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FIELD ASSESSMENT OF SENSITIVITY OF SOME TRANSGENIC AND CONVENTIONAL VARIETIES OF COTTON TO INJURY WITH APHIDS AND COTTON WHITEFLY AND IT'S IMPACT ON PRODUCTIVITY.

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ABSTRACT

The field experiments were conducted to assess susceptibility of seven transgenic varieties of cotton (Aleppo 33; McNair 308; Tashkent 3; McNair 307; McNair 235; TamCot CAMD; McNair 220 As imported varieties and Moubarak93 (conventional cultivar) as local variety to infestation with cotton aphids *Aphis gossypii* and cotton white fly *Bemisia. tabaci*. The results indicate that aphid population had three main peaks (1st peak in July, 2nd peak in the 2nd week of August and the 3rd peak was occurred at the last week of August). Aphid population showed high reduction with low average of infestation (17.9-24.0 %) at May and June with Temp. (22.9-25 ^{o}c), R. H. (48- 56%) Wind speed (1.8 -2.0m/sec.) and sun shine duration (13.6-14.1 hr and mid of September of cultural season.

The most attractive varieties of transgenic cotton with higher insect population and comparatively susceptible to *A. gossypii* were Var. Aleppo 33 , var. McNair235 and var. Tash Kent 3 followed by var. McNair 307, whereas the least attractive varieties of cotton and resistant against *A.gossypii* were var. Tamcot CAMD and var. McNair 220, compared to the conventional variety (Mubarak 93) which was the most tolerant to infestation with cotton aphids. There were high significant difference between infestation of transgenic varieties of cotton with *A.gossypii* .

The population of cotton whitefly, *B. tabaci* had three main peaks in growing season (July, August and September) with Temp. (26.2-26.6 ^{o}c), R. H. (68.3-69.0 %), wind speed (0.77-0.90 m/sec.) and sunshine duration (12.4-13.9 hr), however, the lowest population of whitefly was recorded in May with Temp. 23.0 ^{oc}), R.h. (51.7 %), W. speed (1.7 m/sec.) and sunshine

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duration (13.6 hr). Both *A. gossypii* and *B. tabaci* reached peak population in the third and fourth week of August (2013). The local conventional variety (Moubarak 93) was the most tolerant against infestation with *A. gossypii* and *B. tabaci* . It was found that the rates of cotton yield were decreased with increasing infestation rates of aphid or white fly. The results of seasonal dynamics are detected several weeks differences in peak and main activity period on the host plants.

Keywords: Susceptibility, Cotton varieties, Sucking insects, Environmental factors, Yield

INTRODUCTION

The cotton, *Gossypium hirsutum* L. is the main crop and one of the summer growing season crops. It is consider one of the most important exporting crops beside its local manufacture in Egypt. Cotton is attacked by several hundred species of insects, including such harmful species as The cotton aphid (*Aphis gossypii*) which consider the most common pest causing early to late season damage to terminals, leaves, buds and stems, and are known to transmit Cotton Bunchy Top (CBT) diseases. The major reason of reduction in cotton yield and quality is the attack of about 150 different species of insect and mite pests [3-- Attique, and Rashid, 1983).

Moreover, Stefanie etal. (2008) mentioned that honeydew is excreted by the aphids and this allows sooty moulds to grow, resulting in a decrease in the quantity and quality of the produce which the aphids impact is especially important on vegetable crops such as courgette, melon, cucumber, aubergine and strawberry and on cotton, citrus and mallow.

Honeydew promotes sooty mould, which reduces potential crop yield by blocking sunlight and reducing assimilation of nutrients for plant growth. The mass cultivation of this crop made it a target for several pests especially the sap sucking insects belonging to order Homoptera, i.e. cotton aphid, *Aphis gossypii* Glov. and cotton and tomato whitefly, *Bemisia tabaci* (Gen.) which are the most serious insect pests attacking cotton plants and may cause damage and reduce its yield (Chaudhry,1976 and Matthews,1989).

Bemisia tabaci has become one of the most important sucking pest of world's industrial and food crops like cotton, sunflower, melon, tomato, brinjal etc. Heavy infestation may reduce plant vigor and growth, cause chlorosis and uneven ripening of bolls [7— Greathead (1986). In many countries (Fryxell,1979) not only because of sucking soup of plant but also for transmitting different plant virus diseases to several vegetables and field crops (Cohen and Nitzany, 1966; Osaki and Inouye, 1981 and other weed plants (Duffus ,1987; Pollard,2008; Baldin,2012).

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Host plant selection is particularly great important among insect pests such as aphids and whitefly especially for adult females which are responsible for choosing hosts for oviposition that would be the same for feeding and are preferable for optimal survival of offspring (Futuyama,1983; Rausher,1983; Butler and Wilson,1984,and Thompson ,1988 and Novan et al.,1991).

In China, Zhang etal. (2013) studied the density seasonal dynamics of *Bemisia tabaci* MED on cotton (*Gossypium hirsutum* L.) and six other co-occurring common plants and found that weeds esp. the common ragweed (*Ambrosia artemisiifolia* L.) around cotton fields increase the population density of *B.tabaci* on cotton, while sunflower could act as a trap crop for decreasing pest pressure on cotton. Guo etal.(2013) compared the survival, development, and reproduction of *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) MEAM1 cryptic species over two consecutive generations on three cotton cultivars of different gossypol levels and found that over two consecutive generations on three cotton cultivars of different gossypol levels. Both cotton cultivar and generation significantly affected the fitness of the whitefly and concluded that the comparison of the life histories of *B. tabaci* MEAM1 cryptic species on different cotton varieties is important for the development of an integrated pest management program of the whitefly by using plant secondary metabolic compounds. A study was conducted by Bilal Atta etal (2015) to assess the performance of transgenic and conventional cotton cultivars in response to population dynamics of whitefly (*Bemisia tabaci*) in field under RCBD, the results revealed that transgenic cotton cultivars had higher level of whitefly compared to conventional cotton cultivars.

There are several factors that influence the insect infestation, among them the temperature, relative humidity, wind speed and sun shine are great importance. The physical factors that were taken into consideration in the present study were recorded regularly during the season of 2008,which obtained from nearest meteorological station to the area of experiment. Several studies were performed in the field of Hemipterous insect pests attacking local variety of cotton plants in Egypt, causing hazard damages; (Hassaneinetal.1971 and 1995; Shaheen and AbdelHamid,1994, Mansour et al.1997;El-Shabrawy et al.2001/2002;Salama etal.2001/2002and other countries (Matthews(1989 ;,and Naranjo and Flint (1994)), Zhang,etal (1988), EL-Sayed etal. 1989, Kandoria et al. 1999, Sharma and Pampapathy (2006) Singh and Singh (2007). Biology and control strategies of cotton aphid *Aphis gossypii* Glover were studied by Sarwar etal (2014) and concluded that Cotton aphid *A.gossypii* has harmed cotton crop resulting in low yield and thus economic loss to agribusiness and mentioned that multiple control techniques viz; biological, chemical and cultural conteols have proven as remedy against this notorous pest. Due to the problem of pestcide resistance alternative techniques for chemical control such as the cultivation of different transgenic varieties of cotton.

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The present study was carried out at Shebien El-Kanater province, Qualiyobia Governorate, Egypt, to investigate the susceptibility of different varieties of cotton (imported and local) to infestation with *A.gosspii* and *B.tabaci* insects and to explore the effect of environmental factors (Temperature, Relative humidity, wind speed and sunshine duration) on the fluctuation of insect infestation of cotton varieties and its effect on the yield under field conditions.

MATERIALS AND METHODS

Host plants: The experiments of host preference were carried out under field conditions using different varieties of imported cotton such Aleppo 33; McNair 308; Tashkent 3; Mcnair 307; McNair 235; Tamcot CAMD; McNair 220 and local variety such Mubarak 93 .

Field experiment: In order to evaluate the effect of host selection on the dynamics insect population, eight varieties of cotton plants were grown in private farm at Shebien El-Kanater province, Qualiyobia Governorate, Egypt .Each cotton variety are cultivated in an area (one plot) about 175m2 (5 m wide x 35 m long). Each plot are divided into seven partitions (replicates). Each partition (replicate) are represented by an area about 35m2 (5mx7m). All selected plots were left without chemical control. Normal agronomic practices were performed in the area of experiment.

Host selection: For taking the population estimates and to determine the most preferable cotton variety for insect infestation, cotton plants (35 plants/plot) were investigated weekly after one month of cultivation (mid May) till harvest time at the end of November. Investigated samples are consisted of 5 plants/replicate (5mx7m). Each plot was represented by 5 replicates. In each variety of cotton, the choosen plants were investigated weekly early morning by use field lens in each plant level (upper ,middle and lower) under field conditions. The number of infested plants with *A. gossypii* or *B. tabaci* or both of insects (adult and/or immature) that settled (Landed) on each host plant were counted weekly throughout the season of growing and counted in percentage for each replicate. Monthly averages of infestation percentages of each cotton variety were counted as an indicator to insect population activities and to estimate the peaks of insect during growing season.

The physical factors that were taken into consideration in the present study were recorded regularly during the season of 2008, which obtained from nearest meteorological station to the area of experiment. Ecological factors (temperature, relative humidity, wind speed and sun shine) were recorded as monthly means for location of experiment. The results were statistically analyzed by applying the analysis of variance (ANOVA) to explore the effect of differentiation of cotton varieties on the population dynamics of aphids and white fly under field conditions. Simple correlation coefficient "r" were carried out according to methods of Waller and Duncan

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(1969) and Gomez and Gomez (1984) to study the effect of insect infestation with *A. gossypii* and *B. tabaci* on the yield.

RESULTS AND DISCUSSION

Data in Table (1) revealed that the aphids population had three main activity periods in growing season with three main peaks. The aphid individuals appeared with slightly activity throughout May and June with average of infested plants ranged between 17.9-24.0 % with Temp. (22.9-25^{oc}), R.H (48- 56%) Wind speed (1.8 -2.0m/sec.) and sunshine duration (13.6-14.1 hr). The population of insect recorded started to rebuild up again to reach its first peak in July with an average of infested plants about 30.1% with Temp. (26.2-26.9^{oc}), R.H. (65-70 %), Wind speed (0.6-0.9 m/sec.) and sunshine duration (13.0-14.0 hr). The number of aphids fluctuated again to reach the maximum population recording highest peak (2nd peak) in the 2nd week of August which aphid infestation reached 34 % . Finally, the population of insect declined later to record the minor peak (3rd) occurred at the last week of August with aphid infestation about 27.7 % , then the activity of aphid population showed an obvious reduction with low average of infestation about 18.3 % in mid of September (end of cultural season).

Table (1): Fluctuation of infestation of cotton varieties with cotton aphids, *Aphis gossypii*

Cotton Variety	Field observation date(month)						Mean SD±	F-value
	May 15th	June 15th	July 15th	Aug. 10th	Aug. 30th	Sept. 15th		
Aleppo 33	50	65	70	75	60	45	60,8 10,6 A±	3551,43**
McNair 308	10	12	18	22	25	15	17,0 5,2 D ±	
Tashkent 3	16	26	35	40	31	25	28,8 7,7 C±	
McNair 307	8	10	12	15	10	9	10,7 2,3 E±	

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McNair235	30	40	56	69	55	25	45,8 15,5 B±	
Tamcot CAMD	5	6	9	11	8	5	7,3 2,2 F±	
McNair220	6	9	11	8	5	4	7,2 2,4 F±	
Mubarak93	2	3	4	5	2	2	3,0 1,2 G±	
Mean	E 15,9	D 21,4	B 26,9	A 30,6	C 24,5	E16,3	22.6 5 87±	
F-value	375,339							
Temp.(C)	22,9	25,0	26.2	25,9	26,6	26,7	25,55 1.43±	
R.h.(%)	48	56	65	67	70	68	62,33 8.54±	
Wind speed(m/sc.)	2,0	1,8	0,9	0,9	0,6	1,1	1,22 0.55±	
Sun shine duration(hr)	13,6	14,1	14,0	13,5	13,0	12,4	13.43 0.64±	

Coefficient of variation:8.52

Means followed by the same letter are not significantly different (P=0.05)

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Discussing the foregoing results, it could be seen that the present findings are in line with those obtained by Luo and Gan (1986) for *A. gossypii* and Salem et al. (1988) who stated that *A. gossypii* had a high population peaks in May and 2 in July under field conditions of Egypt. Statistical analysis showed significant differences between months of_ July, August and September, this may be due to the higher variation of infestation level with insect. The present study indicate that the cotton varieties responded differently to infestation with, *A. gossypii* was in the same trend with those obtained by Hassanein et al.(1995), they stated that *A. gossypii* population exhibited two periods of activity, the 1st period was short and extended from the10th of April to 15th of May, whereas the 2nd one was somewhat large and lasted from the last week of July to the end of cotton growing season (October).

The present results was in agreement with those observations obtained on some varieties of cotton in Egypt by Salem et al (1988) who found that the cicadellid showed a distinct preference for Dandara over Macneir 220 and also found that the generations of Jun and July were moderate in size ,whereas the August –September generations were the largest and accordingly considered as the most economically important. Data in Table (1) show that the highest infestation of cotton plants with *A .gossypii* was recorded on Var. Aleppo 33 with an average infestation about 60.8 %,followed by var. Mc Nair235 with 45.8 % then var. TashKent 3(28.8 %). The medium infestation was recorded in var. McNair 307 with infestation about 17.0 % ,whereas the low percentages of infestation were recorded in two varieties as for as. Tamcot CAMD (7.3 %) and. McNair 220 (7.2 %) comparing with 3.0 % in local variety (Mubarak 93) as control .

The statistical analysis showed high significant difference between infestation percentages of cotton varieties with *A.* gossypii and also, there are high significant difference between monthly infestation of cotton plants during growing season. (Coefficient of Variation:8.52%).This results was in agreement with the observations of Sharipova (1987 who found that over the growing season, fewest aphids were found on S9063 and S6037 and the highest number on Tashkent 1,and recorded also, highest rate of aphid reproduction on Tashkent 1 and S9063. The relationship of both infestation density and Susceptibility indices was inverse and significant .

Howeve, the variation of insect infestation of cotton plants may attribute to morphological characteristics and may due to defience mechanisms, Khan and Agarwal (1990) mentioned that *Aphis gossypii* was found to attack severely few cotton varieties and found that moderately hairy varieties were more preferred to *A. gossypii* as compared to the varieties with glabrous or dense pubescent leaf surface. Moreover, Maurille etal. (2014) studied the influence of cotton plant on development of *Aphis gossypii* Glover in Benin and found that the aphid population was higher on whole plants than on detached leaves and the reproduction rate of *Aphis gossypii* was lower on whole plants than on detached leaves ,also development, survivorship and reproduction of the

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aphid were negatively impact by whole cotton plants. Suggesting the possible induction of defence mechanisms.

Data in Table (2) showed that the whitefly population had three main activity periods in growing season (July, August and September) with three peaks, where the population of *B. tabaci* appeared throughout May with an average of infestation about 22.0 % and increased gradually to reach 29.6 % through June. The population activity of *B. tabaci* increased to reach its first peak in July with an average of infestation 36.7 %, while the population of *B. tabaci* suddenly increased to record the 2nd peak at August (45.9 %).The population of *B. tabaci*_ reached its highest activity throughout July and August on the leaves of cotton varieties (Aleppo33 with infestation about 64.0% followed by TashKent 3 (50.4 %) and McNair235 (43.3 %) with Temp.(26.2-26.6ºc), R. h. (68.3-69.0 %), wind speed (0.77-0.90 m/sec.) and sunshine duration (12.4-13.9 hr. The activity of the whitefly extended till the end of growing season to record the 3rd peak at September_(37.6 %) respectively.

Table (2): Fluctuation of infestation of cotton varieties with cotton whitefly, *B.tabaci*

Cotton Variety	May 15th	June 15th	July 15th	Aug. 10th	Sept. 15th	Mean SD±	F-value
Aleppo 33	51	Mean	20.3D	27.1 C	33.5 B	41.6A	34.7 B
McNair 308	12	17	20	31	22	6.3 E ±20.4	
Tashkent 3	33	42	55	62	60	11.4 B±50.4	
McNair 307	10	15	20	26	16	5.4 F±17.4	
McNair235	25	40	51	60	40	11.8 C ±43.2	
Tamcot CAMD	11	18	25	36	17	8.5 E ±21.4	
McNair220	12	19	21	30	36	8.5 D±23.6	
Mubarak93	8	10	11	12	14	2.0 G±11.0	
Mean	20.3D	27.1 C	33.5 B	41.6A	34.7 B	31.44	

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						8.07±	
F-value	46311.3623**						
Temp.(C)	23.0	26.8	26.6	26.6	26.2	25.84 1.60±	
R.h.(%)	51.7	63.0	68.3	68.3	69.0	±64.06 7.31	
Wind speed(m/sc.)	1.7	0.83	0.77	0.90	0.90	1.02 0.38±	
Sun shine duration(hr)	13.6	14.1	13.9	13.2	12.4	13.44 0.67±	

Coefficient of variation:0.83

Means followed by the same letter are not significantly different (P=0.05)

The moderate infestation of cotton plants with *B. tabaci* was recorded on McNair 220 (23.6 %) and Tamcot CAMD (21.4 %) The lowest activity of *B. tabaci* population was recorded in May in var. McNair 307 (17.4 %) compare to the control (var. Mubarak 93) which infestation reached 11.0 % respectively. with Temp. 23.0 oc), R.h.(51.7 %), W.speed (1.7 m/sec.) and sunshine duration (13.6 hr). The findings of Watson *et. al*.(1992) agreed with the results achieved in this study. Statistical analysis showed significant differences between different varieties of tested cotton plants.

The previous studies suggested that the variation of insect infestation of cotton plants may be related to chemical constituents, Mansour, *et al*.(1997) in Egypt, found positive correlation between piercing sucking insect infestation and tannin concentrations in the two cotton varieties ,Giza 80 and Giza 81. However, Acharya and Singh (2007) reported that the genotypes RS-875 ,RS-2013 ,CSH-911 and BBR-1934 were categorized as resistant to whitefly, while 8 genotypes were found susceptible. *Javaid etal*. (2012) mentioned that 10 cultivars of cotton were screened against whitefly in the agro-climate of Faisalabad. The results indicated that NIAB-778 was most susceptible as compared with all other tested cultivars, in contrast MNH-768 was resistant against whitefly. Akram *et al*. (2013) [13] found during study that *Bt* genotypes were more

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susceptible host for the whitefly and thirps than non-*Bt* genotypes. According to experiment by Dhillon and Sharma (2013) to evaluate the effect of *Bt*-transgenic and non-transgenic cotton on arthropod diversity. The results obtained indicated that whitefly, *Bemisia tabaci* was higher on *Bt*-transgenic than on non-transgenic cotton.

From the result it was clear that month of August was the most favorable for whitefly, because during this month population was maximum. On the other hand ,considerable differences were detected in the other seven studied varieties caused by changing in yield rates .Statistical analysis showed that the simple correlation_(r) Table (3) were negative and highly significant between insect infestation of cotton varieties and the yield.

Table (3): Correlation between insect infestation and cotton yield

Yield	White fly	
Aphid	0.870	-0.611
White fly		-0.563

Yield assessment

The results presented in Fig.(1) showed high significant difference between infestation and yield, except varMcNair 307, which was the least infested with both insects and yield. The highest rate of yield was recorded in MacNair220 (2056.1Kg/hect.), Tamcot CAMD (1885.7Kg/hect. And McNair308 (13390.3Kg/hect. when infestation with aphid ranged between 7.2% and 17.0% and between 20.4% -23.6% with whitefly. The moderate yield of cotton were recorded in McNair235 (1242..9 Kg/hect). The less rate of yield (1028.6Kg and1191.3Kg/hect.) was recorded in Alippo33 and Tashkent3, when infestation with aphid and white fly reached to highest infestation which ranged between 60.8% and 64%, respectively. The statistical data of ANOVA, listed in Fig.(1) indicted high significant difference between infestation of all cotton varieties in all months ,except infestation of variety McNair307 and yield. VarMMcNair220 was significantly heavier weights of cotton yield than those of varAlppo33 andTashkent3.

Data in Fig.(1) showed that the cotton yield was varied according to the susceptibility of different varieties of imported cotton to infestation *A. gossypii* and *B. tabaci* .It was found that the rates of cotton yield were decreased with increasing infestation rates of aphid or white fly.

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CONCLUSION

The present results revealed high significant difference between infestation percentages of cotton varieties with *A. gossypii* and also, there are high significant difference between monthly infestation of cotton plants during growing season. The aphids population had three main peaks during growing season (1st in July. 2nd in mid August and 3rd peak occurred at the last week of August.

The same trend was recorded for the population dynamics of *B.tabaci* which had three peaks during growing season. Two of them during July and August on the leaves of cotton varieties(Aleppo33 followed by TashKent 3 and McNair235 with the exception of September which the activity of the whitefly extended till the end of growing season to record the 3rd peak at September. So farmer are advised to remain careful about the outbreak of aphids and whitefly in future by understanding favorable climate and existence of susceptible host plants .

Based on the present assessment carried out McNair 307variety was the most resistant cultivars which was the least infested with both insects. The results presented in Fig.(1)showed high significant difference between infestation and yield. The highest rate of yield was recorded in MacNair220 Tamcot CAMD andMcNair308 when infestation with aphid ranged between 7.2%and 17.0%and between20.4% -23.6% with whitefly. The moderate yield of cotton were recorded in McNair235. The less rate of yield was recorded in Alippo33 and Tashkent3. The local variety (Moubarak 93) was the most tolerant against infestation with *A. gossypii* and *B. tabaci*. It was found that the rates of cotton yield were decreased with increasing infestation rates of aphid or white fly. These results may helpful in cotton breeding programs, focusing on plant resistance to cotton aphids and whitefly.

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