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Comparative Resistance of Some Cotton Cultivars against Sucking Insect Pests

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Abstract

Five cultivars of cotton viz., FH-682, NIAB-78, FH-634, FS-628, and FH-643 were tested for resistance against whitefly, *Bemisia tabaci* (Genn.), thrips, *Thrips tabaci* (Lind.) jassid, *Amrasca devastans* (Dist.) and aphid, *Aphis gossypii* (Glov.) at farmer's field in Dera Ghazi Khan during 2007. The FH-634 was found to be most resistant to the sucking pest complex, whereas, FH-682 was found to be most resistant to the jassid. Only whitefly population showed significant and highly positive correlation (R^2 =0.9436) with the overall sucking insect-pest complex. FS-628 showed maximum susceptibility to whitefly and FH-634 showed minimum. Jassid and whitefly populations almost remained above economic threshold level throughout the season. The maximum activity of most of the insect-pests was observed on August 28, 2007.

Keywords: Host plant resistance, *Gossypium hirsutum*, sucking insects complex.

Introduction

Cotton (*Gossypium hirsutum* L.) is one of the most important fiber and cash crop of Pakistan. In 2007 cotton crop was grown over an area of 3054 thousand hectares with production of 11655 thousand bales (Anonymous, 2008). Pakistan has made progress by increasing yield up to 641 Kg per hectare in 1992 - 2000 (Jiskan, 2001). Still the yield per hectare is less than many other cotton growing countries. Among a variety of reasons of low yield, the magnitude of insect-pests, which damage the cotton crop from sowing to maturity, plays an important role. The insect-pests cause 5-10 percent losses on an average but severe attack of insect-pests can cause heavy qualitative and quantitative losses varying from 40-50% (Naqvi, 1976). There are different pest control tactics, in which varietal resistance is of immense without insecticide application (Bughio *et al.,* 1984; Jin *et al.,* 1999 and Khan *et al.,* 2003). Cotton insect pest complex is divided into two categories; sucking insect pests and chewing insect pests. Important sucking insect pests are whitefly, *Bemisia tabaci* (Genn.), thrips, *Thrips tabaci* (Lind.) jassid, *Amrasca devastans* (Dist.) and aphid, *Aphis gossypii* (Glov.) which are also designated as key pests causing most of the damage to the cotton crop. Cotton whitefly damages the plant by sucking cell sap resulting in 50% reduction in boll production (Ahmad *et al*., 2002) and also acts as a vector of leaf curl virus disease (CLCuV) (Nelson *et al*., 1998), which is threatening our cotton-based economy. Indiscriminate use of insecticides has not only caused the resistance problem in these pests but also has polluted the environment along with other health hazards. (Bashir *et al*., 2001 & Raza and Afzal, 2000). Understanding the host selection behavior and the effect of various morphological plant characters is an important prerequisite for developing the pest management strategy. The breeders, in Pakistan, have focused their attention to increase the yield potential and evolved a number of varieties for this purpose. There are many plant characters which can affect positively or negatively on the plant feeders and their natural enemies (Krips *et al*., 1999; Afzal & Bashir, 2007). The previous attempts were made on exploring the methodologies to develop host plant resistance to pest complex in cotton, in Pakistan, like those of Hassan *et al*. (2000) Bashir *et al*. (2001), Shad *et al*. (2001), Khan *et al*. (2003) etc. but a lot remains yet to be done to arrive at some definite results.

Keeping in view the importance of resistant varieties the present studies were conducted to screen out 5 cotton genotypes i.e., FH-682, NIAB-78, FH-634, FS-628, and FH-643 to determine natural resistance against sucking insect pests and also to observe population development period of insect pests on them.

Materials and Methods

The experiment was conducted at the farmer's field in Dera Ghazi Khan in a RCB design and with 5

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treatments, having 3 repeats each. There were 3 rows of each treatment, in each replicate. The five cultivars of cotton viz., FH-682, NIAB-78, FH-634, FS-628, and FH-643 were employed in the present study. The plot size was kept as 7.5 ft x 18.0 ft. The crop was surveyed daily for the appearance of the sucking insect-pests, which actually appeared around 10-07-07. There afterwards, it was visited after an interval of week time till 16-10-07, when the picking of the cotton crop started and the presence of insect pests could no longer do it an economic injury. Twenty-one plants were selected, at random, per treatment/plot for recording pest population. Three leaves, one each from bottom, middle and top portions of plants were observed for the pest activity (both the adults and the nymphs) during every observation. The data which was based on the average counts of the pest per leaf was considered to be an indirect reflection of pest-resistance in plants, under reference, in these studies. The varietal resistance was decided on the time of a maximum insect-pest activity i.e. towards the close of 8th week, on 28-08-07. The data on the overall as well as on the individual population of each sucking insect-pest species was presented through a multiple comparison of the mean values. The means were separated by DMR test (P=0.05). The correlation matrix between the overall and individual population dynamics of the sucking insect-pests (leaf^{-1}) on different cotton cultivars were also calculated there after.

Results and Discussion

The varietal resistance was decided on the time of a maximum pest-insect activity. As such, the comparative resistance in the cotton cultivars being tested was decided on the bases of population counts presented against T_8, taken towards the close of 8th week, on 28-08-07 (Table 1).

The results (Table.2) revealed on the whole, a highly significant variation in the mean values for the population estimates from one treatment to another, except those for jassid where they were significant, at 5 % only, and for thrips and aphids, they remained negligible throughout the study season. A more critical review of the situation with the overall population of the sucking complex (Table-2 (A)) indicates that it was found to be maximum against T_4 (18.17) and minimum against T_3 (9.90), where FS-628 and FH-634 were employed, respectively. The population situation with the other test cultivars was, however, found to be an intermediate degree and is difficult to describe in clear cut terms. A comparison of this situation with the ones, which prevail in the individual cases indicate that it is exactly similar in the case of whiteflies but varied from the other cases. It means that FH-634 was the most resistant against the sucking complex as well as against the whiteflies, in contrast to FH-682, which was most resistant to jassid. On the contrary, however, FS-628 was least resistant towards the overall pest-composite as well as towards the whiteflies. FH-682 was resistant towards the jassid and aphid. Comparing these trends, it ultimately can be said that the overall resistance situation may or may not be well correlated to that for the individual insect-pest species. For this purpose, therefore, the correlation of the overall estimates on resistance with those for the individual species were calculated and presented in Table-3.

The correlation matrix (Table-3) reveals that the correlation between the overall and individual changes in the pest population exists. Positive correlation existed between whitefly and thrips (R^2 =0.1373) while weak negative correlation existed between overall pest population and jassid & aphid with correlation coefficient values of -0.05622 & -0.04271, respectively. A comparison of these findings with those already completed by Kim (1985), Malik and Nandal (1986) Sharipova (1987), Dhawan *et al*. (1990), Rao *et al*. (1991), Ali and Ali (1993), Tomar and Rana (1994), Arif *et al*. (2004) Aheer *et al*. (2006) and Ali and Aheer (2007) etc., on the comparative resistance of some cotton varieties to the sucking insect-pests was not, however, possible in precise terms, because of the differences in the varietal/pest combinations tried by them. As such, the present efforts were definitely a new addition to the previous fund of knowledge.

The similar results regarding whitefly population but on different tested genotypes are in conformity with those of Raza and Afzal, 2000; Bashir *et al*., 2001. However, observations regarding period of abundance differed to the findings of these workers.

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Table 1. The overall mean population of sucking insect-pests (leaf^{-1}) on five different cotton cultivars from 10-07-07 to 16-10-07 at farmer's field in D.G. Khan.

Treatments	Dates	Mean values
T_1	10-07-07	21.07** ef
T_2	17-07-07	10.02 f
T_3	24-07-07	11.20 f
T_4	31-07-07	51.53 ab
T_5	07-08-07	66.85 a
T_6	14-08-07	46.06 bcd
T_7	21-08-07	47.94 abc
T_8	28-08-07	67.09 a
T_9	25-09-07	33.09 bcde
T_{10}	02-10-07	25.86 def
T_{11}	09-10-07	28.43 cdef
T_{12}	16-10-07	33.28 bcde

** = Highly significant (P = 0.01). LSD value = 18.87
Means sharing similar letters are not significantly different by DMR test (P=0.05)
Cultivars = FH-682, NIAB-78, FH-634, FS-628 and FH-643.

Table 2. A multiple comparison of the mean values of the population of different sucking insect-pests with those of their overall population (number leaf^{-1}) on 28-08-07 on different genotypes of cotton.

Name of genotype/ Treatments	Population/leaf				
	Overall**	Whiteflies**	Jassids*	Thrips	Aphids
T_4 -FS-628	18.17 a	15.69 a	1.32 ab	n.s 1.14	n.s 0.02
T_5 -FH-643	15.54 ab	11.97 ab	2.03 a	1.12	0.42
T_1 -FH-682	13.32 bc	12.04 ab	0.63 b	0.51	0.00
T_2 -NIAB-78	10.15 c	7.80 bc	1.47 ab	0.56	0.31
T_3 -FH-634	9.90 c	6.45 c	1.71 a	1.63	0.10
LSD value	4.01	4.28	0.80	-	-

* = significant (P= 0.05).
** = Highly significant (P= 0.01) and n.s = non significant
Means sharing similar letters are not significantly different by DMR test (P=0.05)

Table 3. A Correlation matrix between the overall and individual population dynamics of the sucking insect-pests (leaf^{-1}) on 28-08-07 on different cotton cultivars.

S.No	Factors	1	2	3	4	5
1	Overall population	1.00000				
2	Whitefly	0.97139**	1.00000			
3	Jassid	-0.05622	-0.24023	1.00000		
4	Thrips	0.32101	0.13730	0.26129	1.00000	
5	Aphid	-0.04271	-0.11102	0.19712	-0.11782	1.00000

** = Highly significant (P= 0.01) and a blank ( ) = non significant