

EFFECT OF SIX VARIETIES OF EGYPTIAN COTTON PLANTS ON THE BIOLOGY OF THE PINK BOLLWORM

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ABSTRACT: *The Effect of six Egyptian cotton varieties (G 45, G 70, G 85, G 86, G 83 and G 89) on the biology of pink bollworm, *Pectinophora gossypiella*, was studied. In this respect, the weight of pupa, the adult female longevity, the mean of preoviposition and oviposition periods and the number of eggs /female were considered. The green bolls of G 89 and G 45 gave the longest larval period and the longest pupal periods. Insignificantly differences had been observed between the longevities of adult male in different cotton varieties. The longest incubation period was on G 45.*

Key Words: *biology, cotton, pink bollworm, *Pectinophora gossypiella*.*

INTRODUCTION

Cotton is subjected to be attacked by several insect pests which cause serious damage to the crop in both quantity and quality. The spiny bollworm *Earias insulana* (Boisd), and the pink bollworm, *Pectinophora gossypiella* (Saund) are considered among the most serious pests (Hassanein, *et al.* 1992).

Recently, there is new trend to use plant defense mechanisms, Differences in the susceptibility or resistance of different plants to an insect are reflected in the magnitude of its population established on them and the resulting damage. The population of an insect on a plant is determined by an interaction between its responses and the plant characters. The following six main types of responses, operating in as many stages, are involved in the establishment of an insect on plant: (1) orientation; (2) feeding responses; (3) metabolic responses; (4) development of insect; (5) egg-production in the adult stage; (6) oviposition. The first, second and last of the above mentioned responses are behavioural which determine the initial selection of a plant by an insect. In order to understand the principles governing the susceptibility /resistance of plants to an insect species, it is necessary to compare the above mentioned responses to susceptible and resistant plant Saxena (1985).

Therefore, the aim of the present work was to study the effect of six varieties of Egyptian cotton plants (G 45, G 70, G 85, G 86, G 83 and G 89) on the biology of pink bollworms, *P. gossypiella*.

MATERIAALS and METHODS

1.The effect of tested cotton varieties on the biology of the pink bollworm, *P. gossypiella* (Saund.) :

1.1. Rearing technique:

Moths of the pink bollworm were obtained from a population reared in laboratory for 4 generations on modified artificial diet as described by Abd El Hafez (1982). 10 Pairs of newly emerged moths were confined in a glass oviposition cage of one liter size. In each cage was suspended a piece of cotton wool, previously soaked in 10 % sugar solution, renewed after 48 hours for moth feeding. Cage tops were covered with muslin secured with rubber bands and the bottoms were covered with screening mesh for stimulating the egg laying response in the females. Eggs were deposited through the screening mesh on a piece of paper put under the cage in open petri dish that served oviposition site. Cages were maintained at a temperature of 27°C. and 80-85% R.H. and were examined daily for collecting eggs. Papers and muslin containing eggs were kept in glass vials 12x3.5 cm and covered with pieces of cotton wool until hatch. Newly hatched larvae were fed individually in glass vials (2x7.5cm.) filled to one third with kidney beans diet covered with absorbent cotton and held in the same conditions. The pupae were collected daily transformed individually to clean glass vials and incubated until moth emergence.

1.2. Effect of different cotton varieties on the biology of the pink bollworm *P. gossypiella* Saund.:

In the present study, 120 plants were selected at random and the new flowers were daily labeled from 15th. of June to 25th of August . At the end of the season, plants were cut and transferred to the laboratory where bolls were separated and sorted out into 1 age group 4 weeks old. Bolls were isolated from the plants and these bolls were kept in glass vials and infested with first stage larvae. As described by Abd El Hafez (1977).

In this experiment newly hatched larvae were obtained from eggs produced by fertilized females kept in standard oviposition cages, these eggs were kept in glass vials and after hatching the larvae were transferred to glass tubes (4x10 cm.) with tops covered with absorbent cotton wool by a moist camel's hair brush to separate tubes. These tubes were contained with bolls as a diet, this diet was examined every 48 hours and the larvae were placed again with fresh diet from the same age of bolls in another clean tube until pupation. The duration of different stages were determined .There was 1 group of bolls (4 weeks olds) for each variety, which had 3 replicates and there were 10 glass tubes for each replicate (3larvae/glass) were kept under laboratory condition (27°C and 80-85% R.H.) .

Statistical Analysis:

The obtained results were subjected to the analysis of variance test (ANOVA) with mean separation at 5% level of significance by LSD test

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according to Snedecor and Cochran (1973) and Duncan's multiple range test were used as described by Fisher (1944).

RESULTS and DISCUSSION

1. Results of this study showed that the various varieties tested clearly affected developmental stages of the pink bollworm, *P. gossypiella* :

1.2. Egg stage

Table (1) shows the incubation periods of eggs produced by females resulted from rearing *P. gossypiella* larvae on the bolls of the tested cotton varieties. From data obtained, the least incubation period was 4.933 days when insects were reared on G70, whereas the longest period was 6.11 days when insects were reared on G 89. Incubation periods were 6.03, 5.733, 5.433, and 5.11 days when insects were reared on G 45, G 83, G86 and G 85, respectively.

Table (1): Effect of different cotton varieties on the egg incubation period and the total larval period.

| Variety | Incubation period (days) | | | |
|---------|-----------------------------|-------|-------|------------------|
| | Mean \pm S . E | S . D | Group | |
| G 86 | 5.43 \pm 0.29 | 0.41 | ab | |
| G 89 | 6.11 \pm 0.1 | 0.17 | a | |
| G 45 | 6.03 \pm 1.73 | 2.45 | a | |
| G 85 | 5.1 \pm 0.25 | 0.36 | b | |
| G70 | 4.93 \pm 0.20 | 0.27 | b | |
| G 83 | 5.73 \pm 0.12 | 0.17 | a | |
| Average | 5.54 \pm 0.4 ^a | 0.64 | | |
| Varity | Total larval period (days) | | | %Larval survival |
| | Mean \pm S . E | S . D | Group | |
| G 86 | 22 \pm 0.31 | 0.43 | b | 60 % |
| G 89 | 23.47 \pm 0.24 | 0.34 | a | 57 % |
| G 45 | 23.43 \pm 0.15 | 0.21 | a | 55 % |
| G 85 | 19.37 \pm 0.41 | 0.57 | c | 61 % |
| G70 | 20.27 \pm 0.55 | 0.78 | c | 66 % |
| G 83 | 22.67 \pm 0.47 | 0.66 | ab | 59 % |
| Average | 21.87 \pm 0.35 | 0.49 | | |

(F) value for the effect of variety on egg incubation period = 5.8704 (significant at 0.05) and L.S.D=0.587

(F) value for the effect of variety on total larval period = 20.2339 (significant at 0.05) and L.S.D=1.166

Values followed by the same letter are not significant different.

1.3. Larval stage:

Table (1) shows that the different cotton varieties had a highly significant effect on the duration of the larval stage of *P. gossypiella*; the shortest larval period was 19.37 days, when the larvae were reared on G 85, while the longest larval period was 23.47 days, when the larvae were reared on G 89

and 23.43 on G 45. Table (1) shows also that the highest larval survival was 66%, when larvae were reared on G 70, whereas the percent survival were 61%, 60%, 59% and 57% when reared on G 85, G 86, G 83 and G 89 respectively, however the survival rate was 55% when larvae were reared on G 45.

1.4. Pupal stage :

Table (2) shows the pupal period of larvae reared on different cotton varieties. Results obtained were statistically significant where the shortest pupal period was 7.73 days, when the larvae were reared on G 70, followed by 7.89 on G 85, 8.33 on G 86, 8.6 on G 83, while the longest pupal period was 9.43 and 9.27 days when the larvae were reared on G 45 and G 89 respectively, and the pupal period ranged from 7.73 on G 70 to 9.43 days on G 45.

The weight of pupae differed significantly on different cotton varieties as shown in Table (2). Insects reared on G 70 produced the heaviest pupae, which was 21.63 mg., the pupal weights were 21.15, 20.5, 20.08, 19.61 and 19.54, mg on G85, G 86, G 83 G 89 and G 45, respectively. Generally, pupal weight ranged between 21.63 mg on G 70 and 19.54 mg on G 45.

Table (2): Effect of different cotton varieties on the duration of pupae and the pupal weight.

| Varity | Pupal period (days) | | |
|---------|---------------------|-------|-------|
| | Mean ± S . E | S . D | Group |
| G 86 | 8.33±0.15 | 0.21 | b |
| G 89 | 9.27±0.41 | 0.58 | a |
| G 45 | 9.43±0.33 | 0.46 | a |
| G 85 | 7.87±0.18 | 0.25 | b |
| G70 | 7.73±0.29 | 0.42 | b |
| G 83 | 8.6 ±0.17 | 0.24 | ab |
| Average | 8.54±0.25 | 0.36 | |
| Varity | Wight of pupa(mg) | | |
| | Mean ± S . E | S . D | Group |
| G 86 | 20.5±0.27 | 0.40 | bc |
| G 89 | 19.61±0.16 | 0.22 | d |
| G 45 | 19.54±0.29 | 0.42 | d |
| G 85 | 21.15±0.19 | 0.27 | ab |
| G70 | 21.63±0.32 | 0.46 | a |
| G 83 | 20.08 ±0.15 | 0.21 | cd |
| Average | 20.08±0.15 | 0.33 | |

(F) value for the effect of variety on pupal period = 6.6648 (significant at 0.05) and L.S.D=0.839

(F) value for the effect of variety on weight of pupae = 11.9911 (significant at 0.05) and L.S.D=0.749

Values followed by the same letter are not significant different.

1.5. Adult stage:

The longevity of the adults was divided into pre oviposition and oviposition and post oviposition periods for females. The data in Table (3)

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showed that the average adult longevity was 12.98 days for females and showed that the longest longevity was 13.51 days followed by 13.19, 12.93, 12.867, and 12.82 days on G 70 ,G 85, G 89, G 86 and G 83 respectively, while the shortest longevity was 12.57 days on G 45.

The different cotton varieties had an insignificant effect on the pre-oviposition and oviposition periods for females. The longest pre- oviposition period was 2.97 days followed by 2.93, 2.90, 2.86 and 2.77 days on G 70 , G 83 ,G 45, G 86 and G 89 respectively, while the shortest pre oviposition averaged 2.63 days on G 85 .Also ,the longest oviposition period was 10.12 days on G70, followed by 9.83, 9.47 ,9.22 and 9.17 days on G 85, G 86, G 83 and G 89 respectively. The shortest oviposition period was 8.80 days on G 45 .Results in (Table 3&4) showed also that the average longevity of males was 12.48 days. The longest longevity was 13 days followed by 12.54, 12.25, 12.78, and 12.14 days on G 70, G 89, G 86, G 85 and G 45, respectively, while the shortest longevity was 12.18 days on G 83.

1.6. Egg laying:

Comparison between the mean number of eggs laid per female during rearing on tested cotton varieties revealed significant differences. The highest and lowest means of obtained eggs were 88.00 and 68.43 eggs/female when insects were reared on G 70 and G 45, respectively, whereas the average numbers were 84.46, 77.69, 75.43, and 69.45 eggs/female when insects were reared on G85, G 86 G 83, and G 89, respectively.

Results obtained from the present study indicated that the type of food has a great effect on the larval development, weight of pupae, reproductive capacity and the longevity of the pink bollworm adults. Similarly, the larval survival was found to be significantly affected when fed on six different varieties of cotton.

These results are in agreement with the findings of Abd El Hafez (1977) who stated that cultivated cotton is the most preferred host for pink bollworm and the okra pods gave a percentage of survival among pink bollworm larvae less than cotton bolls .Owen and Calhoun (1932) mentioned that the feeding and pupal periods were of shorter duration for larvae which fed on cotton bolls.

In the present study a significant difference in the larval periods was obtained when different varieties of cotton were used. The larval period decreased when larvae reared on G85 variety.

Chakravarthy and Sidhu (1986) mentioned that *G. arboreum* varieties G27, LD133 and LD 230 were proved potentially susceptible to bollworms *Earias* spp and *P. gossypiella* damage in laboratory tests .Interestingly the varieties exhibited considerable degrees of field resistance . In the laboratory, the four varieties showed non-significant differences in supporting the growth of

Earias and *Pectinophora* larvae. The number of *Earias* eggs on the four varieties did not vary significantly.

Kostandy and Rashad (1997) mentioned that percentages of mortality of mature larvae and pupae in samples of flowers reached about 41%, while it fluctuated between 17 and 23% in samples of green bolls. Abnormal adults were much higher (6%). Sex ratio of normal moths (male: female) was about 1:0.9 and reached 1:1.5 for both tested years.

Heuberger *et al.* (2008) used laboratory bioassays to examine the effects of Bt contamination on feeding behavior and survival of pink bollworm that were resistant (rr), susceptible (ss), or heterozygous for resistance (rs) to Cry1Ac. In choice tests, rr and rs larvae did not differ from ss in preference for non-Bt versus Bt seeds. Survival of rr and rs also did not differ from ss on artificial outcrossed bolls (a mixture of 20% Bt and 80% non-Bt cotton seeds). On artificial hemizygous Bt bolls (70% Bt seeds) and homozygous Bt bolls (100% Bt seeds), rr had higher survival than ss, although rs and ss did not differ. In a stimulation model, levels of refuge contamination observed in the field had negligible effects on resistance evolution in pink bollworm. However, in hypothetical simulations where contamination conferred a selective advantage to rs over ss individuals in refuges, resistance evolution was accelerated.

Table (3): Effect of different cotton varieties on the preoviposition, oviposition, postoviposition, and the number of eggs deposited / female.

| Variety | Pre oviposition period(days) | | | Oviposition period(days) | | |
|---------|-------------------------------|-------|-------|--------------------------|-------|-------|
| | Mean ± S . E | S . D | Group | Mean ± S . E | S . D | Group |
| G 86 | 2.87±0.38 | 0.54 | a | 9.47±0.32 | 0.45 | ab |
| G 89 | 2.77±0.42 | 0.59 | a | 9.16±0.03 | 0.04 | ab |
| G 45 | 2.9±0.45 | 0.64 | a | 8.8±0.3512 | 0.49 | b |
| G 85 | 2.63±0.26 | 0.37 | a | 9.83±0.37 | 0.52 | ab |
| G70 | 2.97±0.34 | 0.48 | a | 10.12±0.003 | 0.004 | a |
| G 83 | 2.93±0.32 | 0.45 | a | 9.22±0.57 | 0.81 | ab |
| Average | 2.84±0.36 | 0.51 | | 9.43±0.27 | 0.39 | |
| Variety | Post oviposition period(days) | | | No .of eggs / female | | |
| | Mean ± S . E | S . D | Group | Mean ± S . E | S . D | Group |
| G 86 | 1.73±0.32 | 0.41 | a | 77.69±1.47 | 2.08 | c |
| G 89 | 1.20±0.51 | 0.52 | a | 69.47±1.09 | 1.55 | d |
| G 45 | 1.82±0.34 | 0.55 | a | 68.43±1.06 | 1.49 | d |
| G 85 | 1.67±0.22 | 0.33 | a | 84.46±1.44 | 2.04 | b |
| G70 | 1.32±0.21 | 0.25 | a | 88.00±0.89 | 1.26 | a |
| G 83 | 1.57±0.25 | 0.40 | a | 75.43±0.42 | 0.59 | c |
| Average | 1.55±0.31 | 0.41 | | 77.25±1.06 | 1.50 | |

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Table (4): Effect of different cotton varieties on the pre longevity of adults (females and males) .

| Variety | Longevity of adult female(days) | | | Longevity of adult (male) | | |
|---------|---------------------------------|-------|-------|---------------------------|-------|-------|
| | Mean \pm S . E | S . D | Group | Mean \pm S . E | S . D | Group |
| G 86 | 14.07 \pm 0.90 | 1.28 | a | 12.25 \pm 0.58 | 0.83 | a |
| G 89 | 13.13 \pm 0.82 | 1.166 | a | 12.54 \pm 0.52 | 0.73 | a |
| G 45 | 13.52 \pm 0.56 | 0.79 | a | 12.14 \pm 0.61 | 0.87 | a |
| G 85 | 14.13 \pm 1.11 | 1.56 | a | 12.79 \pm 0.86 | 1.22 | a |
| G70 | 14.41 \pm 0.87 | 1.23 | a | 13 \pm 0.62 | 0.87 | a |
| G 83 | 13.72 \pm 0.66 | 0.93 | a | 12.18 \pm 0.55 | 0.78 | a |
| Average | 13.83 \pm 0.82 | 1.16 | | 12.48 \pm 0.62 | 0.83 | |

(F) value for the effect of variety on pre oviposition period = 0.1143
(insignificant at 0.05) and L.S.D=0.131

(F) value for the effect of variety on ovi position period = 2.0129
(insignificant at 0.05) and L.S.D=0.044

(F) value for the effect of variety on longevity of adult (female) = 0.1532
(insignificant at 0.05) and L.S.D=2.586

(F) value for the effect of variety on no. of eggs / female = 49.3036
(significant at 0.05) and L.S.D=3.452

(F) value for the effect of variety on longevity of adult (male) = 0.31525
(insignificant at 0.05) and L.S.D= 1.949

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تأثير ستة أصناف من القطن المصري علي بيولوجي دودة اللوز القرنفلية

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شبين الكوم- مصر

الملخص العربي

أجرى هذا البحث لدراسة تأثير ستة أصناف من القطن المصري وهى الأصناف جيزة ٤٥ - جيزة ٧٠ -جيزة ٨٥ -جيزة ٨٦ - جيزة ٨٣ - جيزة ٨٩ على بيولوجى دودة اللوز القرنفلية وكانت النتائج كما يلى:

وجد أن الصنف جيزة ٧٠ أعطى أعلى نسبة بقاء بين يرقات دودة اللوز القرنفلية عند تغذيتها على اللوز الأخضر لهذا الصنف وكذلك أعطى اعلى وزن للعذراء وأطول فترة حياة للحشرة الكاملة الأنثى وأعلى متوسط لفترات ما قبل وضع البيض ووضع البيض وكذلك أعطى هذا الصنف أعلى معدل لوضع البيض بين الإناث. ولوحظ أن الصنفان جيزة ٨٩ و جيزة ٤٥ أعطيا أطول فترة لمرحلة اليرقة وكذلك أطول فترة لمرحلة العذراء، ولم يلاحظ فروق معنوية بين الأصناف المختبرة من حيث تأثيرها على فترة حياة الحشرة الكاملة الذكر. كما وجد أن أطول فترة حضانة للبيض كانت فى الصنف جيزة ٤٥.

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