضحت النتائج المتحصل عليها ما يلي :-

١- توجد علاقة موجبة بين أعداد ذكور الفراشات المنجذبة للمصائد وبين العدد المستخدم من المصايد الجاذبة الجنسية / الفدان. أظهرت النتائج أن ثلاثة مصايد للفدان أفضلية واضحة في جذب الذكور عن المعدلين الاخرين المستخدمين .

٢- أظهرت الدراسة عدم وجود علاقة محددة بين كل اعداد الذكور المنجذبة للمصايد الجاذبة الجنسية بمعدلاتها المختلفة وبين أعداد اللطع الموجودة في الحقل، في حين أ ن وجود هذه المصايد أدي الي خفض النسبه المئوية للفقس في اللطع وان كان معدل هذا الخفض يتأثر سلبيا بزيادة التعداد العام للفرشات بالمنطقة .

٣- أوضحت الدراسة أنه لا يمكن الاعتماد علي مصايد الفرمون وحدها كوسيلة لمكافحة حشرة دودة ورق القطن خصوصافي حالات الاصابة الشديدة بل إن أستخدامها يمكن أن يكون داخل برنامج المكافحة المتكاملة كوسيلة للتنبؤ بمستوي الاصابة المتوقع ولتحديد الوقت المناسب لاستعمال المبيدات وبذلك يمكن تقنين استخدام هذه المواد السامة .

reported that sex pheromone may be used for the control of insect pests by causing communication disruption for long time enough to decrease mating and, therefore, diminish subsequent larval infestation. Kehat *et al.* (1976) tested a similar formulation in Israel.

Campion *et al.* (1980) and Kehat and Dunkelblum (1993) developed the minor sex pheromone component by adding some chemical compounds to modify its attractiveness. Catches were increased by the new pheromone component. The relationship between physical factors and the movement of *S.littoralis* moths depending on male catches in pheromone traps was studied by Campion *et al.* (1974b) and Nasr *et al.* (1984) whom used pheromone traps to investigate not only the seasonal variation of *S.littoralis* moth numbers as shown by catches, but also the possibility that migration occurs. El-Deeb (1988) proved that the attracted male moths increased in June and reached the maximum peak at 22-24 June followed by great depression due to the end of the 1st generation. Another peak, but in lower number occurred at 21-23 July. Ahmed (1988) in Iraq studied the seasonal flight of cotton leafworm, *S.littoralis* by using pheromone traps in vegetable crops. Data from moth catches indicated many peaks of adult flight during the study periods. Pheromone mass trapping in control insects was discussed by Ingram (1975) in Cyprus and Teich *et al.* (1979 and 1985) in Israel. In Egypt, Hosny *et al.* (1979) attempted to control the cotton leafworm *S.littoralis* by using pheromone traps with the rate of 3 traps/ha. The results they have obtained on the reduced egg mass counts were not conclusive enough to indicate a significant degree of control. Radwan (1985) presented that pheromone traps caused an average reduction of about 56% in the number of egg-masses collected. In this respect, El-Deeb (1988) found that field containing 3 pheromone traps/fed. gave overall reduction in the number of egg-masses collected compared with the control area without traps. He also added, that for every 21 male moths captured there is a reduction of about 10 egg-masses/fed. and the early trapping in clover plantations contributed much in reducing egg-masses population in cotton fields. Salem *et al.* (1995) used sex pheromone traps as an early warning and monitoring system of *S.littoralis* adult moth populations in soyabean cultivation and subsequent selection of the most appropriate time for *Bacillus thuringiensis* application to control the larvae.

Therefore, it became necessary to carry out experiments on the suitable number of pheromone traps which attract significantly more male moths and in the meantime suppress mating and reduce both of egg-mass counts and hatchability percent.