THE SIMULTANEOUS EFFECT OF FOUR WEATHER FACTORS ON THE FIELD INFESTATION OF THE COTTON LEAFWORM *SPODOPTERA LITTORALIS* (BOISD.) IN SIX SUCCESSIVE YEARS.

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Abstract

Infestation percentage of the cotton leafworm *Spodoptera littoralis* (Boisd) was studied at beheira governorate during May and July for the six successive years 1984-1989. Infestation with the cotton leafworm increased gradually and reached its maximum at the beginning of July in all examined seasons. The climatic conditions prevailing in the same period were recorded. Statistical regression analysis was applied to determine significant correlations.

When the four climatic factors; daily mean temperature, daily mean relative humidity, daily mean barometric pressure and daily mean net solar radiation were computed simultaneously, the results showed high significant correlation of infestation in May, June and July, (59%, 38% and 26%, respectively). In July however, the effect of the two factors; daily mean temperature and daily mean net solar radiation showed high significant reverse relation during the six successive years.

The results confirm the importance of weather parameters as limiting factors for the infestation levels of the cotton leafworm under field conditions. Thus, climatic parameters can be used in setting mathematical modelling for the prediction of field infestation by the cotton leafworm. Such prediction is essential for the development of IPM strategies.

INTRODUCTION

The cotton leafworm, *Spodoptera littoralis* Biosd. causes high economic losses to cotton production. The present investigation was carried out to study the relation between climatic conditions and infestation percent by this pest in Beheira Governorate during six successive years from 1984 to 1989.

Williams (1940) emphasized the importance of light traps as a successful method for studying the relationship between weather factors and the field infestation level. Hassanein (1956) indicated that temperature was the factor contributing most largely to seasonal fluctuation in insect population. Hassanein and Badawi (1961) showed that temperature had a positive effect on the catch of *Pectinophora gossypiella* (Saund.) while relative humdity had a negative effect. Hafez *et al.* (1969) studied the effect of some climatic factors on *Earias insulana* (Biosd.) months population. In 1990, Taman studied the relationship between the recorded climatic conditions, and sex pheromone traps catch of each of the cotton leafworm spiny bollworm, and pink bollworm. She also studied in 1991 the relationship between the recorded climatic factors and infestation percentage of spiny and pink bollworms in the field.

MATERIALS AND METHODS

Effect of four weather factors on infestation of the cotton leafworm *Spodoptera littoralis* Boisd.

An experiment was carried out in Beheira Governorate to compare the infestation percent of cotton leafworm during May, June and July for six successive years (1984-1989).

The experimental unit was 1/100 feddan with four replicates in complete randomized block design in 11 provinces of Beheira Govenorate; Abo-Hommos, Shobraghit, Kom-Hamada, Hosh-Eisa, Damanhour, Kafr-el-Dawar, Delengat, Etay el Barod, El-Mahmoudya and El-Rahmania. Numbers of egg-masses were determined in 10 cotton plants in each replicate.

Effect of four weather factors on infestation rate:

Daily mean maximum and minimum temperature, daily mean relative humidity, daily mean barometric pressure and sunshine hours during the six successive years 1984-1989 were obtained from Meteorological Department. The net solar radiation factor was calculated from solar radiation (sunshine hours), temperature and humidity data (Dorenbos and pritutt, 1977) by using the equation:

$$Rn = Rns - Rn1$$

where: Rns = net short wave radiation

Rn1 = net long wave radiation

Regression Analysis for Statistical Correlations

Regression analysis was aplied by using a computer program (Watt, 1963). Regression analysis was computed considering the following independent variables:

Daily mean temperature	(x1),
Daily mean relative humidity	(x2),
Daily mean barometric pressure	(x3),
Daily mean net solar radiation	(x4),
Mean number of egg-masses	(y),

Regression analysis provided the folowing parameters:

1. The average rate of change of number of egg-masses (Y); change in the departure of every physical factor, assuming that the other factors are constant.

2. The correlation coefficient (r) is considered a measure of the correlation between (y) and the tested factor. The remaining unexplained variation may be due to the influence of other factors (environmenal, biological, ... etc.), in addition to the experimental error.

3. The "F" test is considered a measure of significance for the results of regression analysis and the level of significance at probability (P).

4. The standard error (S.E.), and "t" values are also computed to help in the interpretation of the results, and to ensure their validity.

RESULTS AND DISCUSSION

Table 1 shows the averages of the number of egg-masses of the cotton leafworm through May, June and July during the six successive years 1984-1989.

Regression analysis of the effects of these independent variables was carried out and the results are shown in tables 2 and 3. Table 4 presents the original climatic data of the factors included in this investigation, while table 5 shows the impact of these climatic factors on the levels of infestation.

It is evident that field infestation with the cotton leafworm increased gradually and reached its maximum in July. This trend was consistent in the six studied seasons. The "F" values were highly significant at 5% level of probability showing 5.79, 7.63 and 6.7 in May, June and July, respectively. This indicated that the four weather factors together had significant effect on the numbers of egg-masses de-

Table 1. Mean of average number of *S. littoralis* egg-masses durign May, June and July of the cotton seasons 1984-1989.

Time periods for counting egg-masses		Average number of egg-masses / cotton plants
May	1-7	0.0
	8-15	0.0
	16-23	0.0
	24-31	0.4
June	1-7	1.6
	8-15	4.7
	16-23	8.6
	24-31	26.0
July	1-7	50.0
	8-15	37.0
	16-23	14.1
	24-31	2.5

tected during the cotton seasons of the six successive years. However, each of the four weather factors did not show significant effect on the numbers of egg-masses during May and June (Table 2).

Table 2. Interaction regression analysis of cotton leafworm egg-masses and four weather factors in May and June through 1984-1989.

Factors	Value "E"	
	May	June
Daily mean temperature	1.1	0.75
Daily mean relative humidity	0.8	0.67
Daily mean barometric pressure	1.3	0.11
Daily mean net solar radiation	0.3	0.90

As shown in Table 3 each of the four weather factors had a reversible effect, but daily mean temperature and net solar radiation showed high significant effect, where a decrease of 1°C in the daily mean temperature caused an increase of 5.1 egg-masses per day. The decrease of 1.mm/day in the daily mean net radiation resulted in an incrase of 92.5 egg-masses per day.

The results of the combined effect of the four climatic factors on the number

Table 3. Interaction regression analysis of cotton leafworm egg-masses and four weather factors in July through the years 1984-1989.

Factors	Regression		"t"
	Value	S.E.	Value
Daily mean temperature	-5.11	2.1	2.4
Daily mean relative humidity	-0.03	0.03	1.1
Daily mean barometric pressure	-0.03	0.02	1.6
Daily mean net solar radiation	-92.5	19.20	4.8

of egg-masses of the cotton leafworm indicated high significant "F" values during the six successive years in Beheira Governorate.

The results showed an apparent effect of daily mean temperature and net solar radiation on the rate of infestation at the end of the season.

It could be concluded that the daily mean net solar radiation is an important

Table 4. Climatic data during cotton seasons from 1984 to 1989.

Date	Avg.Max. Temp. °C	Avg.Min. Temp. °C	Avg.R.H. %	Avg. atmospheric pressure mbar	Avg. sunshine hours
1984					
May	27.0	16.0	65.0	1014.0	13.6
June	27.0	19.0	70.0	1011.0	14.2
July	29.0	22.0	70.0	1008.4	14.0
1985					
May	27.5	16.7	66.0	1014.3	13.6
June	27.2	19.9	70.5	1011.5	14.2
July	29.4	22.0	69.0	1008.8	14.0
1986					
May	26.1	16.5	65.5	1011.8	13.6
June	26.5	19.1	70.8	1012.1	14.2
July	28.7	22.5	70.7	1010.7	14.0
1987					
May	24.9	15.7	53.5	1013.3	13.6
June	25.7	18.4	62.75	1013.9	14.2
July	28.9	22.0	61.8	1018.4	14.0
1988					
May	27.3	18.2	53.75	1013.3	13.6
June	29.4	20.6	52.5	1010.6	14.2
July	30.1	24.3	63.5	1007.5	14.0
1989					
May	26.9	17.8	53.0	1015.7	13.6
June	28.2	19.8	57.3	1013.0	14.2
July	28.7	22.9	63.3	1009.3	14.0

factor determining the rate of infestation with egg-masses.

The data also showed that hte insect responded to the net solar radiation through the regular photoperiod and that other factors related to the environment might affect the rate of infestation (Hosny 1955; Hafez et al., 1969; Taman 1990, 1991).

The weather factors seemed to affect significantly infestation rate. These cli-

Table 5. Joint correlation of the four weather factors on field infestation with egg-masses of the cotton leafworm through the years 1984-1989.

Date	joint correlation of the four weather factors on percent infestation
May	59%
June	39%
July	37%

matic parameters can be used in the prediction of the dynamics of the cotton leafworm in cotton fields. Such prediction is essential in forecasting the insect outbreak as a part of any integrated pest managemen (IPM) strategy.

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التأثير المتزامن لاربعة عوامل جوية على الإصابة بدودة ورق القطن

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تم دراسة تأثير العوامل الجوية متوسط الحرارة اليومية ، متوسط الرطوبة ، الضغط الجوى ، متوسط فترة سطوع الشمس اليومية على الإصابة بدودة ورق القطن فى الفترة من شهر مايو حتى شهر يوليو فى ٦ سنوات متتالية فى محافظة البحيرة (١٩٨٤ – ١٩٨٩). وجد أن الإصابة بدودة ورق القطن تزداد بإنتظام حتى تصل اقصاها فى اوائل شهر يوليو.

كانت هناك علاقة بين هذه العوامل وتأثيرها على الإصابة بنسب ٥٨٪ ، ٣٨٪ ، ٣٦٪ فى مايو – يونيو ويوليو على التوالى. ولكن فى شهر يوليو كانت العلاقة واضحة للغاية بالنسبة للعاملين متوسط الحرارة اليومية ، متوسط فترة سطوع الشمس.

يتضح من النتائج أن العوامل الجوية لها تأثير هام على الإصابة بدودة ورق القطن تحت ظروف الحقل ، كما يمكن استنباط نموذج رياضى يمكن عن طريقه التنبؤ بمستوى الإصابة بهذه الآفة والذى يعتبر العامل الأساسى فى عمل إستراتيجيات المكافحة المتكاملة للآفات.