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COMPARATIVE EVALUATION OF SOME NOVEL VS COMMERCIAL COTTON GENOTYPES AGAINST INSECT PEST COMPLEX AND CLCuV FOR SEED COTTON YIELD AND FIBRE TRAITS

Haider Karar*, Qaisar Abbas, Sikander Ali** and Muhammad Shahid***

ABSTRACT

Performance of eight genotypes of cotton (AGC-501, BH-185, NIAB-874B, MNH-886, FH-312, CIM-616, IUB-75 and IR-NIBGE-6) was tested at Cotton Research Station, Multan, Pakistan during 2014 against insect pest complex and CLCuV for seed cotton yield and fibre traits. The genotype AGC-501 was found to be resistant against jassid (*Amrasca bigutella bigutella*) having 0.27, whitefly (*Bemisia tabaci*) 1.87 and Thrips (*Thrips tabaci*) 1.00 individuals per leaf. Genotype BH-185 was found to be susceptible having Jassid 0.73, whitefly 4.27 and thrips 7.20 individuals per leaf alongwith spotted bollworm (*Earias* spp.) 0.33 larvae per plant. The genotypes NIAB-874B and IUB-75 had also 0.33 and 0.27 larvae of spotted bollworm per plant. Others genotypes had zero population of spotted bollworm (*Earias* spp.). Regarding pink bollworm (*Pectinophora gossypiella*) larvae the genotypes AGC-501 had maximum and MNH-886 had minimum population of pink bollworm larvae i.e. 88.8 and 31.3 percent in left over bolls. The virus incidence was more on the genotypes FH-312 (98%) and less on genotypes CIM-616 (48%). Highest ginning outturn (GOT) and fibre strength was recorded on the genotype FH-312 (47.6% and 34.3 g/tex). Regarding staple length and fineness of lint, it was found that maximum staple length was recorded in genotypes MNH-988 (24.9mm) and fineness in MNH-886 (6.0 µg/inch) when compared with standard staple length and fineness of lint. Higher yield was recorded in CIM-616 i.e. 17.81 maunds per acre. Our results suggested that breeders should consider ginning out turn (GOT), fibre strength, staple length and fineness of lint for the evaluation of new varieties in the best interest of growers' community. Further this study provides an opportunity for cotton stakeholders to choose tolerant varieties so that indiscriminate insecticide sprays can be reduced.

KEYWORDS: ***Gossypium hirsutum;*** **cotton varieties; insect pest complex; clcuv; fibre characteristics; seed cotton; pink bollworm; spotted bollworm; Pakistan.**

***Entomological Research Sub-Station, Multan. **Oilseeds Research Institute, AARI, Faisalabad, ***Cotton Research Station, Multan, Pakistan.**

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is one of the main fibre and cash crop of Pakistan, considered as backbone of Pakistan's economy (31). Among cotton producing countries, Pakistan ranks fifth, third and fourth in production, export and consumption, respectively (8). Cotton and its products contribute about 68 percent to the foreign exchange earnings and 10 percent to GDP of the nation (21). In general, about 40 percent of the cotton produce is consumed by native industry while rest of the produce is exported in the form of cloth, garments and as raw material (8). Despite the significance of cotton in the economy of Pakistan, cotton production is relatively lower from rest of the world. Talking about various causes of low yield the role of insect pest complex is of significance importance (3). Approximately, 150 species of insect pest reportedly attack on cotton crop (12). Two different types of the insect pests i.e. sucking and chewing attack on cotton crop. Highly injurious pests like jassid, whitefly and thrips which not only suck the sap of plant but also tend to reduce plant vigor resulting in inferior produce quality (19). Alongwith sucking pests, bollworms i.e. spotted (*Earias spp.*), pink [*Pectinophora gossipiella* (Saund)] and American bollworm [*Helicoverpa armigera* (Hub)] play an important role in the reductions of cotton yield to a significant level. It is considered that the insect pests may cause 5-10 percent losses which may increase upto 40-50% (25). To overcome these pests various pest control measures are recommended like cultural, biological and chemical measures but the control of insect pests through the use of resistant varieties holds great importance (13,18,20) which involves either less or small quantity of insecticides without any additional cost. Use of resistant varieties is economical and has no environmental risks (22, 27). The earlier scientists have reported different resistance levels in cotton genotypes against insect pest complex (5, 16, 26). Among them selection of resistance variety is comparatively cheaper and best choice for growers to decrease the damages of insect pest complex (14).

This study was conducted to screen out some genetically resistant material of cotton against insect pest complex as a guideline for cotton breeders and farming communities to plan out their future breeding strategies.

MATERIALS AND METHODS

This study was conducted at Cotton Research Station, Multan in two year 2014. Eight cotton genotypes viz. AGC-501, BH-185, NIAB-874B, MNH-886, FH-312, CIM-616, IUB-75 and IR-NIBGE-6 were sown on 27-05-2014, under

RCBD replicated thrice. The net plot size was 20′ x 10′ and the distance between rows and plants was 75 and 30 cm, respectively. The recommended field practices were conducted like time of sowing, thinning, hoeing and weeding.

Data on population of sucking pests

Population of jassid (adults and nymphs), whitefly (adults) and thrips (adults and nymphs) per leaf was recorded early in morning at weekly intervals starting from July 24 to September 18, 2014. Fifteen leaves from each plot were randomly selected from 15 different plants. These leaves were observed in such a sequence that first leaf from upper one third of first plant, second leaf from middle of second plant and third leaf from lower portion of third plant and so on. The average population per leaf of sucking pest for each genotype was calculated by the simple arithmetic means using the following formula,

$$X = \frac{X1+X2+X3+, \cdots +X14+X15}{N}$$

Where:

N	=	Total numbers of leaves,
X	=	Mean leaves-1, and X1+X2+X3+, …·
+X14+X15	=	Number of observed leaves

Population of spotted and american bollworms

The population of spotted, American and pink bollworms larvae were recorded from ten plants per plot selected randomly. Moreover, rosette flowers were recorded weekly. Average population per plant was calculated by simple arithmetic means using the formula given above.

Population of pink bollworms

The population of pink bollworm larvae in the left over bolls was recorded by plucking total left over bolls from each plot and was kept in lab for 3-4 days. After such period the bolls were opened with knife and pink bollworm larvae were counted. Percent larvae was calculated by the formula:-

$$Damage\ (\%) = \frac{Number\ of\ bolls\ with\ pink\ bollworms}{Total\ bolls} X\ 100$$

Application of pesticides

The crop was sprayed with insecticides on recommended dose when the populations of sucking pest increase above ETL level. On the crop one blank spray of confidor @ 250ml per acre was done to keep it healthy throughout the season.

Seed cotton yield

The total seed cotton was picked from each genotype plot and then it was kept separately and weighed. The recorded seed cotton yield was converted into per acre seed cotton by maintaining plants population.

Cotton leaf curl virus (CLCuV) incidence

The incidence of cotton leaf curl virus (CLCuV) was known by counting all healthy and affected plants per plot throughout the season. The virus percentage was calculated through the formula

$$\textit{Virus percentage} = \frac{\textit{Virus infested plants}}{\textit{Total number of plants}} \textit{ X 100}$$

Fibre characteristics

The seed cotton was picked carefully on full maturity of the crop and dried under the sunshine, after which one sample was taken from each repeat of each genotype. These samples were ginned by experimental small ginning machine. The ginning outturn percentage was calculated by following formula:

$$\textit{Ginning out turn (GOT) percentage} = \frac{\textit{Lint weight}}{\textit{Weight of seed cotton}} \textit{ x 100}$$

Forty grams of lint from each sample was taken in a paper envelope signifying the name of genotype and ginning number on envelope was further sent to fibre testing laboratory of CRS, Multan for fibre quality analysis i.e. GOT (%), staple length (mm), fibre fineness (µ g/inch), and fibre strength (g/tex) on machine HVI spectrum-1 (Manufacturer Uster company made in USA).

Statistical analysis

The data were subjected to analysis of variance (ANOVA) using statistical software (Release 8.1; Lawes Agricultural Trust Rothamsted Experimental Station, Rothamsted, UK). The means were separated by Tukey's HSD (Honestly Significant Differences).

RESULTS AND DISCUSSION

Average population of jassid (*Amrasca biguttula biguttula*) per leaf

The data (Table 1) indicate that there was significant differences among *Bt* cotton genotypes which belong to different companies and research institutions (Private/Government) regarding jassids population. The genotype BH-185 had maximum attack of jassid per leaf (0.73) followed by NIAB-874B, IR-NIBGE-6, MNH-886, FH-312, IUB-75 and CIM-616 i.e. 0.42, 0.40, 0.39, 0.33, 0.31 and 0.30 per leaf, respectively. The genotype AGC-501 had minimum attack of jassid per leaf (0.27).

Table 1. Average population of Insect pest complex on cotton genotypes

Genotypes	Average population of sucking pest per leaf			Average population of bollworms larvae per plant			Percent infestation of PBW larvae in left over bolls
	Jassid	Whitefly	Thrips	Spotted bollworm	American bollworm (NS)	Pink bollworm rosette flowers (NS)	Pink bollworm
	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
AGC-501	0.27±c	1.87±0.16c	1.00±0.04d	0.00±0.00b	0.00±0.00	0.00±0.00	88.89±2.45a
BH-185	0.73±0.01a	4.27±0.07a	7.20±0.02a	0.33±0.00a	0.00±0.00	0.00±0.00	61.54±2.58c
NIAB-874B	0.42±0.02b	3.80±0.16ab	2.87±0.09bc	0.33±0.01b	0.00±0.00	0.00±0.00	72.22±2.36bc
MNH-886	0.39±0.02bc	2.07±0.04c	1.0±0.09d	0.00±0.00b	0.00±0.00	0.00±0.00	31.33±1.94e
FH-312	0.33±0.04bc	3.0±0.18bc	3.67±0.07b	0.00±0.00b	0.00±0.00	0.00±0.00	45.00±1.72d
CIM-616	0.30±0.05bc	3.80±0.03ab	3.87±0.04b	0.00±0.00b	0.00±0.00	0.00±0.00	68.0±0.85bc
IUB-75	0.31±0.01bc	2.87±0.09bc	2.8±0.02bc	0.27±0.00ab	0.00±0.00	0.00±0.00	70.0±1.08bc
IR-NIBGE-6	0.40±0.02b	3.00±0.06bc	1.33±0.20cd	0.00±0.00B	0.33±0.19	0.00±0.00	78.0±2.13ab
Tukey's HSD Value at 0.05%	0.13	1.14	1.90	0.31	-	-	11.00

Means sharing similar letters are not significantly different by Tukey's HSD at = 0.05, HSD = Honestly, Significant Difference, *Significant at P < 0.05, **Significant at P < 0.01, NS = Non-significant

Average population of whitefly (*Bemisia tabaci*) per leaf

The data (Table 1) reveal significant differences among different *Bt* cotton genotypes which belong to different companies and research institutions (Private/Government) regarding whitefly population. The genotype BH-185 had maximum attack of whitefly per leaf i.e. 4.27 statistically similar to CIM-616 and NIAB-874B having 3.80 and 3.80 per leaf population of whitefly

followed by FH-312, IR-NIBGE-6 and IUB-75 having 3.0, 3.0 and 2.87 per leaf population, respectively. The genotype AGC-501 had minimum attack of whitefly per leaf (1.87).

Average population of thrips (*Thrips tabaci*) per leaf

The data (Table 1) reveal significant differences among various *Bt* genotypes of cotton regarding thrips population. The genotype BH-185 had maximum attack of thrips per leaf (7.20) followed by CIM-616, FH-312, NIAB-874B and IUB-75 having 3.87, 3.67, 2.87 and 2.89, respectively. The genotype AGC-501 and MNH-886 had minimum attack of thrips per leaf i.e. 1.87 and 1.0, respectively.

Average population of spotted bollworm (*Earias* sp.) per plant

The genotypes BH-185 had 0.33 per plant living larvae of spotted bollworm statistically similar to IUB-75 (0.27). All other genotypes showed zero population of spotted bollworm.

Average population of American bollworm (*Heliothis armigera*) per plant

In case of american bollworm the population ranged from 0.00 to 0.19 having non-significant differences among genotypes.

Average population of Pink bollworm (*Pectinophora gossipiella*) per plant

The data reveal significant differences among various *Bt* genotypes of cotton regarding PWB population. The genotype AGC-501 had 88.80 percent damage of PBW statistically similar to IR-NIBGE-6 with (78.0%) followed by NIAB-874B, IUB-75 and CIM-616 having with 72.22, 70.0 and 68.0 percent damage respectively. The genotype BH-185 had 61.54, whereas FH-312 had 45.0 percent damage. The genotype MNH-886 showed minimum percent damage of PBW (31.33).

Fibre characteristics

Ginning out turn (GOT%): The maximum GOT was recorded in FH-312 i.e. 47.6 percent against minimum in AGC-501 (19.8%). In all other genotypes it ranged 40.50-44.80 percent (Fig 1).

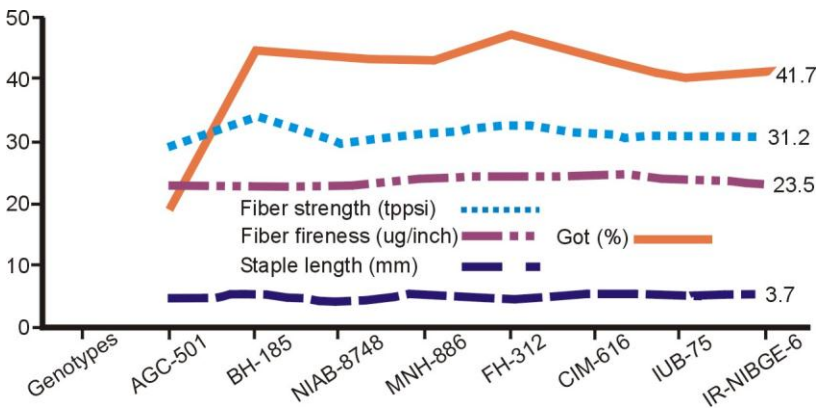

Fig. 1. Fiber characteristics of different genotypes of cotton

Staple length (mm): Maximum staple length was recorded in MNH-988 (24.9 mm). Minimum staple length was recorded in AGC-22.8 i.e. 22.8 mm. All other genotypes range of staple length was 23.0-24.80 mm as shown in Fig 1.

Fibre strength (g/tex): Maximum fibre strength was recorded in FH-312 i.e. 34.3 g/tex) against minimum in AGC-501 (30.0 *g/tex).* In all other genotypes fibre strength ranged 30.2-32.8 *g/tex* (Fig 1).

Fibre fineness (µg/inch): From the results it is concluded that maximum fineness was recorded in genotypes MNH-886 (6.0 µg/inch) as compared with other genotypes of cotton. Minimum fineness was recorded in NIAB-874B (4.3 µg/inch) when compared with standard i.e. below 5.0 µg/inch. All other genotypes showed 5.1-5.7 µg/inch (Fig 1).

Virus (CLCuV) percentage after 120 days of sowing: The data in Fig 2 reveal that maximum virus was recorded in genotypes in FH-312 i.e. 98.0 percent. Minimum virus was recorded in genotypes CIM-616 i.e. 48.00 percent. All other genotypes had 50-88 percent CLCuV 120 days after sowing.

Average number of bolls per plant: Maximum average number of boll per plant was recorded on genotypes CIM-616 i.e. 26.2. The minimum number of boll was recorded on IUB-75 (16.8) per plant as shown in Fig 3. All other genotypes range from 19.6-24.8 regarding the average numbers of bolls per plant.

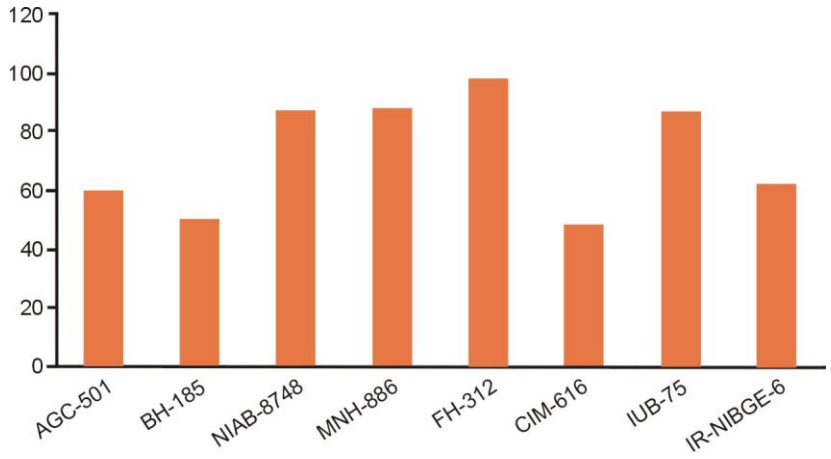

Fig. 2. CLCuV incidence on different genotypes of cotton

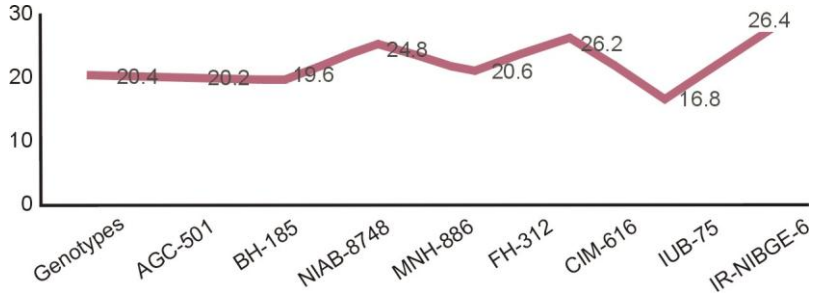

Fig. 3. Average number of bolls per plant of different genotypes of cotton

Average seed cotton per acre: Maximum yield in maunds per acre was recorded in CIM-616 i.e. 17.81 maunds per acre. Minimum yield was recorded in IR-NIBGE-6 i.e. 11.66 maunds per acre as shown in Fig 4.

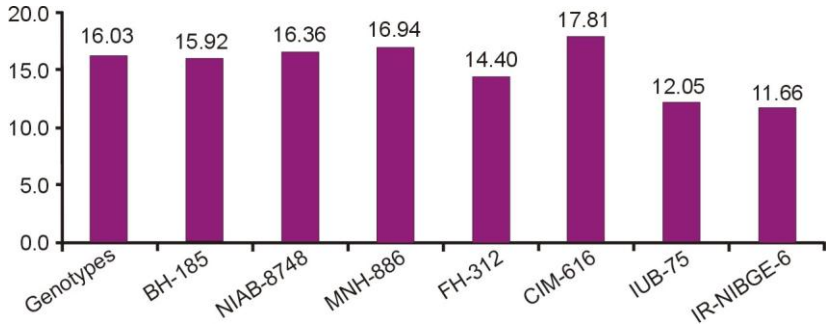

Fig. 4. Seed cotton in maunds per acre of different genotypes of cotton

Insect pests damaged the crops by feeding on its tissue whereas some of them are also considered as vector of transmitting harmful viruses. Different types of management tactics are used to minimize losses caused by insect pests. Among them, cultural controls, varietal resistance, insecticides and biological control agents are commonly used to overcome the pests and losses. In integrated approach to the management of cotton insect pests, varietal resistance is one of the major tactics. It is also considered that resistant varieties increase vulnerability of insect pests to pesticides (17). In order to minimize damage by insect pests on crop, farmers rely on chemical control measure as compared with other control tactics. Choice of crop varieties should be based on resistance to insect attack that is prevalent in locality. It is not only preventive to insect pest attack but also safer for human health with no environmental hazards as reported earlier (22, 27). Such resistant cultivars can be considered which keep insect pest population below economic threshold level (10) and also offer protective control in the form of an effective and inexpensive method which is well-matched with other techniques of pest management (14).

Our study indicates that there is variation among genotypes regarding insect pest attack. The results indicated that the genotype BH-185 was found to be susceptible because of maximum attack of jassid, whitefly and thrips. The genotype AGC-501 proved to be tolerant to jassid, whitefly and thrips with minimum infestation. The rest of genotypes showed intermediate population of sucking pests. The results are in conformity with previous findings (5,16, 26, 29) which concluded that level of tolerance in cotton cultivars varies in opposition to insect pests which suck the cell sap. However, Shad *et al.* (29) investigated the presence of sucking insect pests on four different cotton genotypes *viz*. Karishma, CIM-443, CIM-448, BH-136 and BH-637 and concluded that CIM-443 had highest population of thrips with the lowest population of jassid whereas whitefly infestation was found higher on BH-136 (12.39/leaf). Amjad *et al.* (7) worked on different cotton cultivars and separated five genotypes of cotton *viz.*, FH-634, FH-682, NIAB-78,FS-628 and FH-643 which indicated tolerance in opposition to whitefly (*Bemisia tabaci* Genn.), jassids (*Amrasca devastans* Dist.) and aphid (*Aphis gossypii* Glov.). Further it was concluded that cultivar FH-634 was highly tolerant to sucking pest complex as compared to other tested genotypes.

In case of bollworm infestation on cotton genotypes, results revealed that genotype BH-185 showed susceptibility against spotted bollworm while rest of genotypes indicated resistance with least population. Population of American bollworm had non-significant difference among genotypes. The

pink bollworm population was found maximum on genotypes AGC-501 which indicated susceptibility and genotype MNH-886 proved to be resistant with least infestation against pink bollworm. Assessment of current conclusion with those of work done previously (2, 4, 6, 9, 15, 30, 34) on the relative tolerance of cotton cultivars to insect pests complex was however, not possible in accurate terms because of their differences in the varietal/pest combination.

The virus infestation was found highest on the genotype FH-312 and lowest on CIM-616 under similar conditions. The virus infestation was low initial stages of crop which increases with plant growth in the usual dates of sowing. These results are similar to those of Karar *et al.* (19) who concluded that cotton crop sown in March had less than 1 percent virus infestation as compared to normal and delayed sown crop.

Highest GOT and fibre strength were recorded on the genotype FH-312, while these were lowest on AGC-501. Maximum staple length was found in the genotype MNH-988 while minimum on the genotype AGC-501. Maximum fineness was recorded in genotype MNH-886 against minimum in NIAB-874B when compared with standard. The maximum seed cotton yield was recorded in CIM-616 i.e. 17.81 maunds per acre. Minimum seed cotton yield was recorded in IR-NIBGE-6.

CONCLUSION

The cotton varieties AGC-501 and MNH-886 showed less sucking pest attack and zero bollworm attack except in leftover bolls. The genotype CIM-616 having less virus and more yield is in the best interest of growers community. So these varieties will be preferred for future breeding program and also for the evaluation of new genotypes.

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CONTRIBUTION OF AUTHORS:

Haider Karar	**:**	**Planned the research, collected field data, performed statistical analysis and prepared writeup**
Qaisar Abbas	**:**	**Proof read and addressed reviewers comments**
Sikander Ali	**:**	**Proof reading, prepared tables and developed figures**
Muhammad Shahid	**:**	**Helped in statistical analysis**