INFESTATION WITH COTTON LEAFWORM AND BOLLWORMS IN RELATION TO PHEROMONE AND LIGHT TRAP CATCHES IN COTTON FIELDS

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Abstract

The present study was conducted at Sakha Agricultural Research Station during 1994 and 1995 cotton seasons. The relationship between cotton leafworm and bollworms population and field infestations was investigated. Adult populations of *Spodoptera littoralis, Pectinophora gossypiella* and *Earias insulana* were more attracted to pheromone traps than to light traps. From the total catch, pheromone baited traps attracted 76.38, 78.74 and 93.46, respectively, in 1994. On the second season 1995 they attracted 76.39, 88.12 and 61.98% of adults of the three pests, respectively. Also, they better detect pest population particularly early in the growing season. A week correlation between *S.littoralis* adult catch and egg deposition were computed in spite of high adult catch by both types of traps.

Bollworms adult population progressively increased toward late summer and early fall and then declined, but field infestation consistently increased due to cumulation of larvae. Correlation coefficient values (r) between % infestation and trapped adults of *P.gossypiella* by light and pheromone traps were 0.41 and 0.91 in the first season. Similar trend was noticed during the second one for light-trapped adults, but not for the pheromone trapped ones.

The correlation values between % infestation of *E.insulana* and number of trapped adults were higher in pheromone traps than light traps.

In conclusion, as number of field adults fluctuates and pest depends on many factors, direct examination of cotton fields is a must to detect population changes, consquently timing of insecticide application, if any is required.

INTRODUCTION

In Egypt and world wide as well, there is a growing public concern about environmental pollution which is induced by excessive use of insecticides. Cotton is subjected to pests attacks which required excessive use of insecticides to protect the crop. In order to wise use pesticides, timing the insecticidal applications based on field population levels will minimize farmer's risk, reduce cost and save the environment.

Sex pheromones are utilized in monitoring and estimating insect populations and relating such levels to field infestations and damage. This technique 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). Nasr et al. (1984) suggested that populations of *Spodoptera 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), (3) to conserve populations of beneficial arthropods in pheromone treated areas than those treated with broad spectrum insecticides (Al-Adl et al., 1988) and (4) to increase honey production as it was noticed when incorporation of pheromone treatments in cotton pest management to programme (Moawad et al., 1991).

Relating field population levels of major cotton pests with their subsequent damages would eventually lead to a better pest management programs.

The objectives of the current investigation are:

1. Establishment of the relationships between adult population of the cotton leafworm, *Spodoptera littoralis* (Boisd.), (CLW) and its female oviposition activity in the field.
2. Relating field populations of the pink bollworm, *Pectinophora gossypiella* (Saunders), (PBW), and the spiny bollworm, *Earias insulana* (Boids), (SBW), with their field infestation percentages.
3. Comparison between light trap catches of the adults of the three pests and the pheromone-baited trap ones.

MATERIALS AND METHODS

This investigation was conducted at Sakha Agricultural Research Station Farm, Kafr El-Sheikh Governorate, during two successive cotton growing seasons, being 1994 and 1995. Cotton (Giza 85) was sown on April 14th in the first season and on March 27th in the second one. Plots of 1/50 feddan each received normal agricultural practices with no insecticidal treatments. The eggmasses of the cotton leafworm (CLW) were daily collected after 8.00 a.m. from the field and counted from the 4th of May till the 3rd of September in both seasons. The total numbers of

eggmasses were computed and expressed weekly as total per feddan. As cotton flower buds appeared, the infestation rates of the pink bollworm (PBW) and the spiny bollworm (SBW) were estimated weekly by examining a sample size of 100 bolls (25 bolls/plot). The collected bolls were dissected from late July until mid October of both seasons to determine the number of infested ones. Symptoms of infestation also included bolls containing larvae and those with holes or signs of larval penetration indicating damage of both species of bollworms, PBW and SBW.

The seasonal abundance of adult populations of CLW and SBW was studied by light and pheromone traps. Ultra-violet light trap (250 watt) was used from early May till the end of October. Traps were cleared every morning and the catch was sorted to species level and counted.

On the other hand, pheromone traps (Mcveigh et al., 1979) were placed 50 m apart, traps were situated little above cotton plants, and were progressively adjusted according to plant heights. Three pheromones were individually used. For *S.littoralis*, the pheromone was, (Z,E) 9,11 tetradecadien (-1-Y1 acetate). It was provided by the Tropical Products Institute, ODM, London. As for *P.gossypiella*, the pheromone commonly known as Gossyplure which is a mixture of (Nomate), (Z,Z)-7,11-Hexadecadin-1-10 acetate (3.8%) and (Z-E)7,11-Hexadecadin-1-10 acetate (3.8%). The spiny bollworm, *E.insulana* pheromone (E,E) 10, 12-Hexadecadienal was used. Pheromone capsules were replaced with fresh ones every 3 weeks. The captured moths were daily counted and removed from the traps. Data were statistically analyzed and simple correlation analysis was conducted, (Steel and Toree, 1960).

RESULTS AND DISCUSSION

A. The cotton leaf worm, *Spodoptera littoralis*

Results presented in Table 1 and graphically illustrated in Fig. 1-a revealed five adult population peaks of *S.littoralis* in both seaons (1994 and 1995). Those occurred on May 25, June 14, July 19, August 16 and September 6 of 1994. In 1995 season, they were recorded on May 18, June 21, July 5, August 30 and September 6. It is of interest that both light and pheromone trap catches peaked coincidentally, although the pheromone traps caught much higher numbers of moths than light traps. At the early portion of the season, the difference between catches of light and pheromone traps was obvious. During peak numbers, pheromone traps attracted 87.87% of the total catch during May peak and progressively declined to 61.73% during July peak of 1994. When dealing with the total catch of both traps on

monthly basis, the pheromone traps caught 85.38, 85.90, 90, 65.17, 69.68 and 69.09 percentages of the total adult *S.littoralis* during 1994 season. In 1995, similar trend was also noticed as the pheromone traps caught 70.07, 86.66, 82.22, 65.31 and and 58.43 percentages of the total adults trapped during May, June, July, August and September of 1995, respectively. The pheromone-baited trap caught 76.39% of the total moths trapped by the two kinds of traps during 1994 study season; being 12870. Almost, similar population proportion, 75.22%, was caught during 1995 season.

Eggmasses peaks of CLW were on June 21, July 12 and August 16 of 1994, while during 1995 season the highest peak extended from late June to early July. Another peak was also recorded on early August.

Table 1. Population size of the trapped moths of the cotton leaf-worm, *Spodoptera littoralis* by light and pheromone-baited traps together with egg deposition activities in a cotton field at Sakha, Kafr El-Sheikh Governorate during 1994 and 1995 cotton growing seasons.

Sampling date		1994			1995		
		Trap catch		Egg-masses	Trap catch		Egg-masses
		Light	Pheromone baited		Light	Pheromone baited	
May	11	56	210	0	163	314	0
	18	117	623	0	870	1604	0
	25	156	1130	0	305	732	0
	31	73	384	15	152	839	93
June	7	43	763	26	183	1073	160
	14	171	1219	42	257	1714	360
	21	144	737	244	267	2325	830
	28	133	290	75	187	696	2276
July	5	114	254	103	215	1823	1920
	12	157	308	208	191	848	200
	19	212	342	110	133	198	24
	26	139	260	112	27	112	131
August	2	112	206	118	144	218	730
	9	123	262	184	223	397	453
	16	228	473	286	62	103	43
	23	110	453	176	395	439	73
	30	97	146	50	482	526	128
September	6	639	1369	34	223	341	120
	13	212	402	15	191	241	37
Σ		3039	9831	1798	4670	14179	7578
X ± S.D.		159.59 ± 126.17	517.42 ± 365.62	94.63 ± 88.39	245.79 ± 183.72	746.26 ± 657.35	398.84 ± 646.88

Concerning the total trapped adult population from both traps; 18849 individuals in 1990 was 1.46 times as that of 1994, being 12870, higher numbers of eggmasses were expected for 1995 season. That was interesting happened as the number of eggmasses during 1995 was 4.21 times of those deposited during the first season, X = 398.85 ± 646.88, relative to that of 1994, X = 94.63 ± 88.39. Higher numbers of eggmasses during 1995 season were probably due to an increase of intercrop movements of the female moths from the neighboring fields. The seasonal mean temperature (^{o}C) was slightly higher during 1995 season, 33.29 ± 2.44, than that of 1994, 31.94±.99. Contrary, the relative humidity was slightly lower during 1995, being 70.27±6.75 in comparison to that of 1994, 72.51 ± 5.82. This may account for such higher population size during the second season. Such impact of relative humidity and temperature can significantly affect *S.littoralis* moth catches to pheromone baited traps as recorded earlier by Campion et al. (1974) and Murlis et al. (1982). Correlation coefficient values between eggmass count and temperature were 0.55 and 0.31 during 1994 and 1995 seasons, respectively.

Higher intraspecific competition may occur among female moths for egg deposition sites which may drive higher numbers of moths from neighboring fields.

Statistical analysis revealed a positive correlation between number of eggmassses and light trap catches during 1994 season, (r=0.0023, P=0.05). Contrary, r values between number of eggmasses and pheromone trap catches were, -0.2537 and 0.4651, in 1994 and 1995 seasons, respectively, rather inconsistent values and even confusing. While Sridhar et al. (1988) found significant positive correlation between the number of eggmasses of *S.littoralis* (F.) in ground nut and the total number of males caught during 7-day preceding the eggmass count. They pointed to one major difficulty in developing a pheromone based monitoring system in correlating pheromone trap catches with the population density of the pest and with subsequent damage level in the crop. When adopting such analysis to the current data insignificant correlation coefficient values were obtained.

Eggmasses counts and adult catch weakly correlated which may be attributed to sudden influxes of mated females which might boost the eggmass numbers without a comparable increase in the male catches in the pheromone traps. Rothschild et al. (1981) supported such suggestion. Campion (1994) mentioned that *S.littoralis* is considered as a relatively mobile insect so, quantitative relationship between trap catch and subsequent field infestations have not been insignificant.

B. The pink bollworm, *Pectinophora gossypiella* (PBW)

Low numbers of the PBW adults were caught during June of both seasons. As less than 1% of the total trapped moths was recorded, this may reflect very little interfield movements as reported by Parencia et al. (1962). The number of the PBW trapped moths was progressively increasing during the season toward late summer and early fall, as 51.8% and 55.49% of the total trapped adult moths were recorded during September and October of 1994 for light and pheromone-baited traps, respectively, Tabel 2 and Fig. 1-C. Similar trends were also noticed during 1995 season as 48.46% and 37.53% of the total trapped moths were caught during Sept. 1995 for light and pheromone-baited traps, respectively.

Further examination of the data clearly indicate an interesting relationship, the total number of the trapped PBW moths in pheromone-baited traps, when expressed as percentages in relation to the catch, were 7.13, 31.67 and 55.49 during August, September and October 1994, respectively. The percentages of the total numbers of larvae which were contained in a 100-boll sample during the same period were 5.97, 25.37 and 68.66, respectively. The correlation analysis indicates insignificant but positive values between numbers of adult trapped by light and pheromone traps and number of larvae contained. The values of (r) were 0.26 and 0.85, respectively. Higher values of (r) between percentage of larval infestations and adult trapped by pheromone and light traps, being 0.91 and 0.41, respectively during 1994.

Higher population size of the trapped PBW moths was indicated by pheromone-baited and light traps in 1995 season. While 4019 and 14886 adult moths were trapped during 1994 season, 4358 and 34548 adults were trapped in 1995 season for light and pheromone-baited traps, respectively. Also the number of larvae that were contained in the dissected bolls was also higher in 1995 than in 1994, being 279 relative to 201. Although higher, but it did not correspond with the much higher population trapped by pheromone-baited traps. Similar trend of correlation coefficient values was also noticed during 1995 season.

The percentage of infestation also progressively increased toward the end of summer and early fall of both seasons. Although the adult population declined toward the end of the season as also was noted by Gough (1916), but field infestation did not follow similar trend and that was due to cumulative effect of infestation. The maximum percentages during 1995 was higher than that of 1994. Again, reflecting a

Table 2. Population size of the trapped moths of *Pectinophora gossypiella* by light and pheromone-baited traps together with the numbers of its larval instars in a 100-bolls sample at Sakha, Kafr El-Sheikh Governorate during 1994 and 1995 cotton growing seasons.

Sampling date		1994				1995			
		Trap catch		No. of larvae/ sample	Infestation %	Trap catch		No. of larvae/ sample	Infestation %
		Light	Pheromone			Light	Pheromone		
June	18	9	17	-	-	5	33	-	-
	25	11	62	-	-	9	57	-	-
July	2	7	133	-	-	7	210	-	-
	9	12	142	-	-	5	485	-	-
	16	20	160	-	-	19	790	-	-
	23	61	200	-	-	36	1655	-	-
	30	42	135	0	0	70	2080	0	0
Aug.	6	113	158	0	0	84	2083	0	0
	13	212	202	2	2	208	2975	4	2
	20	267	289	5	2	378	3641	4	3
	21	390	413	5	3	310	3380	6	4
Sept.	3	419	730	7	5	468	2890	9	7
	10	521	1040	10	7	590	3042	12	8
	17	670	1560	14	12	615	3623	18	12
	24	463	1385	20	15	584	3414	34	19
Oct.	1	517	2020	35	19	475	2310	51	27
	8	188	4050	41	23	416	1070	66	29
	15	97	2190	62	28	379	810	75	35
Σ		4019	14886	201	116	4358	34548	279	146
X ± SD.		223.28 ± 218.60	827.00 ± 1068	11.17 ± 17.66	11.67 ± 9.03	258.78 ± 232.55	1919 ± 1307	15.50 ± 24.29	8.11 ± 11.52

higher population during 1995 relative to that of 1994 season.

Insignificant positive correlation coefficient values (r = 0.56 and 0.658, P = 0.05) was found between the number of the PBW larvae contained in a 100-boll sample and the numbers of adult moths caught by light traps during 1995 season but very weak (r) values were computed as of pheromone traps, Table 4, contrary to 1994 values.

It should be noted that light trap catch had the highest peak during the third week of September of both seasons. Similar results were reached by Metwally and Hosny (1974) except for the pheromone trapped, highest peak was recorded during October 1994. Also, a positive relation between trap catch and the relative humidity and a negative relation between trap catch and temperature. Similar relations were recorded by Hassanein et al. (1968).

C. The spiny bollworm, *Earias insulana*, SBW

Like the PBW, the numbers of SBW moths were low during June of 1994 and 1995, Table 3. As the numbers of pheromone-trapped adults were 0.14 and 0.061% from the total trapped adults by light and pheromone traps during both study seasons, respectively. It should be noted that no adults were caught by the light traps during June of both study seasons. On the contrary, pheromone-baited traps caught very few adults during June. This indicates a superiority of pheromone traps in detecting low adult populations. This further support what was reported by Nyambo (1988) and Campion (1994) as the pheromone traps were more sensitive at low populations. This further support what was reported by Nyambo (1988) and Campion (1994) as the pheromone traps were more sensitive more sensitive at low population levels. As the season progressed so did the numbers of adult moths. The maximum percentages were recorded during September 1994 where 49.01% and 52.15% were trapped by light and pheromone-baited traps, respectively. During 1995 seasons, the maximum numbers of adults trapped by both traps were recorded in October, as 78.18% and 76.85% of the total trapped populations for the light and pheromone-baited traps, respectively. Interestingly, the adult moth population of the SBW of higher magnitude during 1995 season than it was during 1994 one, as was noticed earlier for the PBW.

It should be noted as the numbers of the SBW moths increased, so did the numbers of larvae in the bolls and the percentages of infestation. In both seasons, the number of larvae, when expressed as percentages, to the total number of larvae

were 8.14, 34.88 and 56.98% in August, September and October of 1994, respectively. Almost similar trend was also noticed during 1995 season when 11.25, 36.25 and 52.50% were recorded during the same period. Correlation analysis indicated higher values during 1995 season than 1994 one, Table 4, r = 0.62 and 0.56 between the numbers of the SBW and adults caught by light and pheromone-baited traps, respectively during 1994. Those of 1995 season were 0.73 and 0.74, respectively.

Parencia et al. (1962) in their work on bollworm at Texas, USA, were unable to establish the relationship between light trap catch and field infestation. They attributed the difficulty as many factors influence population build up and concluded that any prediction of infestation based on trap catch alone would be difficult to make. On the other hand, they were able to predict the cotton leaf worm, *Alabama argillacea* (Hubner) infestation based on trap catch.

Table 3. Population size of the trapped moths of *Earias insulana* by light and pheromone-baited traps together with the numbers of its larval instars in a 100-boll sample at Sakha, Kafr El-Sheikh Governarate during 1994 and 1995 cotton growing seasons.

Sampling date		1994				1995			
		Trap catch		No. of larvae/ sample	Infestation %	Trap catch		No. of larvae/ sample	Infestation %
		Light	Pheromone			Light	Pheromone		
June	18	0	1	-	-	0	5	-	-
	25	0	3	-	-	0	2	-	-
July	2	2	5	-	-	0	7	-	-
	9	2	5	-	-	1	19	-	-
	16	3	13	-	-	2	38	-	-
	23	9	42	-	-	2	27	-	-
	30	5	21	0	0	5	40	0	0
Aug.	6	5	79	0	0	13	53	0	0
	13	7	112	0	0	22	110	3	3
	20	15	280	4	2	38	142	2	2
	21	10	220	3	3	32	105	4	3
Sept	3	19	294	5	4	89	237	5	4
	10	22	370	6	4	360	436	78	4
	17	28	402	9	7	448	591	7	5
	24	30	440	10	8	585	949	10	6
Oct	1	19	289	14	9	698	1325	11	7
	8	14	170	16	12	3780	5826	14	8
	15	12	142	19	14	1240	2013	17	10
Σ		202	288	86	63	7315	11925	80	52
X̄ ± SD		11 ± 9.35	160.44 ± 152.58	4.78 ± 6.27	3.50 ± 4.59	406.39 ± 908.26	662.50 ± 1402	4.44 ± 5.44	2.89 ± 3.23

It could be concluded that establishment of a relationship between trap catch

and subsequent larval infestation was insignificant in Egypt.

Further field work is needed to establish the relationships between trap catch and subsequent damage under field conditions in Egypt.

Table 4. Correlation coefficient values of the tested variables growing cotton seasons at Kafr El-Sheikh, Governorate Egypt.

Pests	Cotton growing season			
	1994		1995	
	Light traps	Pheromone traps	Light traps	Pheromone traps
S. littoralis				
Egg masses	0.0022	0.2537	-0.1349	0.4091
E. insulana				
Larval density	0.6239	0.5625	0.7313	0.7431
% infestation	0.6304	0.5651	0.6845	0.6986
P. gossypiella				
Larval density	0.2655	0.8585	0.5657	0.0078
% infestation	0.4117	0.9124	0.6504	0.00969

Fig. 1

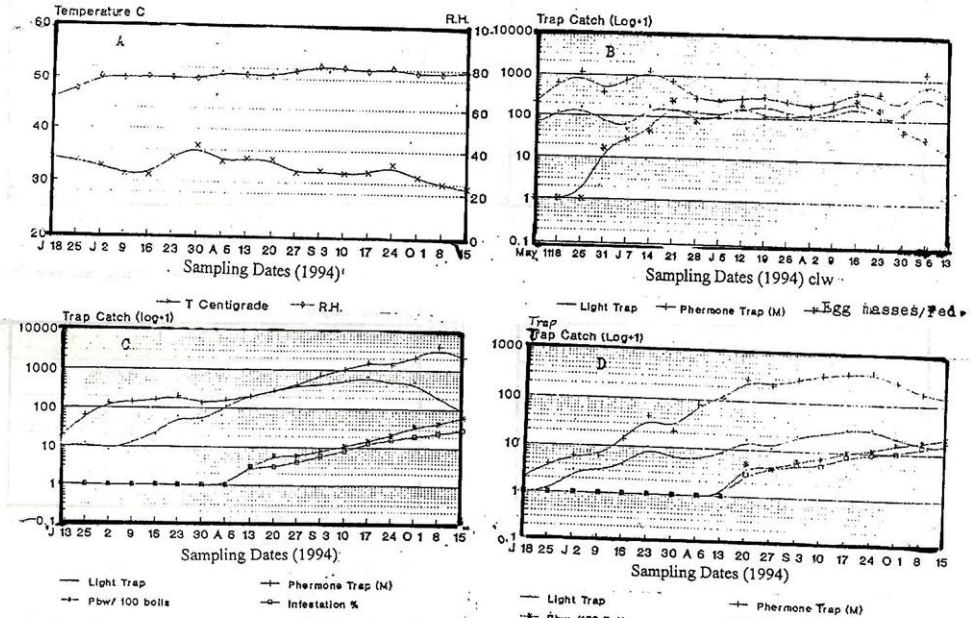

Fig. 1A: Temperature ^{o}C and relative humidity during the study period of 1994 at Kafr El-Sheikh.

Fig. 1C: Trapped adult populations of *P. gossypiella* as caught by light and pheromone traps, number of its larvae in a 100/boll sample and the infestation percentage from a cotton field at Kafr El-Sheikh during the study period, June 18 till October 15, 1994

Fig. 1B: Egg mass counts of the cotton leaf worm *S. littoralis*, light and pheromone trap catches from a cotton field at Kafr El-Sheikh during the study period, June 18 till Oct. 15, 1994

Fig. 1D: Adult populations of *E. insulana* as trapped by light and pheromone traps, number of its larvae in a 100/boll sample and the infestation percentages from a cotton field at Kafr El-Sheikh during the study period, June 18 till Oct. 15, 1994

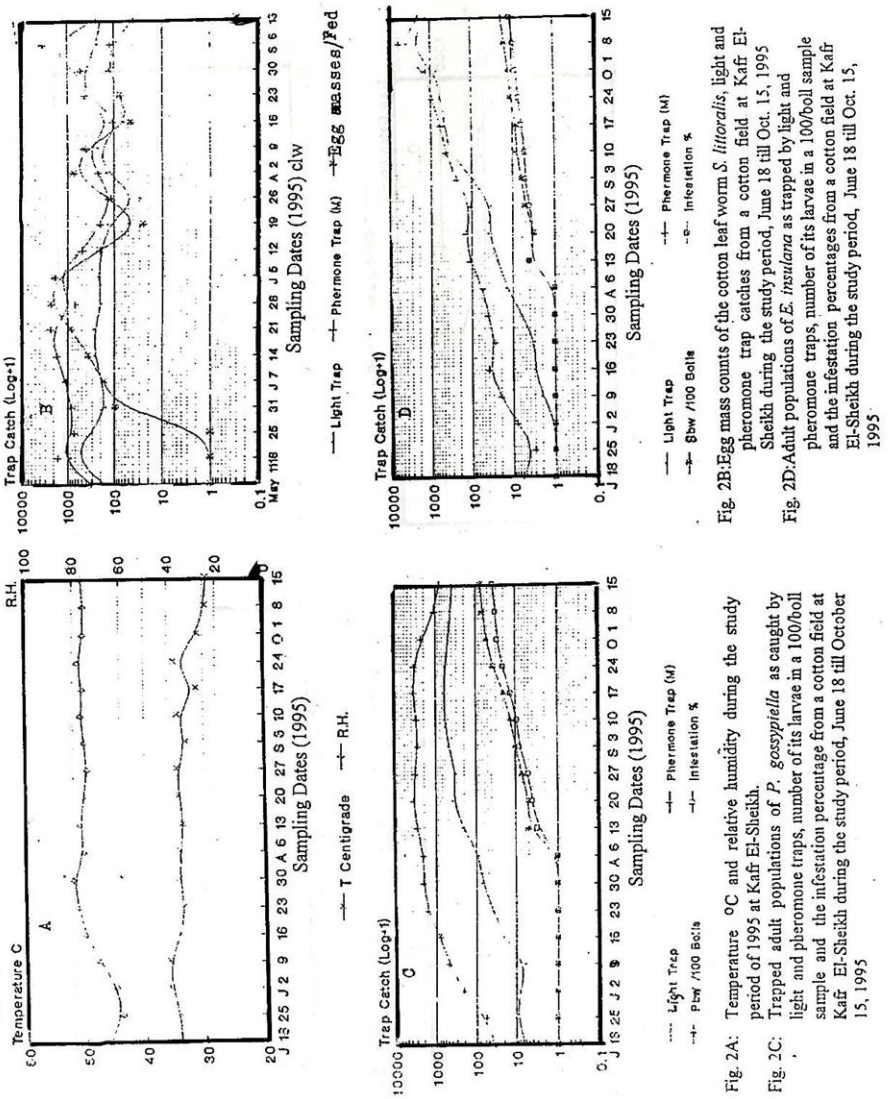

Fig. 2A: Temperature °C and relative humidity during the study period of 1995 at Kafr El-Sheikh.

Fig. 2B: Egg mass counts of the cotton leaf worm *S. littoralis*, light and pheromone trap catches from a cotton field at Kafr El-Sheikh during the study period, June 18 till Oct. 15, 1995

Fig. 2C: Trapped adult populations of *P. gossypiella* as caught by light and pheromone traps, number of its larvae in a 100/boll sample and the infestation percentage from a cotton field at Kafr El-Sheikh during the study period, June 18 till October 15, 1995

Fig. 2D: Adult populations of *E. insulana* as trapped by light and pheromone traps, number of its larvae in a 100/boll sample and the infestation percentages from a cotton field at Kafr El-Sheikh during the study period, June 18 till Oct. 15, 1995

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العلاقة بين الإصابة بدودة ورق القطن وديدان اللوز وتعداد الفراشات المنجذبة إلي المصائد الضوئية والفرمونية في حقول القطن

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أجري هذا البحث خلال موسمي ١٩٩٤ ، ١٩٩٥ بحقول القطن في المزرعة البحثية بمحطة البحوث الزراعية بسخا – محافظة كفر الشيخ بهدف إيجاد العلاقة بين نسب الإصابة بالآفات الاتية:

أ. دودة ورق القطن . ب. دودة اللوز القرنفلية جـ. دودة اللوز الشوكية

وأعداد الفراشات المنجذبة بواسطة المصائد الفرمونية والمصائد الضوئية وأظهرت النتائج مايلي:

١. كانت المصائد الفرمونية أكثر جذبا لفراشات الحشرات الثلاثة من المصائد الضوئية، حيث بلغت النسبة المئوية للفراشات في المصائد الفرمونية ٧٦,٣٨ ، ٧٨,٧٤، ٩٣,٤٦٪ علي التوالي خلال موسم ١٩٩٤، وكانت ٧٦,٣٩ ، ٨٨,١٢ ، ٦١,٩٨٪ خلال موسم ١٩٩٥ من إجمالي تعداد الفراشات المتحصل عليها من المصائد الفرمونية والضوئية. وعلي ذلك تعتبر مصائد الفرمونات أكثر حساسية لتقدير أعداد الفراشات خصوصا في بداية الموسم حيث تكون الأعداد قليلة نسبيا.

٢. علي الرغم من زيادة أعداد فراشات دودة ورق القطن المنجذبة إلي المصائد، إلا أن الإرتباط بين تلك الأعداد وأعداد كتل البيض لم يكن معنويا.

٣. يزداد تعداد فراشات ديدان اللوز تدريجيا ثم ينخفض خلال شهر أكتوبر، بينما تزداد نسب إصابة اللوز وتستمر مرتفعة لتراكمها خلال الموسم. ولقد أوضحت نتائج التحليل الاحصائي أن معامل الإرتباط بين نسب الإصابة وأعداد فراشات دودة اللوز القرنفلية المنجذبة للمصائد الفرمونية والضوئية هي ٠,٩١ ، ٠,٤١ علي الترتيب خلال موسم ١٩٩٤، ولم تظهر نتائج مماثله في الموسم الثاني خصوصا بالمصائد الفرمونية.

٤. كانت معاملات الإرتباط بين أعداد فراشات دودة اللوز الشوكية ونسب إصابتها في حقول القطن أعلي في حالة استخدام المصائد الفرمونية عنها في حالة المصائد الضوئية.