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Correlation analysis for yield and fiber quality traits in upland cotton

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ABSTRACT

Yield and fiber quality are most important and complex trait as they depend on interaction of genetic architecture of plant and environment. To achieve this objective, two parents FH153, KZ191 and their F2 population were evaluated for the existence of inter-relationship of characters under study during 2014-2015, at University of Agriculture, Faisalabad. The experiment was carried out in a randomized complete block (RCB) design with three replications. Data were recorded for Plant height (cm), number of sympodial branches, number of monopodial branches, pedicel length (mm), number of bolls per plant, number of seed per boll, boll weight (g), ginning out turn (%), fiber fineness (µ/inch), staple length (mm), fiber strength (g/tex), seed cotton yield (g). The obtained data were analyzed through correlation analysis at 0.01 and 0.05 significance level. The traits under study showed considerable range of phenotypic variability. The parent FH153 had maximum mean value for all traits under observation expect fiber strength. The parent KZ191 showed maximum fiber strength (21.1 g/tex). The F2 population of parents (FH153×KZ191) had minimum results for all traits. The results also showed positive association of characters with each other except staple length showed negative association with monopodial branches per plant, fiber strength and seed cotton yield.

Keywords: *Gossypium hirsutum*, Correlation, Cotton, Fiber quality, Yield.

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INTRODUCTION

Cotton (*Gossypium hirsutum*) is an important cash crop playing a crucial role in economy of Pakistan. Cotton is a multipurpose crop providing fiber, edible oil and seed cake. About 1.5 million population of Pakistan earn their livelihood from the cultivation of cotton (Hussain et al. 2010). Fiber quality in cotton has supreme importance as yield, which involves growers, ginners and the textile industry simultaneously. Ginners prefer high ginning percentage. Fiber quality is the main interest of textile industry whereas, farmer does not compromise on yield (Tyagi 1987).

Due to its importance, cotton crop has attracted plant breeders to improve the genetic architecture of cotton plant. These efforts have led to the development of high yielding cotton cultivars by improving the quality traits and yield potential through breeding (Shabbir et al. 2016). Since, further genetic improvements are possible. Therefore, cotton breeders should continue their efforts to develop varieties with better quality and higher yield. The knowledge of character association affecting yield is very important for an effective plant breeding programme. In cotton breeding program, the improvement in lint yield is not the only objective but fiber quality characters like length, strength and fineness etc. are also important in textile industry. Science of plant breeding has a documented history of cotton improvement to meet the producer and processor requirements.

Cotton plant traits are linked naturally, so improvement in one trait may affect other traits. Determination of correlation coefficient is the most effective method to study strength and nature of association among traits. The present study was conducted to find correlation among plant height, number of monopodial branches, number of sympodial branches, pedicel length, number of bolls, number of seeds per boll, boll weight, ginning out turn, fiber fineness, fiber strength, staple length and seed cotton yield.

MATERIAL AND METHODS

General information. The experiment was comprised of parents FH153, KZ191 and their F2 population. They were sown in the field area of the Department of Plant Breeding and Genetics, University of Agriculture Faisalabad during normal cotton growing season of the year 2014. The experiment was laid out in randomized complete block design (RCBD) with three replications. Each replication contained one row for each parent and 15 rows for F2 population. Row to row and plant to plant distance was 30 cm and 75 cm respectively. All agronomic practices were followed from sowing till harvest. At maturity, the data was collected from 5 guarded plants from each row of the following traits.

Observed traits. Plant height (cm), Number of sympodial branches, Number of monopodial branches, Pedicel length (mm), Number of bolls per plant, Number of seed per boll, Boll weight (g), Ginning out turn (%), Fiber fineness (µ/inch), Staple length (mm), Fiber strength (g/tex), Seed cotton yield (g).

Statistical analysis. The data collected was subjected to analysis of variance following the method as in Steel et al. (1997) in order to determine the significant differences in plant characters among the genotypes under study. The characters showing significant differences among the hybrids/parents were further analyzed for correlation coefficients, calculated by the formula as outlined by Dewey and Lu (1959) using Minitab programme of computer.

RESULTS AND DISCUSSION

The analysis of variance revealed that the parents and the F2 population showed significant difference for various traits under study, indicating a considerable range of genetic variability. Parents FH153, KZ191 and F2 population had a mean plant height of 105.4cm, 103.1cm and 99.3cm respectively. Plant height had positive influence on the characters under study (Table 1).

Hussian et al. (2000), Echekwn (2001), Pandey et al. (2003) and Naveed et al. (2004) had reported similar results. Whereas, Salahuddin et al. (2010) found plant height had no significant association with seed cotton yield. Parent FH153 had maximum number of monopodial branches per plant (2.3) followed by parent KZ191 (1.8) and F2 population with (1.8). Monopodial branches showed positive association with, sympodial branches, pedicel length, number of bolls, number of seeds per boll, ginning out turn, fiber fineness, fiber strength and seed cotton yield while it had negative correlation with staple length.

Azhar et al. (1999), Shahbaz et al. (2004), Hussain et al. (2000), Ahuja et al. (2006) and Chattha et al. (2010) found the significant association of monopodial branches with other yield and quality traits whereas, Salahuddin et al. (2010) observed monopodial branches per plant had no significant association with seed cotton yield (table 2). The parent FH153, KZ191 and F2 population had mean value of 12, 11.4 and 10.9 number of sympodial branches per plant. Sympodial branches showed positive association with, pedicel length, number of bolls, number of seeds per boll, ginning out turn, fiber fineness, fiber strength and seed cotton yield. Rauf at al. (2004), Annapurve et al. (2007), Salahuddin et al. (2010), Rahman et al. (2013)

Table 1. Mean of the parents and F2 population for yield and quality traits. plant height (PH, cm), number of monopodial branches (MB), number of sympodial branches (SB), pedicel length (PL,mm) , number of bolls per plant (NB), number of seed per boll (NS), boll weight (BW,g), ginning out-turn (GOT%), fiber fineness (FF,µg/inch), fiber strength (FS,g/tex), staple length (SL,mm) and seed cotton yield (SCY,g).

Genotype	PH (cm)	MB	SB	PL (mm)	NB	NS	BW (g)	GOT (%)	FF (µg/inch)	FS (g/tex)	SL (mm)	SCY (g)
FH153	105.4	2.3	12	12.9	28.9	28.5	3.75	39.1	4.26	20.4	29.6	98.4
KZ191	103.1	1.8	11.4	11.7	27.4	27.7	3.70	38.3	4.00	21.1	28.2	93.4
F_2	99.3	1.8	10.9	11	26.4	27	3.60	37.8	3.94	19.3	27.5	89.4

Table 2. Correlation matrix among the traits, plant height (PH, cm), number of monopodial branches (MB), number of sympodial branches (SB), pedicel length (PL,mm), number of bolls per plant (NB), number of seed per boll (NS), boll weight (BW,g), ginning out-turn (GOT%), fiber fineness (FF,µg/inch), fiber strength (FS,g/tex) ,staple length (SL,mm) and seed cotton yield (SCY,g).

	PH (cm)	MB	SB	**PL** (mm)	NB	NSB	**BW** (g)	GOT%	**FF** (µg/inch)	**FS** (g/tex)	SL (g)
MB	0.693**										
SB	0.522**	0.539**									
PL	0.789**	0.693**	0.724**								
NB	0.389**	0.407**	0.520**	0.536**							
NSB	0.611**	0.475**	0.380**	0.556**	0.487**						
BW	-0.050	0.070	0.005	0.114	0.096	0.206					
GOT%	0.396**	0.424**	0.318**	0.444**	0.231	0.230	0.104				
FF	0.565**	0.643**	0.480**	0.749**	0.464**	0.372**	0.091	0.525**			
FS	0.652**	0.470**	0.501**	0.591**	0.335**	0.464**	0.019	0.218	0.451**		
SL	-0.390**	-0.308*	-0.208	-0.180	-0.076	-0.163	-0.122	-0.050	0.041	-0.397**	
SCY	0.925**	0.727**	0.608**	0.870**	0.458**	0.650**	0.056	0.421**	0.655**	0.633**	-0.267*

*=significant

**= highly significant

and Farooq et al. (2013) observed similar results. The parent FH153 had maximum pedicel length (12.9mm) followed by parent KZ191 (11.4mm).

The F2 population showed lowest sympodial branches (11mm). Pedicel length showed positive association with number of bolls, number of seeds per boll, ginning out turn, fiber fineness, fiber strength and seed cotton yield. The genotype FH153 had maximum number of seeds per bolls (28.5) while less number of seeds per bolls (27.4) was observed in KZ191. The F2 population showed lowest number of seeds per bolls (27). Number of seeds per boll showed positive association with fiber fineness, fiber strength and seed cotton yield. Akbar et al. (1994), Bibi et al. (2011) also observe the positive association among these traits. The parent FH153 had maximum number boll weight (3.75g) followed by KZ191 (3.70G) and F2 population with (3.60g). It was observed that boll weight had no positive or negative association with ginning out turn, fiber fineness, fiber strength, staple length and seed cotton yield. Baloch et al. (2001) reported that boll weight had negative relationship with seed cotton yield. Xu et al. (2003) reported that boll weight had negative association with number of bolls per plant and lint percentage. Rasheed et al. (2009) and Salahuddin et al. (2010) reported that boll weight had positive correlation with seed cotton yield.

Parents FH153 and KZ191 had maximum 39.1% and 38.3% followed by F2 population (37.8%) mean value for ginning out turn percentage. GOT% showed positive association with fiber fineness and seed cotton yield. Desalegn et al. (2009) found that high lint percentage showed positive correlation with high cotton lint yield. However they observed negative correlation between fiber length and the fineness indicator (micronaire), short fiber index and uniformity ratio. The parent FH153 and KZ191 showed maximum (4.26µg/inch) and (4.00µg/inch) followed by F2 population (3.94µg/inch) mean value for fiber fineness. It was observed that fiber fineness had positive association with fiber strength and seed cotton yield. Rao and Mary (1996) reported negative correlation of micronaire with fiber length. Shahbaz et al. (2004) studied that Fiber fineness positively correlated with

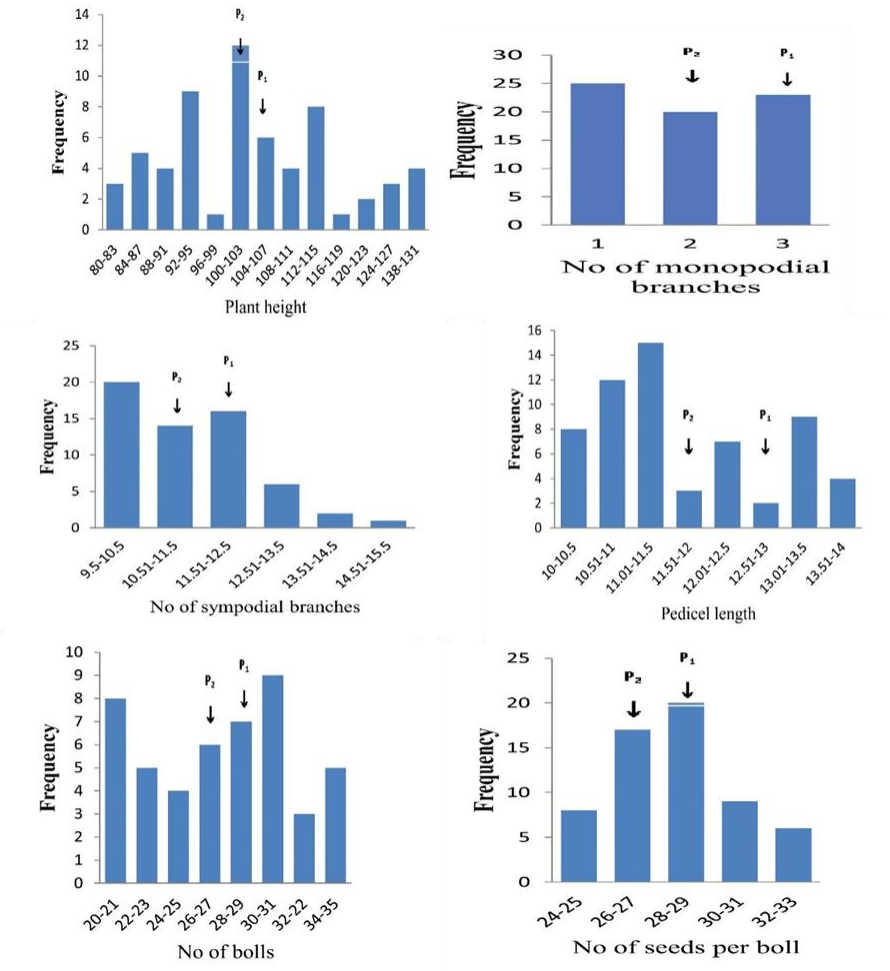

Figure 1. Frequency distribution of parents (FH153, KZ191) and F2 population for plant height, number of monopodial branches, number of sympodial branches, pedicel length and number of bolls per plant and number of seed per boll.

number of monopodial branches and plant height. Chao-zhu et al. (2007) observed positive correlation among boll weight, boll number and lint percentage. Desalegn et al. (2009) found negative correlation between fiber length and fiber fineness. The parent KZ191 had maximum (21.1g/tex) followed by FH153 with (20.4g/tex) and F2 population with (19.3g/tex) mean value for fiber strength. It was observed that fiber strength had positive association with seed cotton yield but had negative association with staple length. Karadimer et al. (2010) reported that negative correlation was found between fiber length and seed cotton yield but fiber length and fiber strength positively associated with each other.

Mendez-Natera et al. (2012) studied that fiber strength negatively correlated with cotton seed yield. The parent FH153 showed maximum (29.6mm) followed by KZ191 (28.2mm) and F2 population had (27.5mm) staple length. It showed negative association with fiber strength and seed cotton yield by Bing et al. (1996), Asif et al. (2008) and Karadimer et al. (2010) also observe Similar result confirming staple length had negative association with seed cotton yield, fiber strength and fiber fineness.

CONCLUSION

The parent FH153 showed maximum results for all the character under study followed by parent KZ191 whereas, F2 population showed minimum mean value for all the traits. The characters like plant height, sympodial branches per plant, pedicel length, number of bolls per plant, number of seed per boll, ginning out turn and fiber fineness had positive association for all other character under observation. Some character like monopodial branches per plant, fiber strength and seed cotton yield showed negative association with staple length. The correlation analysis suggested that selection based on the positive association of these characters with each other would be quite effective to improve the yield and fiber quality in upland cotton.

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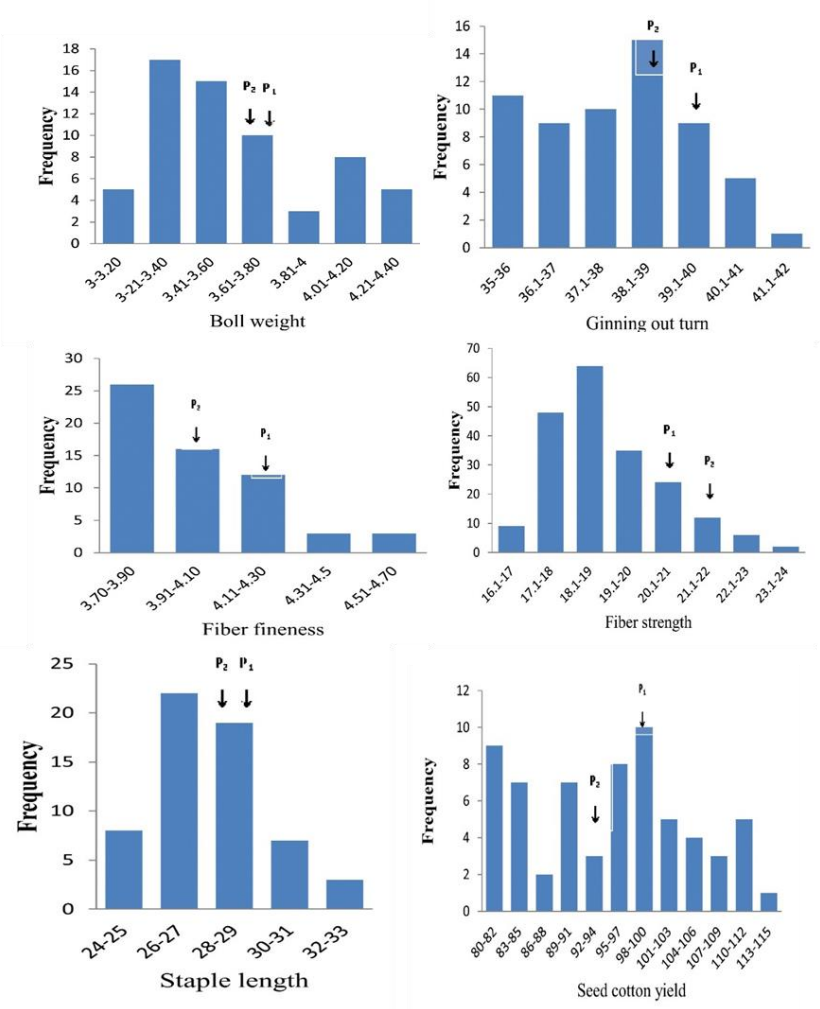

Figure 2. Frequency distribution of parents (FH153, KZ191) and F2 population for boll weight, ginning out turn, fiber fineness, fiber strength, staple length and seed cotton yield.

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