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Assessment of some parents and their hybrids for agronomic traits in Cotton (*Gossypium hirsuitum* L.)

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ABSTRACT

Cotton (*Gossypium hirsuitum* L.) is a major cash crop all over the world. The presence of genetic variation in the available germplasm is pre-requisite for starting breeding program, secondly information about various genetic mechanism controlling various parameters is also important. The present experiment was planned to study the genetic basis of some agronomic traits contributing to yield of upland cotton. In this experiment, four genotypes viz PB-896, PB-76, AGC-2 and VH-282 were used as parents, which were crossed in all possible combinations. The F_1 along with four parents was evaluated in field conditions. These progenies were planted in three replication following randomised complete block design. At the time of maturity, data were recorded on plant height, no. of bolls plant^{-1}, boll weight, seed cotton yield and ginning out turn. The data were used for analysis of variance to test the variation among genotypes for these traits. All the genotypes were highly significant for the parameters under studied. It showed that parent AGC-2 has maximum plant height (84.30 cm) and PB-76 has minimum plant height (72.55 cm) among all the parents while hybrid AGC-2 × PB-76 exhibited maximum plant height (80.13 cm). It revealed that parent AGC-2 has maximum number of bolls (12.00) and while hybrid PB-76 × PB-896 showed maximum number of bolls (14.00). The parent VH-282 exhibited maximum boll weight (3.34 g) and hybrid PB-76 × PB-896 showed maximum boll weight (3.58 g). It showed that parent PB-896 gave maximum seed cotton yield per plant (40.15 g) and hybrid PB-76 × PB-896 showed maximum seed cotton yield (43.40 g). It is showed that parent AGC-2 has maximum GOT (45.23 %) while hybrid AGC-2 × PB-896 showed maximum GOT (45.75 %).

Key words: Cotton (*Gossypium hirsuitum* L.), seed cotton yield, genetic variation

INTRODUCTION

Cotton provides fibre, edible oil and by products are used as food of livestock (Chaudhry and Guitchounts, 2003). In Pakistan cotton seed is major cooking oil source which contributes 70% of the total production of vegetable oil (Batool *et al*., 2010). Primarily cotton is cultivated for fiber purpose which consist of 94% cellulose and 0.4-1.0% lignin (Macmillan *et al*., 2013). Cotton seed has two types of fibers i.e. fuzz fiber and lint fiber where fuzz is short fiber and lint fiber is long fiber. Single celled fiber of the cotton is developed from epidermal cells of ovule. Chemical composition of the cotton fiber is protein (1.3%), ash and pectin (1.2%), oil fats and waxes (0.6%) and sugar (0.3%). Linters contain cellulose which is used as raw material in various industries (Haigler *et al*., 2012). Although marvelous achievements for the enhancement of cotton yield in terms of fiber, seed, and oil are made by Pakistani scientist in past but there is a need of high yielding varieties to meet the increasing demand of fiber and oil sectors in the country. The average yield of existing varieties is low as compare to existing genetic potential available in the germplasm. For improving the genetic architecture and crop production the genetic information of different quantitative traits is helpful for cotton breeders (Abbas *et al*., 2008). The existence of genetic variation within a species is a pre-requisite to start a breeding program for the development of new genotypes (Bajracharya *et al*., 2006). The success of breeding program primarily depends on promising parental lines. The parents are selected due to the presence of favorable genes and their pattern of inheritance (Ali *et al*., 2008). Genetic variability could be induced by using breeding methods like polyploidy, hybridization and introduction of exotic germplasm (Esmail *et al*., 2008). Likewise, several biometrical approaches are available to investigate various mechanism or gene action for the control of important plant parameters. One of them is diallel analysis which is also used to check the nature of inheritance of genetic variation in different plant characters (Griffing, 1956). Full diallel mating design is also used to estimate the general and specific combining abilities of parental lines (Gilbert, 1958). In this research four cotton genotypes and their F_1 hybrids were analysed by Griffing's approach, to check the performance of four parents of cotton and their F_1 hybrids for fiber and agronomic parameters.

Materials and methods

The presented research work was conducted for the determination of combining ability effects of cotton lines for some agronomic traits at the experimental area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. Four lines of cotton namely PB-896, PB-76, VH-282 and AGC-2 were collected from gene pool of cotton research group, which were planted in earthen pots placed in green house. In addition, all recommended cotton production and protection practices was adopted to get healthy plants for hybridization work. At the time of flowering these varieties were crossed in complete diallel mating design and some of buds were self-pollinated. The F_0 cotton seeds from 12 hybrids and their 4 parents were sown in field conditions in three replications under randomized complete block design. Ten plants of each family were planted in each row and plant to plant and row to row distance was maintained 30cm and 75cm respectively. All of agronomic practices were followed uniformly to have good crop. The data was collected from five guarded plants from each row. These guarded plants were tagged separately and data were collected at the time of maturity on individual plant.

Table 1. Material used in breeding program.

Parents	Direct Crosses	Indirect Crosses
PB-896	PB-896 × PB-76	PB-76 × PB-896
PB-76	PB-896 × VH-282	VH-282 × PB-896
VH-282	PB-896 × AGC-2	AGC-2 × PB-896
AGC-2	PB-76 × VH-282	VH-282 × PB-76
	PB-76 × AGC-2	AGC-2 × PB-76
	VH-282 × AGC-2	AGC-2 × VH-282

Results and discussions

Average value for all studied traits of four parents and their 12 F_1 hybrids were subjected to the analysis of variance (ANOVA). Highly significant differences ($p<0.01$) were found among the 16 genotypes (four parents, six direct crosses and six indirect crosses) for plant height, number of bolls per plants, boll weight, seed cotton yield and ginning out turn% while in replication non-significant differences were found table 2. Mean comparison of parents and their F_1 hybrids on individual basis are presented in Fig 1. It showed that parent AGC-2 has maximum plant height (84.30 cm) and PB-76 has minimum plant height (72.55 cm) among all the parents while hybrid AGC-2 × PB-76 exhibited maximum plant height (80.13 cm) and hybrid PB-896 × VH-282 attained minimum plant height (61.96 cm) among direct and indirect crosses. Mean values of parents and their F_1 hybrids for number of bolls on individual basis are presented in Fig 2. It revealed that parent AGC-2 has maximum number of bolls (12.00) and PB-76 has minimum (10.33) among all the parents while hybrid PB-76 × PB-896 showed maximum number of bolls (14.00) and hybrid PB-896 × VH-282 showed minimum (7.00) among direct and indirect crosses. Mean comparison of parents and their F_1 hybrids for boll weight on individual basis are shown in Fig 3. The parent VH-282 exhibited maximum boll weight (3.34 g) and AGC-2 has minimum (3.04 g) among all the parents while hybrid PB-76 × PB-896 showed maximum boll weight (3.58 g) and hybrid VH-282 × PB-76 showed minimum (2.54 g) among direct and indirect crosses. Mean performance of parents and their F_1 hybrids for seed cotton yield on individual basis are demonstrated in Fig 4. It showed that parent PB-896 gave maximum seed cotton yield per plant (40.15 g) and AGC-2 gave minimum (38.75 g) among all the parents while hybrid PB-76 × PB-896 showed maximum seed cotton yield (43.40 g) and hybrid VH-282 × PB-76 showed minimum (35.78 g) among direct and indirect crosses. Fig 5 presented mean performance of parents and their F_1 hybrids for lint % of upland cotton on individual basis. It showed that parent AGC-2 has maximum GOT (45.23 %) and PB-896 has minimum (39.80 %) among all the parents while hybrid AGC-2 × PB-896 showed maximum GOT (45.75 %) and hybrid PB-76 × AGC-2 showed minimum (40.35 %) among direct and indirect crosses. Genetic change in plant character through natural selection play crucial role to create genetic variation in traits. Different components of genetic variation in characters hold valuable information that helps in selection of breeding population. Characters such as uniformity in fibers, fiber strength and elongation, boll weight, fiber fineness, staple length, ginning out turn, number of nodes first effective boll formation, node height up to first fruiting branch, number of monopodial branches, node of first fruiting branch, number of sympodial and monopodial branches exhibit significant differences among parents and their crosses that showed existence of genetic variability. Subhan *et al.* (2000) and Neelima *et al*. (2004) revealed that non- additive genetic effect played important role in controlling number of bolls, plant height and lint percentage. Both type of gene actions i.e. additive and non-additive found to be important for plant height (Khan 2003, Neelima *et al.*, 2004 and Iqbal *et al.*, 2013). The character lint percentage was governed by non-additive genetic effects which confirms the results of Sayal and Sulemani (1996). Lint percentage have an important role for lint production.

Table 2. Analysis of variance for plant height, number of bolls, boll weight, seed cotton yield per plant and lint% in parents and crosses of upland cotton

Source of variation	D.F.	Plant height	Number of bolls	Boll weight	Seed cotton yield	Lint %
Replication	2	1.19^{ns}	0.43^{ns}	0.03^{ns}	0.05^{ns}	0.17^{ns}
Genotype	15	102.69**	8.20**	0.16**	8.39**	9.55**
Error	30	0.93	0.77	0.02	0.55	0.49
Total	47					

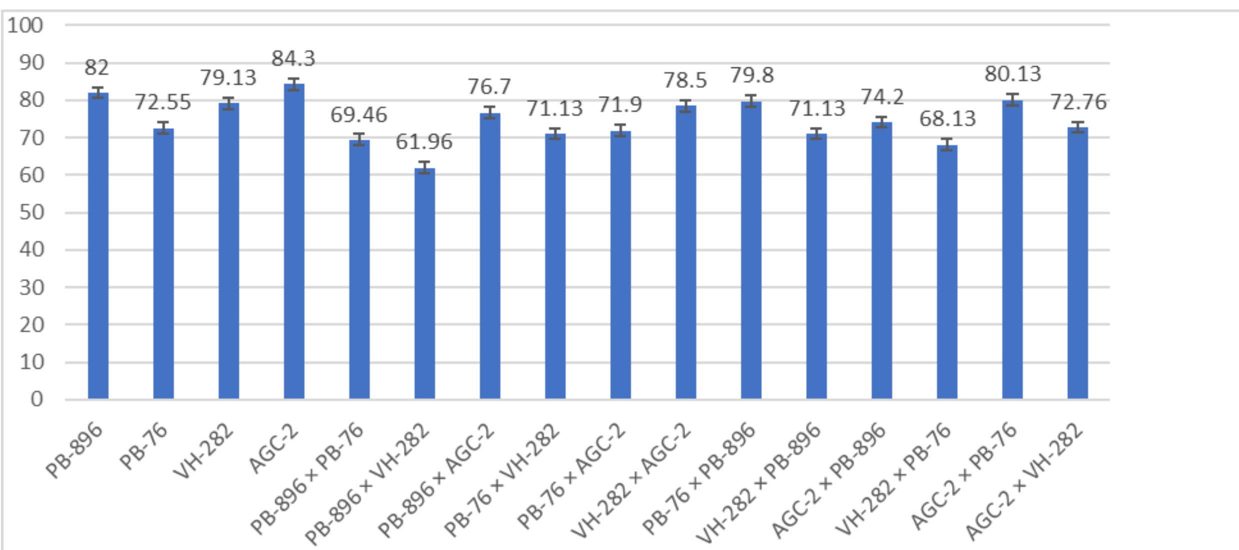

Fig 1 Mean performance of parents and hybrids for plant height in upland cotton

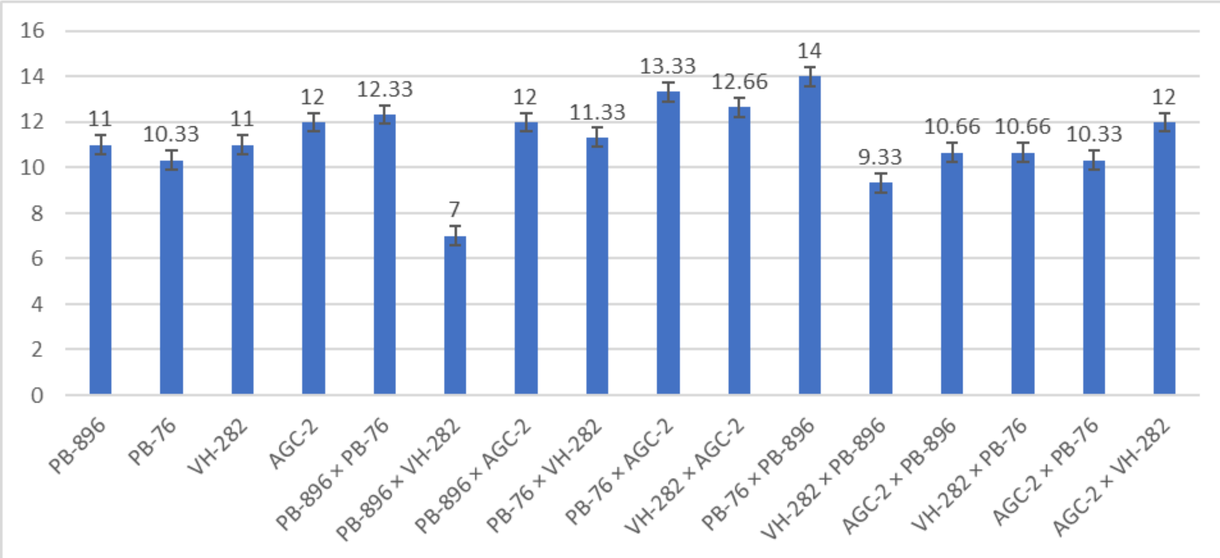

Fig 2 Mean performance of parents and hybrids for number of bolls per plant in upland

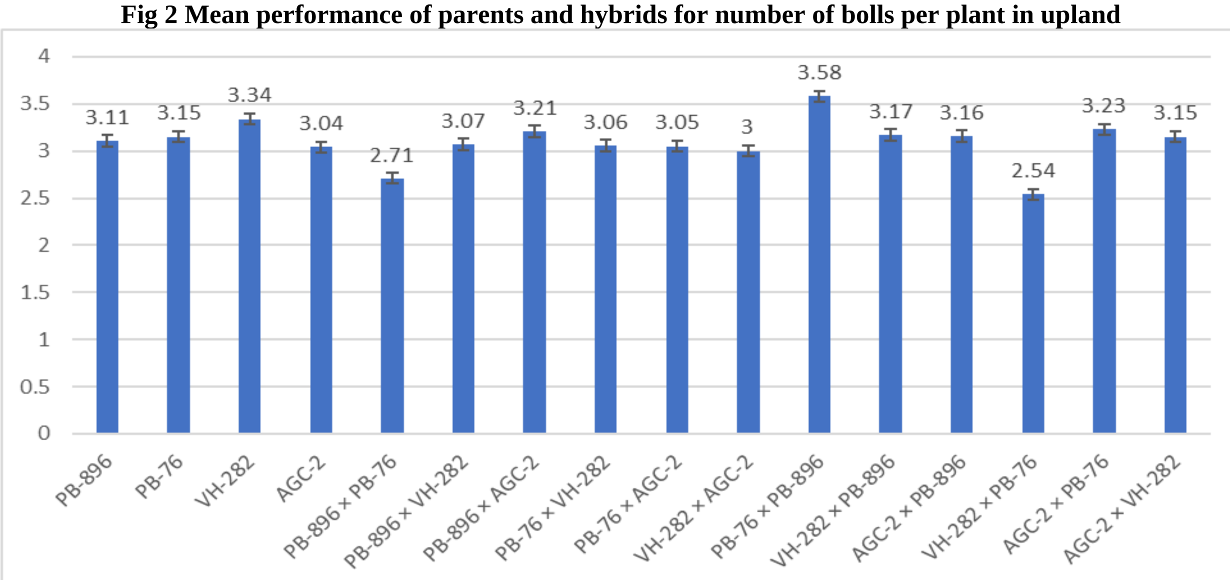

Fig 3 Mean performance of parents and hybrids for boll weight in upland cotton

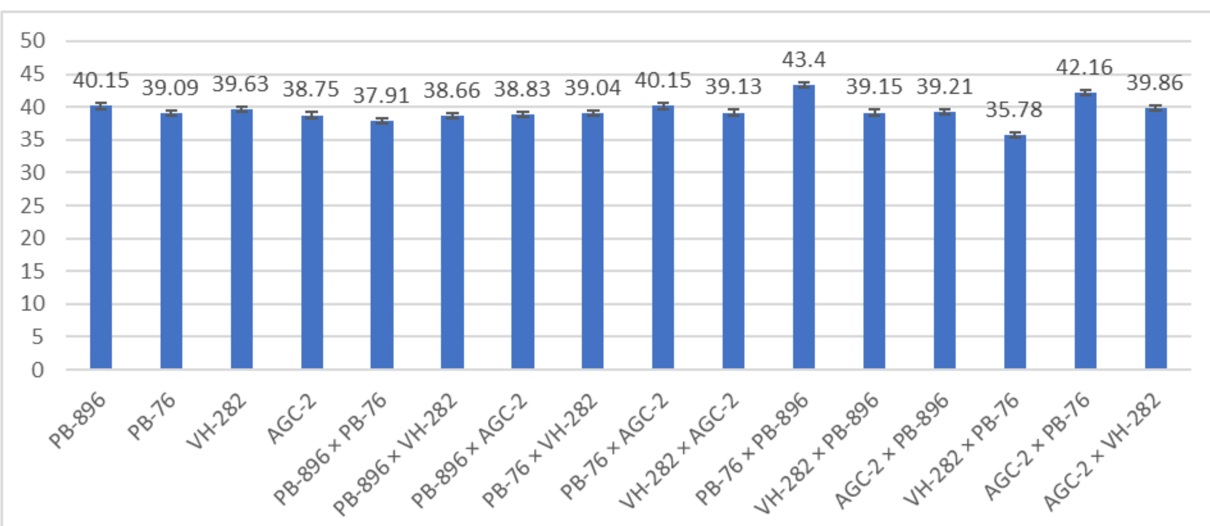

Fig 4 Mean performance of parents and hybrids for seed cotton yield per plant in upland cotton

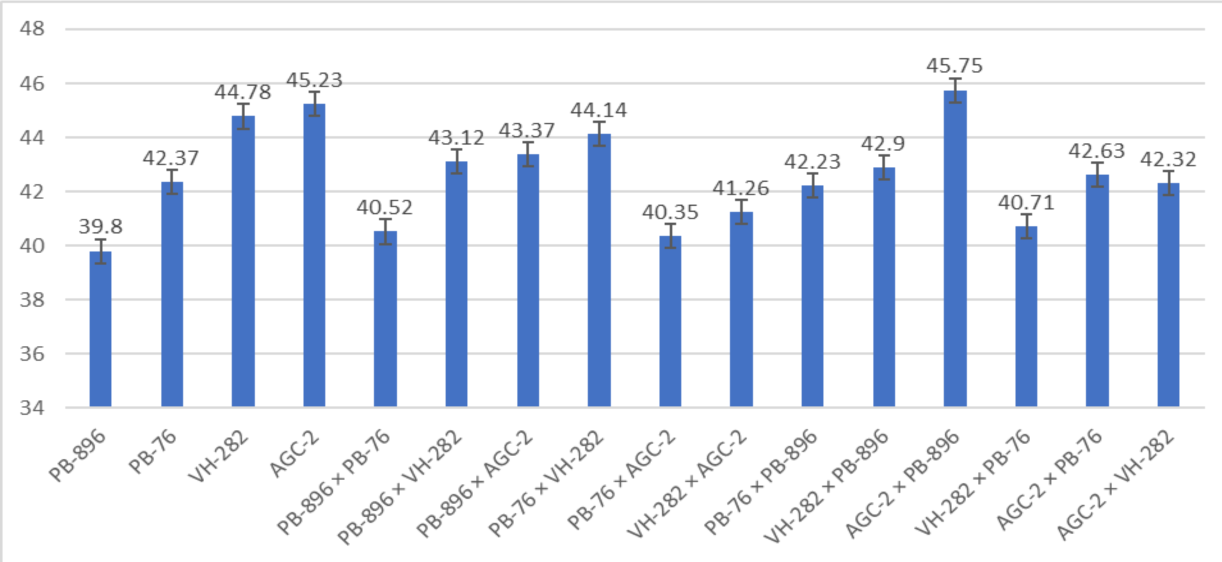

Fig 5 Mean performance of parents and hybrids for lint % in upland cotton

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