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Response of some new cotton genotypes against insect pests complex and cotton leaf curl virus

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Abstract
Twenty five genotypes of cotton viz, MNH-2007, CIM-588, FH-942, PB-900, NN-3, CIM-573, BH-173, NIAB-852, NIAB-2009, CIM-473, BH-172, FH-941, MNH-886, N-2008, FH-113/1000/P7, FH-113/126, CIM-496, FH-2015, VH-289, CIM-552, VH-280, MNH-814, SLH-317, RH-625 and FH-4243 were tested for resistance against insect pests: whitefly (*Bemisia tabaci* Genn.), Jassid (*Amrasca devastans* Dist.), Thrips (*Thrips tabaci* Linn.), Spotted bollworm (*Earias* spp.), and Cotton leaf curl virus (CLCV) in field conditions during 2012 and 2013. Out of twenty five cultivars MNH-2007 and CIM-588 were found comparatively resistant, showing minimum average population of white-fly (3.26 & 3.43 /leaf), FH-941 and PB-900 against Jassid (1.54 & 1.47 /leaf), VH-280 and FH-942 against Thrips (6.46 & 6.59/ leaf). FH-113/126 and PB-900 showed minimum bolls infestation by Spotted Bollworm (1.05 & 1.87%). VH-289 and VH-280 exhibited minimum CLCV incidence (2.83% & 3.0%) respectively. Maximum average population of whitefly was found on cultivars FH-4243 and RH-625 (4.75 & 4.72/leaf), cultivars BH-172 and MNH-814 against Jassid (10.90 & 2.61/leaf), MNH-814 and NIAB-852 against thrips (10.44 & 10.18/leaf) respectively. NIAB-852 and VH-280 showed maximum bolls infestation by Spotted Bollworm (10.56 & 8.51%), FH-942 and MNH-886 exhibited maximum CLCV incidence (78.67% & 73.67%) respectively during 2012.

Keywords: Cotton genotypes, Varietal Resistance, Insect pests & CLCV

1. Introduction
Cotton being a nonfood cash crop contributes significantly in foreign exchange earning. Cotton accounts for 8.6 percent of the value added in agriculture and about 1.8 percent to GDP. The crop was sown on the area of 2,806 thousand hectares. The production is estimated at 12.76 million bales for 2013-14. However, the cotton production was nearly 2.0 percent less than the target of 13.36 million bales mainly due to the shortage of irrigation water, high temperatures in the month of August resulting in excessive fruit shedding, flare up of sucking pest complex and wide spread of Cotton Leaf Curl Virus (CLCV) [1]

One of the many factors that contribute for reducing cotton quantity and quality is attack of different insect pests [2] Cotton with, its green, succulent leaves, many large open flowers, nectaries on every leaf and flower, and abundance of fruit attract a variety of insect pests and mites, such as sucking pest complex (whitefly, jassids, thrips and mites) and bollworm pest complex (Spotted, Pink and American bollworm).

Whitefly, *Bemisia tabaci* (Genn.), jassid, *Amrasca devastans* (Dist.) and thrips, *Thrips tabaci* (Lind.) are serious sucking insect pests of cotton in Pakistan [3]. These insects cause considerable damage to the crop from seedling stage to the harvesting stage. Insect pests are responsible for inflicting heavy losses to the cotton crop by reducing yield and quality of seed cotton, are the basic cause of worry and financial loss to the growers [4]. The estimated losses on an average range from 30-40% and could be as high as 50-60% in some areas [5].

Resistant varieties offer an inexpensive preventive measure, which is generally compatible with other methods of pest control [6]. Increasing demand for food and clothing resulted in the adoption of diversified intensive agricultural programmes coupled with higher energy subsidiaries and excessive use of pesticides. It resulted in development of insect resistance to pesticides, resurgence of target pests, secondary pest out breaks, killing of non-target organisms, disturbance of biological equilibrium, environmental pollution, and health hazards [7]. The cotton genotypes resistant to whitefly were identified by several workers under free choice conditions [8-10]

One of the most promising ways to reduce dependence on pesticides in agriculture is to plant insect-resistant crops. Planting resistant cultivars when available is one of our most effective, economical, and environmentally safe tactic. Work done in Pakistan on resistance in cotton against insect pests in the past has shown significant role of hair density and gossypol glands [11]. Thus keeping in view the above mentioned facts the present study was undertaken to find out relative resistance in different genotypes against insect pest complex

2. Materials and Methods

Twenty five varieties of cotton viz; FH-942, MNH-886, FH-113/126, BH-172, RH-625, VH-289, MNH-814, SLH-317, FH-4243, NIAB-852, FH-941, CIM-496, BH-173, CIM-552, NN-3, FH-113/1000 P7, MNH-2007, N-2008, FH-2015, CIM-573, PB-900, VH-280, CIM-588, NIAB-2009 and CIM-473 received from Director Agronomical Research Institute, Faisalabad were sown at Entomological Research Institute, Faisalabad during 2012 and 2013 to evaluate their resistance against the key insect pests and CLCV incidence. The plants and rows spacing were maintained at 28 cm and 75 cm.

The experiment was designed in randomized complete block with twenty five treatments (varieties) and three replications. Plot size was 15 x 32 sq.ft. Data regarding sucking insect pests, bollworms and CLCV incidence was recorded at ten days interval. For sucking insect pests, data was recorded by counting number of white-flies, jassids and thrips from 15 randomly selected leaves from 15 plants from each treatment, in such a way that one leaf from upper portion of one plant, 2nd leaf from middle portion of 2nd plant and 3rd leaf from lower portion of 3rd plant.

For bollworm pests, data was recorded from 5 randomly selected plants per treatment, by counting total number of bolls, infested bolls, squares/flowers and infested squares/flowers to work out % infestation. Cotton Leaf Curl Virus incidence was recorded by taking all healthy and infected plants/plot.

3. Results and Discussion

3.1 Whitefly, *Bemisia tabaci Genn.*

Maximum average population of whitefly (4.75/leaf) and (6.00/leaf) was observed on FH-4243, while minimum (3.26/leaf) and (3.49/leaf) on MNH-2007 during the year 2012 and 2013, respectively. Against white-fly all other genotypes showed partial resistance during the year 2012 (Table 1).

Against white-fly attack, genotypes MNH-2007 (3.49/leaf), CIM-588 (3.95 /leaf), FH-942 (4.0/leaf), CIM-573 (4.09/leaf), NIAB-852 (4.27 /leaf), MNH-814 (4.47 /leaf) VH-289 (4.63 /leaf), VH-280 (4.64 /leaf), CIM-473 (4.67 /leaf), CIM-552 (4.73 /leaf), FH-941 (4.78 /leaf), PB-900 (4.78 /leaf), MNH-886 (4.8 /leaf) and BH-172 (4.89 /leaf) showed partial resistance while BH-173 (5.05 /leaf), CIM-496 (5.29 /leaf), FH-113/126 (5.33 /leaf), N-2008 (5.36 /leaf), NIAB-2009 (5.4 /leaf), FH-113/1000 P7 (5.47 /leaf), CIM-588 (5.55 /leaf), SLH-317 (5.62 /leaf), NN-3 (5.73 /leaf), RH-625 (5.74 /leaf) and FH-4243 (6/leaf) showed susceptible behavior during 2013 (Table 2).

Table 1: Varietal resistance/susceptibility of cotton genotypes against insect pests complex and CLCV during 2012:

Sr. No.	Genotypes	White fly/leaf	Jassid/leaf	Thrips/leaf	(%) infestation by SBW	CLCV incidence (%)
1	FH-942	3.52bc	1.64	6.59d	4.62fgh	78.67a
2	MNH-886	4.0abc	1.79	7.76cd	2.98ij	73.67a
3	FH-113/126	4.13abc	1.75	8.51abcd	1.05k	58.17b
4	BH-172	3.79abc	10.90	7.59cd	4.73fgh	51.17bc
5	RH-625	4.72a	2.13	9.14abc	4.23ghi	51.83bc
6	VH-289	4.29abc	1.91	8.19bcd	3.26hij	2.83k
7	MNH-814	4.38ab	2.61	10.44a	5.11efg	14.17hijk
8	SLH-317	4.69a	2.33	8.55abcd	6.65cde	13.0ijk
9	FH-4243	4.75a	1.98	9.63abc	5.09efg	28.17efgh
10	NIAB-852	3.71abc	1.56	10.18ab	10.56a	26.67efghi
11	FH-941	3.88abc	1.54	9.11abc	8.01abc	51.33bc
12	CIM-496	4.16abc	1.90	8.56abcd	2.82ij	53.33bc
13	BH-173	3.63bc	1.99	8.76abc	3.19hij	17.50fghij
14	CIM-552	4.29abc	1.72	9.28abc	3.21hij	20.33efghi
15	NN-3	3.61bc	1.85	8.55abcd	4.00ghi	15.50ghijk
16	FH-113/1000 P7	4.08abc	2.10	7.54cd	5.09efg	43.73cd
17	MNH-2007	3.26c	1.73	8.67abc	4.79fgh	31.83de
18	N-2008	4.07abc	2.16	8.63abc	8.27ab	38.183ef
19	FH-2015	4.18abc	1.92	9.60abc	6.64cde	29.50efg
20	CIM-573	3.63bc	2.06	7.62cd	2.74ij	43.33jk
21	PB-900	3.52abc	1.54	8.40abcd	1.87jk	20.50efghi
22	VH-280	4.33ab	1.76	6.46d	8.51abc	3.0k
23	CIM-588	3.43bc	2.14	7.65cd	2.57ij	23.50efghi
24	NIAB-2009	3.73abc	1.84	8.21bcd	6.89abcd	3.0k
25	CIM-473	3.77abc	1.84	8.74abc	6.02def	22.67efghi
LSD at 5%		0.86	NS	1.77	1.43	12.10

*Means sharing same letters does not differ at 5% probability level.

Table 2: Varietal resistance/susceptibility of cotton genotypes against insect pests complex and CLCV during 2013

Sr. No.	Genotypes	White fly/leaf	Jassid/leaf	Thrips/leaf	(%) infestation by SBW	CLCV incidence (%)
1	FH-942	4.00 def	1.64 f	5.93 m	5.13 hijk	76.67 a
2	MNH-886	4.80 abcdef	2.64 abcd	7.67 k	3.63 m	69.33 b
3	FH-113/126	5.33 abcde	2.40 cde	8.82 hij	2.03 n	62.67 c
4	BH-172	4.89 abcdef	3.04 a	8.64 ij	5.83 f	59.00 cd
5	RH-625	5.74 ab	2.87 ab	10.04 bcde	5.57 fghi	62.67 c
6	VH-289	4.63 abcdef	2.73 abc	9.13 efghij	4.80 jkl	11.00 j
7	MNH-814	4.47 bcdef	3.00 e	11.60 a	5.80 fg	21.33 hi
8	SLH-317	5.62 ab	2.73 abc	9.15 efghij	7.00 e	20.33 hi
9	FH-4243	6.00 a	2.11 e	10.20 bcd	5.67 fgh	40.00 e
10	NIAB-852	4.27 bcdef	1.57 f	10.91 ab	9.66 a	32.67 f
11	FH-941	4.78 abcdef	1.47 f	9.80 cdefg	8.18 c	58.33 cd
12	CIM-496	5.29 abcde	2.27 de	9.40 defghi	4.34 l	54.67 d
13	BH-173	5.05 abcde	2.13 e	9.42 defghi	5.62 fgh	31.00 f
14	CIM-552	4.73 abcdef	2.04 e	10.51 bc	5.04 ijk	27.00 fgh
15	NN-3	5.73 ab	2.31 de	9.40 defghi	5.78 fg	23.33 ghi
16	FH-113/1000 P7	5.47 abcd	2.87 ab	8.96 fghij	5.26 ghij	53.67 d
17	MNH-2007	3.49 f	2.78 abc	8.38 jk	4.71 kl	43.00 e
18	N-2008	5.36 abcde	2.76 abc	9.27 defghij	8.77 b	43.33 e
19	FH-2015	5.55 abc	2.29 de	6.75 l	7.58 d	39.67 e
20	CIM-573	4.09 cdef	2.82 ab	10.67 bc	4.65 kl	52.33 d
21	PB-900	4.78 abcdef	1.53 f	9.87 cdef	3.17 m	19.33 i
22	VH-280	4.64 abcdef	2.04 e	5.87 m	8.78 b	10.33 j
23	CIM-588	3.95 ef	2.77 abc	8.91 ghij	7.76 cd	26.67 fgh
24	NIAB-2009	5.40 abcde	2.13 e	9.60 defgh	6.95 e	11.33 j
25	CIM-473	4.67 abcdef	2.53 bcd	10.00 cde	7.96 cd	29.33 fg
LSD at 5%		1.22	0.348	0.80	0.49	6.29

*Means sharing same letters doesnot differ at 5% probability level.

3.2 Jassid, *Amrasca devastans* Dist.

BH-172 exhibited maximum average population of Jassid (10.9 and 3.04/leaf), while minimum (1.54/leaf) on FH-941 and PB-900 during 2012 respectively and (1.47/leaf) during 2013. Against jassid attack, all cultivars showed susceptible behavior during 2012 and 2013.

3.3 Thrips, *Thrips tabaci* Lind.

Maximum average population of Thrips (10.44 & 11.60/leaf) was observed on MNH-814, while minimum (6.46 & 5.87/leaf) on VH-280 during 2012 and 2013 respectively. Thrips attack all cultivars showed susceptible behavior during 2012 and 2013.

3.4 Spotted Bollworm, *Earias Spp*.

Regarding % Spotted bollworm infestation, cultivars FH-113/126 (1.05%), PB-900 (1.87%), CIM-588 (2.57%), CIM-573 (2.74%), CIM-496 (2.82%), MNH-886 (2.98%), BH-173 (3.19%), CIM-552 (3.21%), VH-289 (3.26%), NN-3 (4%), RH-625 (4.23%), FH-942 (4.62%), BH-172 (4.73%) and MNH-2007 (4.79%) showed relatively resistant behaviour, while FH-4243 (5.09%), FH-113/1000/ P7 (5.09%), MNH-814 (5.11%), CIM-473 (6.02%), FH-2015 (6.64%), SLH-317 (6.65%) and NIAB-2009 (6.89%), showed partially resistant behaviour while FH-941 (8.01%), N-2008 (8.27 %), VH-280 (8.51%) and NIAB-852 (10.56%) showed susceptible behaviour during 2012.

During 2013, cultivars FH-113/126 (2.03%), PB-900 (3.17%), MNH-886 (3.63%), CIM-496 (4.34%), CIM-573 (4.65%), MNH-2007 (4.71%) and VH-289 (4.8%), showed relatively resistant behaviour, while CIM-552 (5.04%), FH-942 (5.13%), FH-113/1000 P7 (5.26%), RH-625 (5.57%), BH-173 (5.62%), FH-4243 (5.67%), NN-3 (5.05%), MNH-814 (5.8%), BH-172 (5.83%), NIAB-2009 (6.9%), SLH-317 (7%), FH-2015 (7.58%), CIM-588 (7.76%), and CIM-473 (7.96%) showed partially resistant behaviour. However FH-941 (8.18%), N-2008 (8.77%), VH-280 (8.78%), and NIAB-852 (9.66%) showed susceptible behaviour.

3.4 CLCV% Infestation.

Regarding CLCV% infestation, cultivars VH-289 (2.83%), VH-280 (3.00%), NIAB-2009 (3.00%), SLH-317 (13.00%), MNH-814 (14.17%), NN-3 (15.5%), BH-173 (17.5%), CIM-552 (20.33%), PB-900 (20.5%), CIM-473 (22.67%), CIM-588 (23.5%), NIAB-852 (26.67%), FH-4243 (28.17%), FH-2015 (29.5%) showed relatively resistant behaviour against CLCV, while MNH-2007 (31.83%), N-2008 (38.18%), CIM-573 (43.33%), FH-113/1000/P7 (43.73%), BH-172 (51.17%), FH-941 (51.33%), RH-625 (51.83%f), CIM-496 (53.33%), and FH-113/126 (58.17%) showed partially resistant behaviour against CLCV. However MNH-886 (73.67%), and FH-942 (78.67%), showed susceptible behaviour against CLCV during 2012

During 2013, cultivars VH-289 (10.33%), VH-280 (11%), NIAB-2009 (11.33%), PB-900 (19.33%), SLH-317 (20.33%), MNH-814 (21.33%), NN-3 (23.33%), CIM-588 (26.67%), CIM-552 (27 /leaf), CIM-473 (29.33%), showed relatively resistant behaviour against CLCV, while BH-173 (31.00%), NIAB-852 (32.67%), FH-2015 (39.67%), FH-4243 (40%), MNH-2007 (43%), N-2008 (43.33%), CIM-573 (52.33%),

FH-113/1000 P7 (53.67%), CIM-496 (54.67%), FH-941 (58.33%), BH-172 (59%) showed partially resistant behaviour against CLCV. However FH-113/126 (62.67%), RH-625 (62.67%), MNH-886 (69.33%), and FH-942 (76.67) showed susceptible behaviour against CLCV during 2013.

The research methodology of the experiment is in conformity with those of Amjad [12], Rafiq and Shah [13], Anonymous [14] and Anonymous [15], but their results are different due to variation in genotypes used and climatic conditions of the areas of study. The observations are in conformity with Aslam, *et al.* [16] as they observed the pests' populations at peak in the end of July and August.

The research findings are also in line with those of Javed [17] and Aheer, *et al.* [18] who found significant differences among genotypes regarding all the parameters. However, the results are not in conformity with Khan, *et al.* [19], Ali, *et al.* [11] and Hassan, *et al.* [20] as they formulated their results on the basis of physio-morphic features of plant imparting resistance on some other genotypes in different climatic conditions.

4. Conclusion

Present study results revealed significant variations among genotypes regarding per leaf population of sucking pests, % bollworms damage and CLCV incidence. Out of twenty five none of genotypes gave complete resistant against insect pests. However some genotypes showed comparative resistance which may be due to variation in morphological, biochemical or genetic factors and BT genes.

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