Egypt. J. Agric. Res. , 77 (2), 1999

THE SIMULTANEOUS EFFECT OF PHYSICAL ENVIRONMENTAL FACTORS GOVERNING THE POPULATION ACTIVITY OF COTTON BOLLWORM MOTHS

G.B. EL-SADAANY[1], A.M. HOSSAIN[2], S.M. EL-FATEH RADWAN[2], AND M.A. ROMEILAH[2]

1 Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

2 Plant Protection Research Institute, Agricultural Research Centre, Dokki, Giza.

(Manuscript received 5 November 1997)

Abstract

The present study was carried out to investigate the simultaneous effect of certain environmental physical factors on the population activity of pink and spiny bollworms during 1993, 1994 and 1995 seasons in three different localities (Gharbia & Kafr El-Sheikh and Beheira Governorates). The relationship between accumulative thermal units and the corresponding population density of the pink bollworm was studied. The effect of maximum and minimum temperature and relative humidity on the population density of *Pectinophora gossypiella* (Saunders) and *Earias insulana* (Boisd.) moths was also investigated. It appears from the results that a strong positive relationship prevailed between the changes in the population density of each generation and the required accumulative thermal units for the three years combined in the three tested localities. The effect of the three weather factors combined was relatively the highest for Gharbia, while the corresponding population size of SBW was on contrary the least. A similar trend could still be observed for PBW.

INTRODUCTION

The pink bollworm, *Pectinophora gossypiella* (Saunders) and the spiny bollworm, *Earias insulana* (Boisd.) are serious pests of cotton in Egypt. Due to the great damaging potential of these pests, great attention has been paid to reduce crop losses as far as possible.

Thus, the present work was dedicated to study the effect of certain physical environmental factors on the changes in the population dynamics of moths of both bollworms. The relationship between the population density of moth generations and the required accumulative heat units for completing the generation duration for three years combined play an important role in predecting the infestation in cotton fields.

MATERIALS AND METHODS

In stable agro-ecosystems only steadly or periodic changes in the natural cultivations occur; and insect population maintain, more or less, definite levels. Any variation in these levels would largely be due to environmental changes. Therefore, if temperature would be the most important factor governing the population activity of a certain insect pest, in a certain habitat, the besic population level and its seasonal, monthly and perhaps weekly fluctuation could be determined provding the following data are available:

a. A long series of observation as continuous sex-pheromone trap catches over a number of years in different tested area (localities).

b. A record of a long term average of temperature (maximum, minimum and daily average) and relative humidity (RH%) for the tested localities.

These data were available for pink and spiny bollworms at Gharbia, Kafr El-Sheikh and Beheira agro-ecosystems.

The weekly and monthly catch figures were grouped for studying the changes in the population activity of cotton bollworms in relation to the corresponding physical (thermal) environmental conditions.

In order to interpret the relationship between the time needed for the pink bollworm for completion a whole generation was estimated depending on the accumulated thermal units expressed as degree (dds).

The effect of certain physical environmental factors on the changes in the population density of *Pectinophora gossypiella* and *Earias insulana* moths

The weather factors: The records of the three weather factors considered in the present study were supplied by the Agro-Meterological Station at Abbasia, Cairo. These weather factors are the day maximum temperature, nigh minimum temperature and daily mean relative humidity (R.H. %) during 1993, 1994 and 1995.

The analysis of variance: The partial regression values indicate the average rate of changes in moth activity due to a unit change in any of the three weather factors under test, provided the other two factors remain constant around their averages. The partial regression method used in this analysis (termed the "C" multipliers, Fisher, 1950), was helpful in obtaining basic information about the amount of variability in the activity of the pink and spiny bollworms which could be attributed to all three weather factors combined (explained variance).

In the mean time, the significance levels of the partial regression values could be obtained through:

1. The calculation of the standard error.

2. The variance ratio (F) for all three regressions combined.

Preliminary tests were carried out to most practical regression of the weather factors data (Xs) and of the weekly pheromone catch figures (Ys) in the statistical analysis.

Estimating the accumulated temperature: To estimate the accumulated temperature [d.(t-x)], needed for the annual generations of *Pectinophora gossypiella* at any time, the developer formula was used (Jasic 1975) as follows:

$$g = \frac{d\,(t-x)}{y}$$

where:

g = The number of probable generation.

d = The number of days in that examined period.

t = Mean temperatures during an examined period.

x = The thermal theshold.

y = The total effective temperatures required for the insect development.

RESULTS AND DISCUSSION

It appears from the data in Table 1-3 that a strong positive relationship prevailed between the population density of each generation and the required accumulative thermal units for the three years combined in the three tested localities with the exception of the 2nd generation at Gharbia Governorate, where the average number of moths/night/trap/ generation decreased while the accumulative temperature increased as compared with those during the same generation at Kafr El-Sheikh and Beheira Governorates.

The total number of captured moths in the 3 rd and 4th generations were commonly higher than in the 5th, 2nd and 1st generation. There were few moths emerging during the 1st generation duration. The reliable increase in the accumulated number of the captured moths during the 3rd and the 4th generations (June-July, August

Table 1. Approximate number, duration and accumulated thermal units of *Pectinophora gossypiella* field generations during three tested seasons combined (1993, 1994 and 1995) at Gharbia Governorate.

Period of Activity	Generation number	Duration of generation		Duration in weeks	Number of moths/trap	Accumulated temperature
		From	To			
First	1st	2nd week of Mar.	1st week of Jun.	10	5.5	673.4
Second	2nd	1st week of May	1st week of Aug.	11	11.4	1254.4
	3rd	2nd week of Jun.	1st week of Sept.	10	24.9	1209.6
	4th	2nd week of July	1st week of Oct.	10	28.2	1176
	5th	2nd week of Sept.	1st week of Dec.	10	19.1	898.8

Table 2. Approximate number, duration and accumulated thermal units of *Pectinophora gossypiella* field generations during three tested seasons combined (1993, 1994 and 1995) at Kafr El-Sheikh Governorate.

Period of Activity	Generation number	Duration of generation		Duration in weeks	Number of moths/trap	Accumulated temperature
		From	To			
First	1st	2nd week of Mar.	2nd week of Jun.	11	7.6	655.2
Second	2nd	1st week of May	4th week of July	11	17.6	999.6
	3rd	3rd week of Jun.	3rd week of Sept.	12	31.7	1101.1
	4th	3rd week of July	2nd week of Oct.	10	37.6	1226.4
	5th	3rd week of Sept.	2nd week of Dec.	11	22.8	806.4

and September) was a result of a corresponding increase in the accumulative temperature during the same period.

The relationship between the population density of captured pink bollworm moths expressed as number of moths/night/trap/generation and the corresponding accumulative thermal heat units expressed as daily degree temperature needed for completing one generation are shown in Tables 1-3. To determine the probable number of the annual generations of the pink bollworm moths under field conditions, the modified Jasic (1975) formula was adopted. According to previous results (Desukey, W.M. 1994) total effective temperature for the development of the target insect equal to 478.7.

Table 3. Approximate number, duration and accumulated thermal units of *Pectinophora gossypiella* field generations during two tested seasons combined (1993 and 1994) at Gharbia Governorate.

Period of Activity	Generation number	Duration of generation		Duration in weeks	Number of moths/trap	Accumulated temperature
		From	To			
First	1st	1st week of Mar.	4th week of May	10	3.3	512.4
Second	2nd	2nd week of May	2nd week of Aug.	11	10.4	1201.2
	3rd	4th week of Jun.	2nd week of Sept.	11	21.9	1251.6
	4th	3rd week of July	2nd week of Oct.	11	24.1	1218
	5th	2nd week of Sept.	3rd week of Dec.	12	14.1	837.2

From the obtained results, it could be concluded that the thermal heat units play an important role in predecting the first and last dates of appearance of the field generations of the pink bollworm moths.

The relationship between accumulative thermal units and the corresponding population density of the pink bollworm moths

Data in Tables 4, 5 and 6 show the interrelationship between the changes in the accumulative thermal heat units and the corresponding changes in the population activity of the pink bollworm moths expressed as accumulated number of moths. It

Table 4. Accumulated number of PBW captured male moths and the corresponding accumulated day degree temperatures during 1993, 1994 and 1995 at Gharbia Governorate.

Month	Accumulated daily temperaure			Actual number of catch moths			Accumulated catch			Ratio of accumulative moths		
	1993	1994	1995	1993	1994	1995	1993	1994	1995	1993	1994	1995
Jan.	34.1	68.2	18.6	0	0	0	0	0	0	0	0	0
Feb.	28	39.2	50.4	0	0	0	0	0	0	0	0	0
Mar.	43.4	89.9	120.9	21	38	28	21	38	28	0.53	0.8	0.6
Apr.	219	210	123	170	178	193	191	216	221	4.8	5	5.4
May	303.8	334.8	449.5	166	254	223	367	470	444	9.3	10.9	11
Jun.	426	396	456	431	424	443	798	894	887	20.2	20.8	21.9
Jul.	449.5	449.5	452.6	682	648	732	1490	1542	1619	37.7	35.9	40.1
Aug.	455.7	449.5	449.5	671	674	654	2161	2216	2273	54.8	51.6	56.3
Sept.	396	468	399	867	1096	941	3028	3312	2314	76.8	70	79.6
Oct.	390.6	403	300.7	772	860	729	3800	4172	3943	96.3	97.3	97.7
Nov.	210	180	159	142	115	91	3942	4287	4034	100	100	100
Dec.	117.8	37.2	37.2	0	0	0	3942	4287	4034	100	100	100

Table 5. Accumulated number of PBW captured male moths and the corresponding accumulated day degree temperatures during 1993, 1994 and 1995 at Kafr El-Sheikh Governorate.

Month	Accumulated daily temperaure			Actual number of catch moths			Accumulated catch			Ratio of accumulative moths		
	1993	1994	1995	1993	1994	1995	1993	1994	1995	1993	1994	1995
Jan.	37.2	114.7	52.7	0	0	0	0	0	0	0	0	0
Feb.	19.6	61.6	81.2	0	0	0	0	0	0	0	0	0
Mar.	71.3	96.1	139.5	21	33	39	21	33	39	0.4	0.5	0.6
Apr.	210	228	162	203	225	242	224	258	281	4.4	4.4	4.8
May	254.2	294.5	254.2	291	354	288	515	612	569	10.3	10.6	9.8
Jun.	369	369	417	376	382	359	891	1494	1460	17.8	26	25.2
Jul.	430.9	440.2	461.9	918	721	826	1809	2215	2286	36.2	38.6	39.4
Aug.	443.3	452.6	477.3	851	934	990	2660	3149	3276	53.3	54.8	56.5
Sept.	402	435	423	1171	1163	1265	3831	4312	4541	76.9	75.1	78.4
Oct.	396.8	406.1	353.4	968	1098	896	4799	5410	5437	96.2	94.2	93.9
Nov.	246	213	189	183	322	340	4982	5732	5777	99.8	99.8	99.8
Dec.	173.6	74.4	117.8	6	6	11	4988	5738	5788	100	100	100

appears from the data that there was a gradual increase in the population density of PBW expressed as number of captured moths/month/sex pheromone from January correlated with the increase of the corresponding thermal accumulated units/month and continued in the following months forming distinct peaks during June, July, August and September months. A corresponding increase took place in the thermal units during the same period, tables 4, 5 and 6, expressed as day degree temperatures (d.d.s.). The correlation between the accumulated thermal heat units expressed as day degree temperatures "d.d.s." and the accumulative numbers of captured PBW moths was strongly positive.

An obvious increase in the accumulative number of the caught moths started from May at the three tested localities and throughout the three tested years 1993, 1994 and 1995. For Gharbia governorate, the number of trapped moths was 191, 216 and 221 moths during April increased to 367, 470 and 444 moths during May, to ca 798, 894 and 887 moths in June of 1993, 1994 and 1995.

For Kafr El-Sheikh, it appears from the data in Table 5 that an obvious increase for the accumulative "d.d.s." from 210, 228 and 162 to 245.2, 249 and 254.2 during the three successive season 1993, 1994 and 1995. An obvious increase was observed in the same Table for the accumulative number of moths trapped during April 1993 (203), 1994 (225) and 1995 (242 moths).

For Beheira, a similar trend was observed and an obvious increase was observed for the accumulative "d.d.s." during April from the ranges 192 and 258 to the ranges 288 and 325 in May 1993 and 1994, respectively. On the other hand, the corresponding number of trapped moths increased during April from 120 and 111 moths to 157 and 186 moths during May 1993 and 1994, respectively. As for July, August and September months, the amount of increase was relatively high for the accumulative d.d.s. temperature and the corresponding number of captured male moths of *Pectinophora gossypiella*. It could be concluded, however, that the accumulated thermal unit figures and the corresponding number of moths demonstrated a slight increase during October and started to decrease during the following months, November and December.

The results emphasized that a considerable increase in the number of PBW moths occurred during August (990 moths) and September (1265 moths) months required an obvious increase in the accumulative thermal heat units equal to 477 and 423 accumulated thermal unit/month.

From the above results, it may be also concluded that in the Northern Central Governorates of Delta the earlier emerging PBW moths were trapped in the sex pheromone traps in relatively few numbers during January, February and March when the rate of the accumulative day degree temperature was less than 100 during January and February when the corresponding number of moths/month was zero or hardly above zero level during March of the three tested years at Gharbia, Kafr El-Sheikh and Beheira Governorates.

The results obtained during the following months show relatively high increase in the accumulative ratios for the population abundance of PBW during June, July, August and September months of the three successive seasons at Kafr El-Sheikh district. During that period the sequares, flowers and green bolls were well formed as a suitable food and shelter for the PBW larval stage. The accumulative day degree/month at Kafr El-Sheikh were the highest ranges and ratio % and consequently preventive control measurements had to be applied against *Pectinophora gossypiella* infestation as early as possible for Kafr El-Sheikh cotton fields.

To manage the PBW control measurements, the day degree temperature should be assesed in relation to the plant age and time of application in each of the three tested ecosystems.

Our results were in agreement with the findings of Bariola (1973), Butler and Hamilton (1976), Ashoket et al. (1977), Henneberry (1977), Moftah et la. (1988) and Desuky (1994), they reported that heat units influence and govern to a great extent the drastic changes in the population activity of PBW moths.

The effect of certain physical environmental factors on the changes in the population density of *Pectinophora gossypiella* and *Earias insulana*

The separate and the simultaneous effects of three main weather factors namely "day maximum temperature", night minimum temperature and relative humidity (RH%) on the changes in the population density of *P.gossypiella* and *E.insulana* moths (as indicated by sex pheromone traps) throughout the years 1993, 1994 and 1995 in Gharbia and Kafr El-Sheikh were estimated. For Beheira only 1993 & 1994 seasons were considered.

The simple correlation values helped in detecting any apparent relationship between the dependent variable "y" and each of the corresponding independent "x" variables (weather factors).

The precise effect of each factor on the population changes of the target pests was obtained by simply calculating the partial regression values. The partial regression values (b) are bound to indicate the average rate of change in the population due to the unit change in any of the three tested factors, should the other two weather factors remain constant around their respective averages.

Table 6. Accumulated number of PBW captured male moths and the corresponding accumulated day degree temperatures during 1993 and 1994 at Beheira Governorate.

Month	Accumulated daily temperaure		Actual number of catch moths		Accumulated catch		Ratio of accumulative moths	
	1993	1994	1993	1994	1993	1994	1993	1994
Jan.	24.8	89.9	0	0	0	0	0	0
Feb.	22.4	58.8	0	0	0	0	0	0
Mar.	49.6	99.2	6	8	6	8	0.1	0.12
Apr.	192	258	120	111	126	119	3.7	3.4
May	288	325.5	157	186	283	305	8.3	8.8
Jun.	408	396	260	226	543	531	16	15.4
Jul.	458.8	474.3	490	528	1033	1059	30.4	30.8
Aug.	461.9	474.3	733	695	1766	1754	52.1	51.1
Sept.	411	453	869	810	2635	2564	77.7	74.7
Oct.	362.7	409.2	591	721	3226	3285	92.2	95.7
Nov.	234	162	147	131	3373	3416	99.5	99.5
Dec.	136.4	62	14	16	3387	3432	100	100

Pectinophora gossypiella

1. Effect of day maximum temperature: Table 7 shows the simple correlation and partial regression values of this factor on the fluctuation in the number of trapped moths. The correlation coefficient "r" values were positive and highly significant (at 1 % level of probability) for the three tested localities (Gharbia, Kafr El-Sheikh and Beheira). These "r" values infer that the relationship between moth activity and the maximum temperature was generally positive during the whole period of the present investigation.

The partial regression values on this factor, along with its levels of probability, Table 7, indicate a highly significant positive effect of this factor. This means that the day maximum temperature was nearly around its optimum for the activity of moth. Considering the average mean of this factor, Table 8, during the selected period of activity, it appears that 30.6°C (the average for Gharbia and Beheira) and 27.3°C (for KAfr El-Sheikh) were the optimum ranges of temperature for the activ-

Table 7. The simple correlation and partial regression values of pink and spiny bollworm male moths on the three weather factors (Maximum, Minimum temperatures and relative humidity) at the three tested localities during 1993, 1994 and 1995 seasons combined.

Insect	*Pectinophora gossypiella*						
Location	Weather factors	r	b	S.E	t	p	E.V
Gharbia	Max. temp.	0.61**	13.078	3.10	38.16	0.001	37.1%
	Min. temp.	0.74**	13.96	3.70	21.16	0.001	21.5%
	RH%	0.76**	7.64	6.10	18.55	0.001	18%
	Total						76.6%
Kafr El Skeikh	Max. temp.	0.71**	21.38	2.93	30.06	0.00	49.2%
	Min. temp.	0.21ns	19.08	3.42	6.26	0.02	10.9%
	RH%	0.67 **	8.43	3.15	0.062	0.80	0.1%
	Total						60.2%
Beheira	Max. temp.	0.73**	18.24	2.87	37.41	0.00	53.9%
	Min. temp.	0.21ns	14.53	3.42	0.41	0.5	0.6%
	RH%	0.67**	9.49	5.08	7.45	0.01	10.8%
	Total						65.3%
Insect	*Earias insulana*						
Gharbia	Max. temp.	0.66**	28.29	5.85	49.37	0.00	43.3%
	Min. temp.	0.71**	33.88	5.27	8.55	0.005	7.4%
	RH%	0.06 ns	2.52	6.07	12.36	0.001	10.8%
	Total						61.5%
Kafr El Skeikh	Max. temp.	0.71**	41.6	4.88	46.16	0.00	50.48%
	Min. temp.	0.72**	40.79	5.038	1.075	0.30	1.2%
	RH%	0.088ns	-8.71	3.21		0.65	0.2%
	Total						51.88%
Beheira	Max. temp.	0.655**	61.2	5.69	37.77	0.00	42.8%
	Min. temp.	0.655**	66.09	5.27	0.819	0.4	0.9%
	RH%	0.088ns	9.12	5.17	5.5	0.02	6.3%
	Total						50%

ity of PBW moths in the three tested localities and average of 29°C could be considered as the optimum for the population activity of *Pectinophora gossypiella* moths.

2. Effect of night minimum temperatue: The simple correlation "r" and the partial regression (b) values of the relationship between *P.gossypiella* moths activity and the night minimum temperature, as shown in Table 8, indicate that 17.2°C and 20.4°C averages of night minimum temperature in Gharbia and Kafr El-Sheikh during the selected period of the three years combined demonstrated a highly significant positive relationship. For Beheira, the "r" value was insignificant, thus infering that this factor (average of 18.3°C) represents the optimum night degree for the population activity of moths. For Beheira, the night minimum temperature was far or out the low level of temperature tolerant zone (generally negative). Considering the average mean of this factor, it appears that 18.3°C may be considered as the lowest effective temperature zone for PBW moths.

3. Effect of daily mean relative humidity (RH%): The simple correlation values, Table 7, indicate that daily mean relative humidity expressed a significant relationship for Gharbia and Beheira and insignificant relationship for Kafr El-Sheikh. The partial regression values indicate that 65.9% and 67.3%, averages for Gharbia and Beheira were the nearest to the optimum figure for the flight activity of the moths, it also indicate that 72.2% average for Kafr El-Sheikh was around the preferendum range for the degree activity of the PBW moths.

4. The combined effect of the three main weather factors on the changes in *Pectinophora gossypiella* moths: Table 7 shows that the variance explained % by the three factors combined was significant in the three tested localities. The amount of explained variance by day maximum temperature was generally the highest followed by night minimum temperature and relative humidity (RH%). The results indicate that in Gharbia, the day maximum, night minimum temperatures and daily mean relative humidity demonstrated highest levels hence the explained variance was 76.6% for the three weather factors combined and accordingly, considered as the most important environmental factors influencing the activity of PBW moths. The explained variance in Kafr El-Sheikh came next in this respect.

Earias insulana

1. Effect of day maximum temperature: Data in Table 7 indicate that the correlation coefficient "r" values were positive and highly significant for the three tested localities; Gharbia, Kafr El-Sheikh and Beheira during the three years combined. The partial regression values for this factor along its levels of probability indicated the strong and positive effect of this factor (highly significant). The averages of this factor were 26.4°C, 23.7°C and 27.7°C in the three tested locations, respectively and an average for the three localities equal to 26°C is still far from the optimum temperature degree to the population activity of SBW moths.

2. Effect of night minimum temperature: The simple correlation "r" and the partial regression (b) values of the preliminary relationship between *E.insulana* and the night minimum temperature are shown in Table 7. The estimated 13.7°C, 16.9°C and 16.8°C averages of this factor seem to be quite near the preferendum range for night minimum degree of temperature for this nocturnal moth in Gharbia, Kafr El Sheikh and Beheira, respectively during the selected period of activity and 15.8°C is accordingly considered as the lowest effective degree of night minimum temperature.

3. Effect of daily mean relative humidity (RH%): The simple correlation values, Table 7, indicate the insignificant effect of the daily main relative humidity and the corresponding number of captured male moths in the three tested locations during the three seasons combined. The significant partial regression values indicate that an average of 68.5, 72.7 and 72.2% for the daily mean relative humidity in the aforementioned three localities were quite close to the optimum humidity for the activity of *E.insulana* moths.

4. The combined effect of the three main weather factors on the changes in the population activity of the spiny bollworm moths

Table 7 shows that the variance explained by the three weather factors was the highest in Gharbia ecosystem. The amount of explained variance by day maximum temperature was generally the highest one. The results also reveal that, in the three tested localities, day maximum and night minimum temperatures are the most influencing environmental physical factors, thus governing the population activity of *Earias insulana* moths during the whole period of the present investigation.

The partial regression, however, on any factor indicates the average effect of the unit change in each, of the considered factors. The prevailing day maximum temperature, night minimum temperature and daily mean relative humidity appear to be the most important weather factors influencing the activity of pink and spiny bollworm moths in the three tested different localities at Delta area. The greater portion of the variability in activity of moths during the three years combined of the present investigation was due to the combined effect of the three tested weather factors.

Most of the calculated explained variance % by these factors combined on the activity of each bollworm were significant. Thus, charifying the close relationship between the activity of bollworm moths and the weather factors tested.

The influence of each factor and the combined effect of the three weather factors, were markedly variable from one locality to the other. Gharbia district demonstrated the highest explained variance % (76.6% for PBW and 61.5% for SBW) from the one hand, while on the other, maximum day temperature underwent the highest level of effect.

Such dissimilarity in the effect of the three weather factors is attributed to one or more of the following reasons;

i. The strong interrelationship between the three tested weather factors; ii. the irregular effect of other physical environmental factors on them (not considered in the present analysis); iii. The effect of the population trend (cycles).

The day maximum temperature, the night minimum temperature and RH% appeared to be the most important weather factors governing the activity of both pink and spiny bollworm moths in the present investigation.

The three factors showed a positive effect in the different tested localities for the three years combined. The positive influence was either highly or insignificant.

Generally speaking, the effect of the three weather factors combined was relatively the highest for Gharbia, while the corresponding population size of SBW was on the contrary the least. A similar trend could still be observed for PBW. These results suggest that the rather highly explained variance % for the three weather factors was supported by the bioenvironmental factors in the same ecosystem. This prevent the expected population build up of both pink and spiny bollworm moths and accordingly their growth was quite low. The occurrence of earlier warm spans in Upper Egypt during Spring months encouraged the earlier occurrence of SBW moths in cotton fields before PBW moths. From the data in Tables 7 & 8 it appear that the tolerant zone of temperature for the population activity of PBW moths consists of minimal 16°C temperature degree nd maximal degree of 29.9°C. Temperature with an average degree of 25°C as the prefer degree for the activity of PBW moths.

For the spiny bollworm, these effective thermal values were estimated as 15.8°C for the minimal and 26.6°C for the maximal effective temperatures. An average of 23°C temperature may be considered as the optimum for SPW activity.

From the economic point of view, the moths of PBW emerging during February, and up to May are of no significant value specially in the Delta, since their most favorable plant stages i.e. squares, flowers and green bolls have not yet occurred. In the mean time, the different stages of *Pectinophora gossypiella* need larger accumulative thermal units for completion of its field generations than that needed for SBW field generations. In Upper Egypt, such an early emergence and reliable occurrence of SBW in cotton fields could be attributed to the favorable environmental conditions prevailing throughout the cotton growing season. A conditionales favourate if compared with PBW moths.

A careful examination of the data in Tables 7 and 8 shows that the readings for the three factors at Beheira were markedly higher than the corresponding figures for Kafr El-Sheikh and Gharbia, in the mean time the number of captured moths during the corresponding period was again fairly higher in Beheira than Kafr El-Sheikh and Gharbia. The results suggested that the least range daily temperature prevailing (6.9°C) in Kafr El-Sheikh encoureged the reliable occurrence of moths than that observed for Beheira and Gharbia ecosystems. A further examination of the data in Tables 7 and 8 shows that the total number of trapped moths was rather high when the corresponding explained variance % was comparatively low and this may be attributed to the : i. The fairly weak effect of the considered weather factors (independent factors); ii. The wide use of insecticides affecting the unreliable role of the related biological agents; iii. The favorable weather conditions prevailing from April to September, encouraging the reliable abundance of bollworm moths in cotton fields. The amount of changes in the maixmum day temperature, night minimum temperature and daily mean relative humidity (RH%) required to alter the catch of either pink and spiny bollworms when the tested factors remain constant around their averages, Tables 7 and 8. The data in these Tables infer that the unit increase of the day maximum temperature from the general average was 18 moths/trap/week. The results obtained here are in harmony with those obtained by Butler and Hamilton (1976) and Ashok et al. (1977), they conculded that 26°C seems to be optimum for the frequency of mating and level of duration. Henneberry et al. (1977)

confirmed the present results and stated that at 32°C seems to be optimum for the frequency of mating and level of duration. Henneberry et al. (1977) confirmed the present results and stated that at 32°C the reproductive ratio for *Pectinophora gossypiella* reached the lowest level.

From the above results, it could be concluded that, our findings were in close agreement with the findings of Omar (1980), Khaliq and Yousaf (1986), Gills and Sidhu (1986-1989), Chu and Henneberry (1990), Hussain (1990) Taman (1990) and Hamid (1994).

Table 8. The average mean of pink and spiny bollworm captured male moths and the corresponding averages of day maximum, nigth minimum temperatures and relative humidity (RH%) during 1993, 1994 and 1995 seasons combined at the three tested locations .

Insect	*Pectinophora gossypiella*			
Location	Average mean of captured male moths	Average mean of day maximum temperature	Average mean of night minimum temperature	Average mean of daily relative humidity (RH%)
Gharbia	138.3	30.6	17.2	65.9
Kafr El Skeikh	168.1	27.3	20.4	72.3
Beheira	114.4	30.6	18.3	67.3
Insect	*Earias insulana*			
Gharbia	252.7	26.4	13.7	68.5
Kafr El Skeikh	281.3	23.7	16.9	72.7
Beheira	494.4	27.7	16.8	72.7

REFERENCES

1 . Ashok, K.R., R.A. Bell and R.B. Carlson. 1977. Influence of the temperature on development of an India strain of the pink bollworm in the laboratory and observation on fecundity. Annals of Entomological Society of America 70, 4: 628-630.

2 . Bariola, L.A., J.C. Keller, D.L. Turley and J.R. Fairis. 1973. Migration and population studies of the pink bollworm in the Arid West. Environ., Entom., 2 (2): 205-208.

3 . Butlur, D.J. and A.G. Hamilton. 1976. Temperature dependent development rates of four strains of *Pectinophora gossypiella* (Saund.) Annals of the Entomological Society America, 69 (3): 450-452.

4 . Chu, C.C. and T.J. Henneberry. 1990. *Pectinophora gossypiella*. Population dynamics. Seasonal variation. Pheromone traps. sex pheromone. fields *gossypium hirsutum* California. Procbeltwide cotton prod. Res. conf. Mymphis. Tenn.: National cotton council. of America. 1990. : 184-185.

5 . Desuky, W.M. 1994. Ecological studies on some cotton pests in Sharkia Governorate, Ph. D. Thesis. Plant Protection Department. Zagazig University.

6 . Gill, J.S. and A.S. Sidhu. 1989. Comparatives survival and development of *Earias spp* in relation to some constant ecological factors. Indiana. J. Ecol. 16 (2): 142-146.

7. Hamid, A.M., A.M. AlBeltagy and M.A.El Aky. 1994. Influence of certain weather conditions on the bollworm at El-Mansoura district. J. Agric. Sci. Mansoura Univ., 19 (2): 815-821.

8. Henneberry, T.J., M.H. Flint and L.A. Bariola. 1977. Temperature effects on mating sperm transfer and oviposition of pink bollworm. Environmental Entomology 6 (4): 513-517.

9. Hussain, A.M. 1990. Studies on the effect of some weather factors on the population activity of bollworm at Fayoum Governorate. Ph.D. Thesis. Fac. Agric. Ain-Shams Univ. Cairo, Egypt.

10. Khaliq, A. and M. Yousef. 1986. Effect of weather factors on the light trap captured of some insect pest of cotton. Journal of Agricultural Research Lahore. 24 (4): 313-319; 8 ref.

11. Moftah, E.A., A.M. Younis, Y.F. Girgis and A.A. Khidr. 1988. Thermal requirements and predection models for pink bollworm *Pectinophora gossypiella* (Saunders). Minia, J. Agric. Res. Rev., 10 (4): 1563-1573.

12. Omar, M. H. 1980. Meterological factors affecting the epidmiology of the cotton leaf worm and the pink bollworm. Technical Note No. 167, WMO. Geneva 46PP.

13. Taman, F.A. 1990. The effect of four weather factors on the field infestation with the pink and spiny bollworms five successive years. Alex. Exch. 11 (4): 61-75.

دراسة التأثير المتزامن لعوامل البيئة الطبيعية علي النشاط الموسمي لديدان اللوز

جميل برهان الدين السعدني[1]، سمير محمد الفاتح رضوان[2]،
عبد الحميد محمود حسين[2]، محمد عبد الحميد روميله[2]

١ كلية الزراعة - جامعة عين شمس - القاهره.
٢ معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - جيزة.

أشتملت الدراسة علي مناقشة التاثير المتزامن لبعض عوامل البيئة الطبيعية علي نشاط دودتي اللوز القرنفلية والشوكية خلال مواسم ١٩٩٣ و ١٩٩٤ و ١٩٩٥ في محافظات الغربية وكفر الشيخ والبحيرة وقد تم دراسة العلاقة بين كمية الحرارة المتراكمة والكثافة العددية لدودة اللوز القرنفلية. كما تمت دراسة تاثير كل من درجات الحرارة العظمي والصغري والرطوبة النسبية علي الكثافة العددية لفراشات دودتي اللوز القرنفيلة والشوكية. وقد أوضحت النتائج وجود علاقة قوية بين التغيرات التي تحدث في الكثافة العددية لكل جيل وكمية الحرارة المتجمعة - خلال الثلاثة مواسم في المحافظات الثلاث محل الدراسة. وكان تاثير العوامل الجوية الثلاث معا أعلي ما يمكن في محافظة الغربية - بينما كان حجم مجموع فراشات دودة اللوز الشوكية عكس ذلك (أقل) كما لوحظ نفس المعدل بالنسبة لفراشات دودة اللوز القرنفلية.