THE SIMULTANEOUS TRIANGULAR RELATIONSHIP BETWEEN CERTAIN WEATHER FACTORS TEMPERATURE, HUMIDITY, NUMBER OF CAPTURED PINK BOLLWORM MALE MOTHS AND INFESTATION IN GREEN BOLLS

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Abstract

A field trial was carried out to study the combined effect of day maximum temperature, relative humidity on the corresponding number of captured *Pectinophora gossypiella* (Saunders) male moths as indicated by sex trap and the infestation in green cotton bolls in field.

This study was conducted at Assiut and Gharbia Governorates throughout 2000 cotton growing season. The number of captured male moths was recorded each three days during the season.

The relationship between day maximum temperature and the corresponding number of male moths captured in the traps was estimated during spring revealed that number of moths increased gradually, thus forming a peak when day maximum temperature ranged between 36°C on 5th May at Assiut and 33°C on 20th May at Gharbia. The correlation value yielded a significant and positive "r" value between day maximum temperature and number of trapped moths in trap and insignificant positive correlation between minimum temperature, minimum relative humidity and number of captured moths during the valuable occurrence of green bolls susceptible to infestation (three weeks old).

The same trend was obtained, *i.e.* insignificant positive correlation between temperature degrees and activity of newly hatched larvae which attack the green bolls in cotton fields, the average temperature fluctuated between 29°C & 30°C at both Governorates; Gharbia and Assiut, respectively.

The study also revealed that there is a relationship between average relative humidity and the corresponding average number of newly hatched larvae of pink bollworm inside the green bolls and insignificant positive correlation for Assiut Governorate (R.H. between 39 % and 46 %). A significant positive correlation for Gharbia governorate (R.H. between 66 % and 73 %) was found suitable for activity of newly hatched larvae.

INTRODUCTION

The pink bollworm, *Pectinophora gossypiella* (Saunders) has been considered destructive insect pest of cotton in Egypt. The number of moths captured by sex pheromone trap depends greatly on weather conditions; temperature,

relative humidity (R.H.) and wind speed. Chu and Henneberry (1990), Gupta *et al.* (1990) and Dhaliwal *et al.* (1991) showed that average day temperature and average day humidity demonstrated significant positive impact on the population build-up of the changes in the population density of pink bollworm moths. Qureshi *et al.* (1992), Beasley and Adams (1994), Schouest and Miller (1994) and Adams *et al.* (1995) reminded that the major factors affecting the number of pink bollworm caught and the time of peak catch were temperature, wind speed and time of sunset. Temperature below 20°C suppressed flight activity. Dhawan and Simwat (1996) showed that the relationship of pink bollworm moth catch with temperature was positive, while relative humidity was negative. El-Saadany *et al.* (1999) found that positive relationship prevailed between the changes in the population density of *P. gossypiella* (Saund.) and the required accumulative thermal units. El-Sayed (2001) stated that max. temp. revealed different effects on the population activity of pink bollworm moth. Max. temp. demonstrates positive correlation during the season.

The present study was conducted to determine :

- The effect of maximum temperature on the emergence activity of pink bollworm moths from pupae of diapausing larvae during the spring.

- The relationship between certain weather factors and the population activity of pink bollworm moths during both flowering period and formation of preferred green cotton bolls.

- The triangular relationship between certain weather factors, relative humidity, temperature, population of pink bollworm moths and infestation in green bolls.

MATERIALS AND METHODS

A large scale experiments were carried out at Assiut and Gharbia Governorates during 2000 cotton growing season. Monitoring the changes in the number of pink bollworm moths was obtained by pheromone Delta traps. The impregnated pheromone capsules were replaced with new ones every two weeks. Traps were examined once each three days. 85 and 453 traps were placed in gin-houses at Assiut and Gharbia Governorates, respectively. The number of male pink bollworm moths emerged from pupae of diapausing larvae from double cotton seeds was recorded from the beginning of spring (21st March) until the end of April. Relationship between those moths and maximum temperature in the two regions was estimated.

During the cotton growing season, the traps were distributed (one trap/30

feddans) at the top of the cotton canopy and adjusted at the level periodically with the crop growth throughout the season, 1498 and 1503 traps were distributed in cotton field at Assiut and Gharbia Governorates, respectively.

From 23rd May to 28th June at Assiut and from 10th June to 10th July at Gharbia, the number of captured male pink bollworm moths was counted. The effect of certain weather factors and on the fluctuation in the population activity of moths was estimated.

Hence, middle-aged bolls (21-30 days) were most preferable for infestation by newly hatched larvae of pink bollworm (Kostandy and El-Gemeiy, 1996). The relationship between minimum temperature, relative humidity and number of moths in trap was evaluated, while green cotton bolls (three weeks old) were forming during July and from second week of July to second week of August at Assiut and Gharbia Governorates, respectively.

Samples of 100 green middle-aged cotton bolls were picked. A total of 31- 122 samples* were completed during July from Assiut Governorate, while 110-316 samples* were collected from the 2nd week of July to the 2nd week of August at Gharbia Governorate. The bolls were dissected and the numbers of newly hatched larvae of pink bollworm were recorded. The effect of daily mean relative humidity, the daily mean temperature and the infestation by the newly hatched larvae of pink bollworm to green middle aged bolls was studied.

RESULTS AND DISCUSSION

Table 1 shows the relationship between maximum temperature and average number of pink bollworm male moths per night which emerged from pupae of diapausing larvae in double cotton seeds at sweeping of gin- houses from 1st March to 29th May 2000 at both of Assiut and Gharbia Governorates. Number of trapped moth in traps increased gradually from the beginning of spring at which the highest number of moths was obtained when temperature reached to 36°C on 5thMay and 33°C on 20th May at Assiut and Gharbia, respectively. The values revealed the presence of significant positive correlation values between maximum temperature and average number of captured moths. This agrees with the finding of Beasley and Adams (1994) and Adams *et al.* (1995) in California, revealed that peak time of occurrence correlated positively and significantly with maximum temperature.

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* The difference in number of samples was due to the time of forming green bolls three weeks old in the fields.

Table 1. The fluctuations in day maximum temperature* figures and number of trapped pink bollworm moths emerged from diapausing larvae in sweeping of ginning cotton in gin-house at Assiut and Gharbia during spring season of 2000.

Inspection date	Assiut Governorate		Gharbia Governorate	
	Max. temp. °C	Av. no.of moths/trap/ night	Max. temp. °C	Av. no.of moths/trap/ night
21/3	23.0	0.05	21.0	0.5
24	25.0	0.06	18.0	0.6
27	23.5	0.07	21.0	0.47
30	26.0	0.07	23.0	0.47
2/4	32.0	0.07	29.0	0.62
5	34.0	0.06	25.0	0.72
8	34.5	0.06	29.0	0.79
11	30.0	0.06	23.0	0.79
14	35.0	0.07	24.0	0.83
17	32.5	0.1	25.0	0.94
20	36.5	0.2	27.0	0.95
23	30.0	0.4	27.0	0.9
27	31.0	0.5	28.0	0.82
30	34.0	0.4	28.0	0.98
2/5	37.0	0.4	29.0	1.04
5	36.0	0.5	27.0	1.03
8	32.0	0.26	26.0	1.15
11	32.0	0.3	28.0	1.05
14	37.0	0.2	32.0	1.29
17	38.0	0.3	33.0	1.49
20	36.0	0.3	33.0	1.58
23	35.0	0.3	32.0	1.62
26	36.0	0.3	32.0	1.43
29/5	34.0	0.3	33.0	1.46

* C.F. Central Lab. for Agric. Climate, Agric. Res. Center.

The integration of the data in Table 2 reveal that the relationship between day minimum temperature, day relative humidity and mean number of male moths/trap/night placed in cotton fields during cotton flowering season, i.e. before middle aged boll formation from the last week of May to the last week of June at Assiut and from the *2nd* week of June to the *2nd* week of July at Gharbia during cotton season 2000. A positive correlation coefficients value between the day minimum temperature and number of moths in trap was achieved. Similar findings were obtained by Chu and Henneberry (1990) in the Imperial Valley (U.S.A.) and Adams *et al.* (1995) in California and Dhawan and Simwat (1996) in India. These results were contrary to that obtained by Qureshi *et al.* (1992) in

Pakistan who stated that correlation between pink bollworm moth catches and temperature was negative and significant.

The obtained data yielded the insignificant correlation between day minimum temperature and number of moths in traps. This result may explain that the decreasing of minimum temperature is unsuitable for moth flight activity, this was in agreement with the findings of Schouest and Miller (1994) in California who found that temperature below 20°C suppressed flight activity of pink bollworm moths to the minimum.

Table 2. The fluctuations in day minimum temperature, relative humidity % figures* and the corresponding number of captured pink bollworm moths in cotton fields at Assiut and Gharbia Governorates during cotton flowering, season of 2000.

Inspection date	Assiut Governorate			Gharbia Governorate		
	Min. temp. °C	Min. R.H. (%)	Av. no. of moths/ trap/night	Min. temp. °C	Min. R.H. (%)	Av. no. of moths/ trap/night
23/5	20	17	0.3			
26	21	17	0.4			
29	21	15	0.4			
1/6	22	16	0.5			
4	21	20	0.6			
7	20	18	0.7			
10	22	16	1.14	22	40	10.85
13	22	11	1.27	20	35	8.14
16	22	9	1.2	19	28	7.48
19	21	12	1.2	20	35	7.01
22	20	20	1.15	19	35	6.2
25	22	18	1.3	20	30	4.6
28	22	14	1.5	20	35	4.11
1/7				20	34	4.2
4				21	37	4.4
7				21	40	4.6
10				21	40	5.2

* C.F. Central Lab. for Agric. Climate, Agric. Res. Center.

r1 = +0.495

r2 = +0.208

Flight activity of moth was strongly affected by weather factors. Beasley and Adams (1994) and Schouest and Miller (1994) in California confirmed that time of maximum pink bollworm occurrence was correlated with time between sunset and sunrise, prevailing temperature, relative humidity (R.H. %) and wind speed.

The obtained results revealed the insignificant positive correlation between day minimum relative humidity (R.H. %) and number of catches. This confirms the earlier finding of Gupta *et al.* (1990) in New Delhi, India. These results were contrary to that obtained by Qureshi *et al.* (1992) and Dhawan and Simwat (1996) who found that the relationship between pink bollworm moth catch with relative humidity (R.H. %) was negative and significant.

The data in Table 3 show the relationship between minimum temperature, relative humidity and activity of pink bollworm moths during formation of green middle aged bolls in July at Assiut and from the 2nd week of July to the 2nd week of August at Gharbia, cotton season 2000. Data revealed an insignificant positive correlation between minimum temperature, relative humidity and number of captured moths. This agree with the findings of Chu and Henneberry (1990) and Gupta *et al.* (1990).

The integration of the data in Table 4 reveal that the relationship between day average temperature, relative humidity (R.H. %) and activity of newly hatched larvae which attacked the cotton green bolls during July for Assiut and from the 2*nd* week of July to the 2*nd* week of August in Gharbia. The analysis of the data yielded an insignificant positive correlation "r" value between day average temperature and average number of newly hatched larvae occurred inside the green bolls. This confirms the previous findings of Gupta *et al.* (1990).

The data also revealed that there is a relationship between average relative humidity and the corresponding average number of newly hatched larvae of pink bollworm inside the green bolls and insignificant positive correlation for Assiut (R.H. % between 39 % and 46 %). A significant positive correlation for Gharbia (R.H. % between 66 % and 73 %) was found suitable for activity of newly hatched larvae. Husain *et al.* (1935) found that oviposition of pink bollworm was the highest when the relative humidity was on an average 70 %. A high relative humidity appeared to be the most favourable for the developmental rates of the insect.

The present data for the correlation between day average relative humidity % and average number of newly hatched larvae infesting green bolls confirms the observations of Gupta *et al.* (1990) who concluded that average humidity had significant positive impact on the population build-up of pink bollworm in cotton fields.

Table 3. The fluctuation in the day minimum temperature, relative humidity % figures and population activity of pink bollworm moths in fields at Assiut and Gharbia during the reliable presence of green middle aged bolls.

Inspection date	Assiut Governorate			Gharbia Governorate		
	Min. temp. °C	Min. R.H. (%)	Av. no. of moths/ trap/night	Min. temp. °C	Min. R.H. (%)	Av. no. of moths/ trap/night
3/7	21.5	22.0	1.5			
9	21.5	14.0	1.4	20.0	40.0	5.9
15	22.0	20.0	1.5	21.0	41.6	6.9
21	23.0	18.0	1.7	21.0	40.0	6.1
27	22.0	18.0	1.7	22.0	43.0	6.5
2/8				22.2	45.0	7.8
8/8				22.0	45.0	6.8

Table 4. The change in the average day temperature, relative humidity % figures and the newly hatched larvae of pink bollworm infesting the green bolls at Assiut and Gharbia during formation of cotton green middle aged bolls.

Inspection date	Assiut Governorate			Gharbia Governorate		
	Average temp. °C	Average R.H. (%)	Av. no. of larvae/ 100 bolls	Average temp. °C	Average R.H. (%)	Av. no. of larvae/ 100 bolls
3/7	29	45.5	0.16			
9	32	46.0	0.42	27.5	67.0	0.27
15	32	39.0	0.21	27.0	66.0	0.23
21	30	40.0	0.10	28.0	69.0	0.39
27	30	44.0	0.13	30.0	73.0	0.55
2/8				30.0	71.0	0.53
8				29.0	70.0	0.53

Table 5 shows the correlation coefficient "r" and regression coefficient "b" values between relative humidity %, temperature figures and number of pink bollworm male moths in trap, newly hatched larvae infesting green bolls in cotton field.

GENERAL CONCLUSION

The study revealed that during the spring season, a significant positive correlation values between maximum temperature and pink bollworm moths emerged from diapausing larvae was observed. During cotton flowering season, *i.e.* before middle aged boll formation there was an insignificant positive correlation between the day minimum temperature and number of moths/trap/night. This result may explain that decreasing of minimum temperature is unsuitable for moth flight activity. An insignificant positive correlation between day minimum relative humidity (R.H. %) and number of catches was noticed.

During formation of middle aged bolls in cotton field in July at Assiut and from the 2nd week of July to the 2*nd* week of August at Gharbia, data revealed an insignificant positive correlation between minimum temperature, relative humidity and number of captured moths.

An insignificant positive correlation (r) value between day average temperature and average number of newly hatched larvae occurred inside green cotton bolls.

A relationship between average relative humidity and the corresponding average number of newly hatched larvae of pink bollworm inside the green bolls revealed that insignificant positive correlation for Assiut (R.H. % between 39 % and 46 %). A significant positive correlation for Gharbia (R.H. between 66 % and 73 %) was found suitable for activity of newly hatched larvae. A high relative humidity appeared to be the most favourable for the developmental rates of the insect.

Table 5. The simple correlation and regression coefficient values for the relation between relative humidity %, temperature, number of pink bollworm moths and number of newly hatched larvae infesting the green bolls of 21 day age in cotton fields at Assiut and Gharbia districts, 2000 season.

Parameters	Assiut Gov.		Gharbia Gov.	
	Correlation	Regression	Correlation	Regression
Between max. temp. and number of moths during spring	+0.459*	+0.016	+0.437*	+0.003
Between min. temp. and moths during cotton flowering season	+0.495	+0.254	+0.208	+0.489
Between min. humidity and moths during cotton flowering season	+0.010	+0.001	+0.098	+0.053
Between min. temp. and moths during green boll formed	+0.761	+0.167	+0.725	+0.576
Between min. humidity and moths during green boll formed	+0.176	+0.008	+0.803	+0.238
Between av. temp. and newly hatched larvae in bolls	+0.714	+0.068	+0.051	+0.003
Between av. humidity and newly hatched larvae in bolls	+0.145	+0.180	+0.943*	+0.052

* Indicates significant correlation values.

REFERENCES

1. Adams, C.J., C.A. Beasley and J.. Henneberry. 1995. Effects of temperature and wind speed on pink bollworm (Lepidoptera : Gelechiidae) moth captures during spring emergence. J. Econ. Entomol., 88 (5) : 1263-1270.

2. Beasley, C.A. and C.J. Adams. 1994. Relationship between environmental factors and capture time of male pink bollworm moths in traps baited with sex pheromone. J. Econ. Entomol., 87 (4) : 986-992.

3. Chu, C.C. and T.J. Henneberry. 1990. Pink bollworm seasonal distribution, yearly variation and male moth trap catch relationships to population increases in cotton. Southwest Entomol., 15 (3) : 273-280.

4. Dhaliwal, Z.S., Joginder Singh, H.S. Sekhon and A.S. Sidhu. 1991. Trop. Agric., 68 (3) : 268-270.

5. Dhawan, A.K. and G.S. Simwat. 1996. Monitoring the seasonal abundance of cotton bollworms with pheromone traps. Indian J. Ecol., 23 (2) : 123-129.

6. El-Saadany, G.B., A.M. Hossain, S.M. El-Fateh Radwan and M.A. Romeila. 1999. The simultaneous effect of physical environmental factors governing the population activity of cotton bollworm moths. Egypt. J. Agric. Res., 77 (2) : 591-609.

7. El-Sayed, A.A. 2001. Studies on pink bollworm, *Pectinophora gossypiella* (Saund.) and spiny bollworm, *Earias insulana* (Boisd.) in cotton fields at Sharkia Governorate. M.Sc. Thesis, Fac. Agric., Zagazig Univ., 126 pp.

8. Gupta, G.P., P. Kishore and A.K. Vashisht. 1990. Monitoring of pink bollworm, *Pectinophora gossypiella* (saunders) males through pheromone traps and weather parameters affecting population build-up. J. Entomol. Res., 14 (1) : 21-29.

9. Husain, M.A., M.H. Khan and N. Ahmad 1935. Ecological studies of pink bollworm. Curr. Sci., 3 (7) : 304-305.

10. Kostandy, Samir N. and Hayat M. El-Gemeiy. 1996. Impact of cotton boll age and moisture content on the incidence of pink and spiny bollworms. Fayoum J. Agric. Res. & Dev., 10 (1) : 172-182.

11. Qureshi, Z.A., N. Ahmad and T. Hussain. 1992. Pheromone trap catches of pink bollworm as influenced by crop phenology and climatic factors. Proceedings of Pakistan Congress of Zoology, 12 : 43-47.

12. Schouest, L.P., Jr. and Miller. 1994. Automated pheromone traps show male pink bollworm mating response is dependent on weather conditions. J. Econ. Entomol., 87 (4) : 965-974.

العلاقة بين درجات الحرارة ، الرطوبة النسبيه وتعداد فراشات دودة اللوز القرنفلية فى مصائد الجاذبات الجنسية وأعداد اليرقات حديثة الفقس لدودة اللوز القرنفلية

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أجريت الدراسات بمحافظتى أسيوط والغربية موسم ٢٠٠٠، باستخدام مصائد الجاذب الجنسى لدودة اللوز القرنفلية والتى كانت تفحص كل ثلاثة أيام لتقدير تعداد الفراشات خلال الموسم.

درست العلاقة بين درجة الحرارة القصوى وعدد الفراشات بالمصائد التى وضعت فى المحالج خلال الربيع ووجد أن الزيادة فى أعداد الفراشات بالمصائد تتدرج فى الإرتفاع إلى أن تصل الزيادة قمتها عندما تصل درجة الحرارة العليا إلى ٣٦° م ، ٣٣° م فى ٥ مايو ، ٢٠ مايو بمحافظتى أسيوط والغربية على التوالى. وقد وجد إرتباط معنوى موجب بين درجة الحرارة القصوى وعدد الفراشات فى المصيدة فى الليلة الواحدة حيث أن إرتفاع درجة الحرارة كانت أحد العوامل الأساسية فى خروج الفراشات القرنفلية من عذارى اليرقات الساكنة.

أظهرت العلاقة بين درجة الحرارة الدنيا ودرجة الرطوبة الدنيا وعدد الفراشات القرنفلية فى المصيدة خلال فترة تزهير القطن وجود إرتباط موجب غير معنوى ويعنى ذلك أن إنخفاض درجة الحرارة عن حد معين يكون غير مناسب لطيران الحشرة ودخول الفراشة فى المصيدة وأن العوامل الجوية من حرارة ورطوبة تؤثر على طيران الحشرة.

أوضحت العلاقة بين درجة الحرارة الدنيا ودرجة الرطوبة الدنيا ونشاط الفراشات خلال فترة تكون اللوز الأخضر القابل للإصابة أنه يوجد إرتباط موجب غير معنوى.

أظهرت العلاقة بين متوسط درجات الحرارة وأعداد اليرقات حديثة الفقس التى تهاجم اللوز الأخضر فى الحقل بمحافظتى أسيوط والغربية وجود إرتباط موجب غير معنوى.

وعند دراسة العلاقة بين متوسط درجات الرطوبة النسبية وعدد اليرقات حديثة الفقس الموجودة فى اللوز الأخضر وجد إرتباط موجب غير معنوى بمحافظة أسيوط حيث كان متوسط الرطوبة النسبية يتراوح بين ٣٩% ، ٤٦% - بينما كان الإرتباط موجب ومعنوى بمحافظة الغربية حيث أن متوسط درجات الرطوبة النسبية يتراوح بين ٦٦% ، ٧٣% وهو مناسب جداً لنشاط وحيوية اليرقات ومن ثم دخولها لوزة القطن.