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SUSCEPTIBILITY OF SOME EGYPTIAN COTTON VARIETIES AND GENOTYPES TO BOLLWORMS INFESTATION

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ABSTRACT

Ten cotton varieties and genotypes, Giza 70, Giza 85, Giza 86, Giza 92, Alexandria 4, Bahteem 101, Karshensky 2, Pima S 6, Pima S 6 x G. 89 and Seuvin were evaluated for their relative resistance against chewing insect pests i.e., *Pectinophora gossypiella* (Sound.), *Earias insulana* (Boisd.) and *Helicoverpa armigera* (Hub.) in Egypt. The study was conducted at Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt during the two successive seasons, 2011 and 2012. The results revealed that Karshensky 2, Giza 70 and Alexandria 4 were the most susceptible genotypes to infestation of green bolls by *P. gossypiella* and *E. insulana*, while Pima S 6 X G.89 was the most resistant one to both insects. On the other hand, Giza 92, Bahteem 101, Giza 86, Seuvin and Pima S 6 X G.89 were significantly resistant genotypes to infestation of green bolls by *H. armigera* during 2011 and 2012 seasons. A negative relationship between concentration of gossypol and ratio of infestation by insects was observed, this means the importance of gossypol concentration for reduction of the infestation by insects.

INTRODUCTION

Cotton (*Gossypium barbadense* L.) is the most economic agricultural crop in Egypt that is attacked by a wide range of insect pests throughout growing stages until maturity. Insect complex is divided into categories; sucking insect pests and chewing insect pests. Among the main chewing insect pests are pink bollworm, *Pectinophora gossypiella* (Saund.) (Lepidoptera: Gelechiidae), spiny bollworm, *Earias insulana* (Boisd.) (Lepidoptera: Arctiidue), and American bollworm, *Helicoverpa armigera* (Hub.) (Lepidoptera: Noctuidae) (Mohyuddin *et al*.,1997). In Egypt, bollworms are well known insect pests causing considerable damage to squares, flowers and green bolls (Khalifa *et al.,* 1974). Differences in the susceptibility of cotton varieties to bollworm infestation have been previously reported, i.e. Lukefahr *et al.,* 1966; Lukefahr and Martin, 1966; Scales and Stadelbacher, 1972; Abdel-Rahim *et al.,* 2000; El-Mezayyen, 2004; Bhatti, *et al.,* 2007; Jamshed *et al.,* 2008 and Al-Ameer*, et al.*, 2010. Chemical control of these insects is expensive, environmentally disruptive and largely ineffective. Therefore, it is necessary to select resistant varieties as one of the efficient and useful tactics in integrated pest management programs.

The present investigation aims to evaluate the susceptibility of some cotton varieties and genotypes to infestation by the abovementioned bollworms at Kafr El-sheikh region, also study the relationship and effect of the infestation and the role of gossypol ratio to infestation tolerance and its variation in cotton genotypes.

MATERIALS AND METHODS

This experiment was conducted at Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt during the two successive seasons; 2011 and 2012 in a Randomized Complete Block Design (RCBD). Ten cotton genotypes were evaluated to tolerance and resistance to insect infestations i.e., Giza 70, Giza 85, Giza 86, Giza 92, Alexandria 4, Bahteem 101, Karshensky 2, Pima S 6, Pima S 6 x G. 89 and Seuvin. The Plot size measured 42 m^2 (1/100 feddan) with four replicates for each variety and genotype. Each cotton genotype plot consisted of five rows, four meters long and 70 cm. wide among the rows. Seeds were sown in hills, spaced 25 cm. apart in the row. After full emergence, the hills were thinned to two plants. All cultural practices were done according to the standard recommendations.

A sample of 40 bolls / genotype was taken for estimating gossypol ratio in green bolls at the chemical laboratory of Chemical Research Department, Cotton Research Institute at Giza. The mean population of different bollworms, i.e., Pink bollworm (*Pectinophora gossypiella*), spiny bollworm (*Earias insulana*) and American bollworm (*Helicoverpa armigera*) were recorded on weekly basis as long as the infestation existed in field from second week of July until mid of September during the 2011 and 2012 season. Weekly random samples of 25 green bolls were collected from each plot (100 green bolls as total) and then the percentages of infestation were determined as bolls containing larvae. The data were subjected to statistical analysis and Duncan's multiple range test (DMRT) (1955). The present study is a preliminary trial to control the three bollworms on cotton plants in open field during two successive seasons. The pesticides which were used in this experiment for Cotton bollworms are listed in Table (1). All these many pesticides were used continually to prevent the insects from taking tolerance and resistance for the pesticides, prevention of insect feeding or reproduction and prevention appearance resistance varieties or resistance strains from the insects.

Table (1): Pesticides used to control cotton bollworms

Number of spray	pesticide	Concentration per feddan
1	Agerin	500 gm. / feddan
2	Pestban+ Atabron	one liter + 400 ml / feddan
3	Teliton+ Cascade	750 ml/ feddan+400 ml I feddan
4	Match	160 ml / feddan
5	Sumi-Alpha KZ	400 ml / feddan
6	Bulldock	150 ml / feddan
7	Decis	350 ml / feddan
8	Sumi-Gold KZ	150 ml / feddan

RESULTS AND DISCUSSION

1. Susceptibility of Egyptian cotton varieties and genotypes to infestation of Pink bollworm *P. gossypiella* :

As shown in Tables (2 , 3) and Fig (1 , 2) infestation of green bolls by pink bollworm *P. gossypiella*, indicated that Kar.2 and Giza 70 (G.70) were the most susceptible cotton genotype while Pima S 6 X G.89 and Seuvin were the most resistant during 2011 and 2012 seasons at Kafr El-Sheikh region. This may be due to the early blooming of Pima S 6 X G.89 and Seuvin, a phenomenon which help escaping the heavy attack occurring at the end of the season. In this respect, Shawer (2000) and El-Mezayyen (2004) indicated that G.45 (late bloomer variety) was the most susceptible variety while G.89 (early bloomer variety) was the most resistant one to *P. gossypiella*.

2. Susceptibility of Egyptian cotton varieties and genotypes to infestation of Spiny bollworm *E. insulana*:

Results in **Tables (2, 3)** and **Fig (1, 2)** revealed that Kar.2 , Alex.4, Giza 85 (G.85) and Giza 70 (G.70), Bahteem 101 and Pima S 6 were significantly the most susceptible cotton varieties and genotypes to green boll infestation by spiny bollworm (*E. insulana*) while Pima S 6 X G.89, Seuvin, Giza 92 (G.92) and Giza 86 (G.86) were the most resistant during 2011. While during 2012 season Alex.4 came the first rank before Kar.2 followed by G85, G70 and Pima S 6 to infestation of green bolls by *E. insulana*.

El-Mezayyen (2004) found that G.89 had the lowest numbers of spiny bollworm larvae; consequently it was the most resistant variety, while G.45 had the highest number of larvae *E. insulana* followed by G.85 and G.86 at Kafr El-Sheikh region.

Table 2 : Susceptibility of cotton green bolls to bollworm infestation, during 2011 season.

Genotypes	% of green boll infestation			% Gossypol in green boll wall
	Pink bollworm	Spiny bollworm	American bollworm	
G.70	5.12 a	7.76 abc	2.22 ab	0.90
G.85	4.11 ab	8.24 ab	1.98 ab	1.14
G.86	4.00 ab	6.09 bc	0.50 c	1.70
G.92	4.56 ab	5.67 bc	0.60 c	1.40
Alex. 4	4.11 ab	8.25 ab	1.38 ab	1.39
Bahteem 101	4.57 ab	7.42 ab	0.50 c	1.41
Kar. 2	5.45 a	9.33 a	1.39 ab	1.27
Pima S 6	4.22 ab	7.67 ab	0.90 bc	1.32
Pima S 6 xG.89	3.11 b	4.67 c	0.89 c	1.71
Seuvin	3.89 b	5.00 c	0.68 c	1.73

***Means followed by the same letter in a column are not significantly different at the 5% level of probability (Duncan Test).**

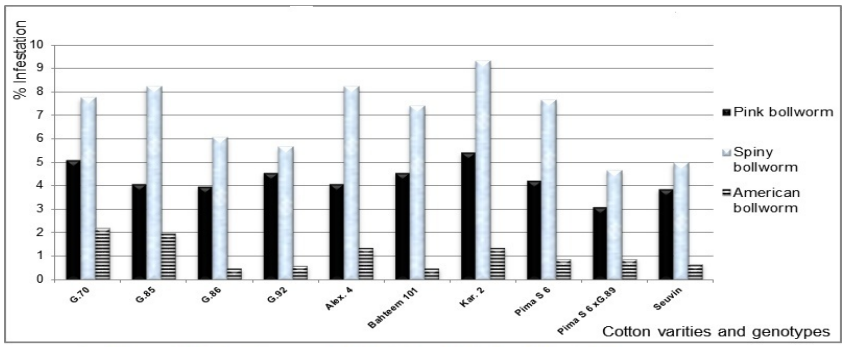

Fig: 1 Susceptibility of cotton green bolls to bollworm infestation, during 2011 season.

Table 3 : Susceptibility of cotton green bolls to bollworm infestation, during 2012 season.

Genotypes	% of green boll infestation			% Gossypol in green boll wall
	Pink bollworm	Spiny bollworm	American bollworm	
G. 70	6.59 ab	13.56 ab	4.56 a	0.92
G. 85	5.33 abc	13.67 ab	1.89 b	1.17
G. 86	4.78 abc	8.67 bc	0.67 c	1.77
G. 92	3.33 bc	6.78 c	0.59 c	1.45
Alex. 4	5.00 abc	16.22 a	1.39 b	1.40
Bahteem 101	4.79 abc	8.05 bc	0.56 c	1.43
Kar. 2	6.67 ab	12.69 bc	1.89 b	1.29
Pima S 6	6.00 abc	12.22 abc	0.84 bc	1.33
Pima S 6 x G. 89	2.89 c	7.67 bc	0.64 c	1.74
Seuvin	2.78 c	7.89 bc	0.56 c	1.75

***Means followed by the same letter in a column are not significantly different at the 5% level of probability (Duncan Test).**

3. Susceptibility of Egyptian cotton varieties and genotypes to infestation of American bollworm *H. armigera*:

Data in Tables (2, 3) and Fig (1, 2) revealed that the green bolls of G.70, G.85, Kar.2 and Alex.4 were the most susceptible genotypes to infestation by *H. armigera* during 2011 and 2012 seasons. While Giza 86, Giza 92, Bahteem 101, Pima S 6 X G.89 and Seuvin were significantly the most resistant

From the above mentioned results, it could be concluded that Kar.2, Alex.4, Giza 70, Giza 85 and Pima S 6 were the most susceptible cotton varieties and genotype to infestation of green bolls by *P. gossypiella* and *E. insulana*, while Pima S 6 X G.89 and Seuvin were the most resistant varieties. On the other hand, Giza 86, Giza 92, Bahteem 101, Seuvin and Pima S 6 X G.89 were significantly resistant cotton genotypes to infestation of green bolls by *H. armigera* during 2011 and 2012 seasons. So, these cotton genotypes can be used as a source of resistance to bollworm infestations.

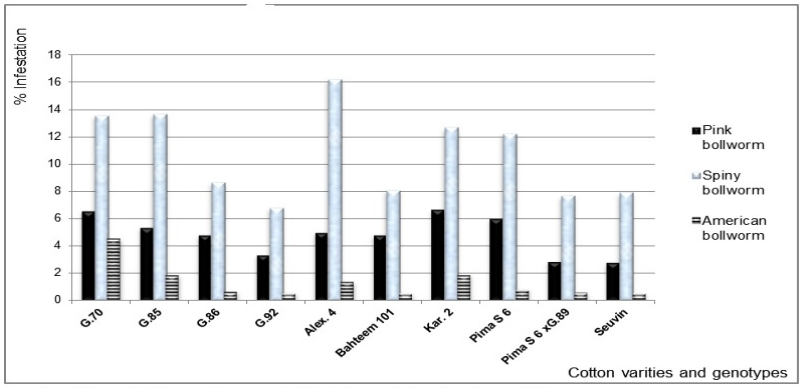

fig: 2 Susceptibility of cotton green bolls to bollworm infestation, during 2012 season.

4. Effect of concentration of gossypol

The results presented in Tables (2 and 3) showed the concerning effect of gossypol ratio, the genotype Giza 86 had high supremacy in gossypol concentration followed by the genotypes of Seuvin, pima S 6 x G.89 and Giza 92 which gave low values comparing with Giza 86, however the rest of genotypes were more depressed in concentration of gossypol. All these results are desirable to provide an insect resistant plant that comprises a gossypol. These results were in agreement with the results reported by Baloch *et al*. (1982) and White *et al*. (1982) who found that maximum cotton yield was obtained from a high- gossypol variety that was comparatively resistant to sucking pests as well as to the bollworms. Also, results of Yuan *et al*. (2000) showed that there were no apparent linkage associations between the glandless gene and most agronomic traits; fiber and seed characters of Upland cotton, except for seed quality, also showed that the gossypol content of seed in dominant glandless lines in Upland cotton was very low (<0.04g/kg). Therefore, it is suggested that the glandless gene can play an important role in breeding glandless or low seed-gossypol Upland cotton cultivars. Also, Bottger (1964) showed that gossypol is also toxic to cotton bollworms, further Shaver and Lukefahr (1969) who showed effect concentration of gossypol for their effect on bollworms and bud worms.

The results also indicated that cotton genotypes often showed differential responses effect to insects infestation, where the genotype Pima S 6 x G.89 had high supremacy in tolerance to the infestation of insects and followed by the genotypes of Giza 92, Seuvin and Giza 86 showed low values comparing with Pima 5 6 x G.89, mean while the remaining genotypes showed less tolerance to the infestation of insects. Raulston (1985) observed a significant increase in budworm tolerance to gossypol during thirteen generations. Further, the genotype Giza 70 was very high in sensitivity to the infestation to insects and followed by the genotypes of Alexandria 4 (Alex.4), Pima S 6 and Karshensky 2 (Kar.2) which cleared low sensitivity values comparing with Giza 70, but the rest of genotypes were less sensitive to the infestation insects. Raulston (1985) observed a significant increase in bud

worm tolerance to gossypol during thirteen generations. This agreement with results of Vilkova (1989) who reported that even though high gossypol lines had a detrimental effect on cotton bollworm development, survival and larval weight when compared to those on low gossypol lines, the larvae from the high gossypol lines that survived had a higher pupal weight because of their apparent induced resistance to gossypol, but fecundity of these survivors was significantly reduced.

Results in Tables (2 and 3) showed that the concentration of gossypol in cotton is desirable in the relationship between existence of gossypol and insect infestations ratio. Therefore, the cotton breeder selec, genotypes with low gossypol in cotton seed (for food industries and feeding) and high gossypol concentrations in the organs of plants i.e.,(leaf, stem, branch, bud, and boll wall), this means the importance of gossypol concentrations to decrease the insect infestations without negative effect on cotton yield. Baloch *et al*. (1982) and White *et al*. (1982) who showed that maximum yield was obtained from a high gossypol variety that was comparatively resistant to sucking pests as well as to the bollworms, Also Yuan *et al*. (2000) showed that there were no apparent linkage associations of the glandless gene with most agronomic traits; fiber and seed characters of Upland cotton, except for seed quality, also the gossypol content of seed in dominant glandless lines in Upland cotton was very low (<0.04g/kg). Therefore, it is suggested that the glandless gene can play an important role in breeding glandless or low seed-gossypol Upland cotton cultivars. Also, Bottger (1964) showed that gossypol is also toxic to cotton bollworms, further Shaver and Lukefahr (1969) who showed effect concentration of gossypol for their effect on bollworms and bud worms. Also, the results go in line with those obtained by Abou-Tour (1986) who showed that the correlation was negative and significant between resistance to bollworms infestation and number of glands/cm^2 of boll wall and total gossypol contents. Vilkova (1989) reported that even though high gossypol lines had a detrimental effect on cotton bollworm development, survival and larval weight when compared to those on low gossypol lines, the larvae from the high gossypol lines that survived had a higher pupal weight because of their apparent resistance to gossypol, but fecundity of these survivors was significantly reduced. Also, Abd El-Hamid and Helw (1973) and Meisner *et al*. (1977) suggested that gossypol content may be one of the factors associated with resistance to cotton leaf worm, so these genotypes can be used as a stock in breeding programs or using in the direct and general agriculture.

REFERENCES

Abd El-Hamid, A.M. and M.R. Helw (1973). Cotton leafworm on different genotypes of cotton. Cott. Gr. Rev., 50: (4), 338

Abdel-Rahim, W. A.; S. M. I. Metwally and F. El-Dakroury (2000). Susceptibility of some Egyptian cotton varieties to the infestation by *Pectinophora gossypiella* (Sound.) and *Earias insulana* (Boisd.). J. Agric. Res., Tanta Univ., 2(2): 332-338.

Al-Ameer, M. A.; M.E. Abd EL-Salam; W. M. B. Yehia and I. A. I. Saad. (2010). evaluation of some cotton Ggenotypes for Ability to Infestation Tolerance to Bollworms for Improving of Some Important Economical Characters. J. Agric. Res. Kafer E1-Sheikh Univ., 36 (2): 147-172.

Abou-Tour, H.B. (1986). Genetical studies on resistance to insects in Egyptian cotton. Ph. D. Thesis. Faculty of Agric. Tanta Univ.

Baloch, A.A.; B.A., Soomro and G.H., Mallah, (1982). Evaluation of some cotton varieties with known genetic markers for their resistance against sucking and bollworm complex. (En, Tr, 11 ref.) Cotton Res. Inst. Sakrand, Pakistan. (From Review of Applied Entomology, A (1982) 70 (12) 7180.

Bhatti, J. A.; M. A. Khan; M. A. Murtaza; M. Z. Majeed and F. F. Jamil (2007). Respons of America bollworm (*Helicoverpa armigera*) (Hub.) to weather factors in cotton under unsprayed conditions. J. Agric. Res., 45(3): 209-214.

Bottger, G.T. (1964). Relation of gossypol content of cotton plants to insect resistance. [1964] J. Econ. Entomol. 57: 283-285.

Duncan, D. B. (1955). Multiple range and multiple F test. Biometrics, 11: 1-42.

El-Mezayyen, G. A. (2004). Evaluation of some Egyptian cotton varieties to infestation of piercing sucking insects, cotton leafworm and bollworms at Kafr El-Sheikh region. J. Agric. Sci. Mansoura Univ., 29(1): 433-441.

Jamshed, K.; A. Suhail; M. Arshad; M. Asghar and M. M. Majeed (2008). Comparative infestation of bollworms on transgenic BT and conventional cotton cultivars. Pak. Entomol. 30(2): 193-197.

Khalifa, A.; M. F. El-Sharawy and S. M. Shehata (1974). Studies on the control of bollworms. 2nd Egypt. Pest Control Conf., Alex., 1: 207-233.

Lukefahr, M. J. and D. F. Martin (1966). Cotton-plant pigments as a source of resistance to the bollworm and tobacco budworm. J. Econ. Entomol., 59(1): 178-179.

Lukefahr, M. J.; L. W. Nobel and J. E. Houghtaling (1966). Growth and infestation of bollworms and other insects on glanded and glandedless strains of cotton. J. Econ. Entomol., 59(4): 817-819.

Meisner, J.; M. Zur; E. Kabonci and K.R.S.Ascher (1977). Influence of gossypol content of leaves of different cotton strains on the development of *Spodoptera Littoralis* larvae. J. Econ. Entomol, 70, (6):714 – 716.

Mohyuddin, A.I., G. Jilkani, A.G. Khan, A. Hamza I. Ahmad and Z. Mahmood,(1997). Integrated Pest Management of major cotton pests by Conservation, Redistribution and Augmentation of Natural Enemies. Pak. J. Zool., 29: 293-298.

Scales, A. L. and E. A. Stadelbacher (1972). Population of bollworms, tobac budworms, Tarnished plant bugs and other cotton pests in four varieties of plant cotton. J. Econ. Entomol., 65(2): 213-215.

Shaver, T.N. and Lukefahr, M.J. (1969). Effects of flavonoids pigments and gossypol on growth and development of the boll worm, tobacco bud worm, and pink boll worm. J. Econ. Entomol. 62: 643-646.

Shawer, D. M. B. (2000). Ecological studies on some insect pests infesting cotton plants. M. Sc. Thesis, Fac. Agric. Kafr El-Sheikh, Tanta Univ.

Raulston, J.R. (1985). Tobacco bud worms response to gossypol and selection in a field-collected strain under laboratory conditions. J. Econ. Entomol. 78: 158-162.

Vilkova, N.A. (1989). Effect of cotton cultivars with high content of gossypol on development of the cotton boll worm, Heliothis armiqera [Hbn.][Lepidoptera: Noctuidae], J. Econ. Entomol. Rev.68: 129-137

White, W.H.; J.C. JR. McCarty; D.H. Gollum; and P.A. Hedin (1982). Strains and within season variability of various allelochemics within a diverse group of cottons, *Gossypium hirsutum* L. Crop Sci. 22(6): 1235 – 1238.

Yuan, Y.L., Y.H. Chen, C.M. Tang, S.R. Jing, S.L. Liu, J.J. Pan, R.J. Kohel and T.Z. Zhang (2000). Effects of the dominant glandless gene Gl_2^e on agronomic and fiber characters of Upland cotton. Plant Breeding 118, 59-64 (2000).

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حساسيه بعض أصناف القطن وتراكيبه الوراثية للإصابة بديدان اللوز

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معهد بحوث وقاية النبات – مركز البحوث الزراعية – مصر

تمت دراسة حساسية عشرة أصناف من القطن هي جيزة ٧٠, جيزة ٨٥ , جيزة ٨٦ , جيزة ٩٢،اسكندرية ٤ , بهتيم ١٠١ , كارشنسكي ٢ , بيما س٦ , سوفين و الهجين بيما س٦ x جيزة ٨٩ للإصابة بديدان اللوز الشوكية والقرنفلية والأمريكية. وقد أجريت الدراسة بمحطه البحوث الزراعية بسخا بمحافظه كفرالشيخ. أوضحت النتائج أن الأصناف كارشينسكى٢ وجيزة ٧٠ وإسكندرية ٤ هي أكثر الأصناف حساسية للإصابة بديدان اللوز القرنفلية والشوكية بينما كان الصنف بيما إس ٦ x جيزة ٨٩ أكثرها مقاومة للإصابة بالحشرتين.

من ناحية أخرى كانت الأصناف جيزة ٩٢ ، بهتيم ١٠١ ، جيزة ٨٦ ، سوفين ، بيما إس ٦ x جيزة ٨٩ أكثرها مقاومة للإصابة بديدان اللوز الامريكية بدرجة معنوية خلال الموسمين ٢٠١١ ، ٢٠١٢. وقد لوحظ انخفاض درجه الإصابة الحشرية كلما ذاد تركيز مادة الجوسيبول في جدار اللوزة وهذا يعنى أهمية تلك المادة وتركيزها فى خفض الإصابة الحشرية بديدان اللوز.

قام بتحكيم البحث

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