



Association and Heritability Analysis for Yield and Fiber Traits in Promising Genotypes of Cotton (*Gossypium hirsutum* L.)

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Abstract: Seed cotton yield and fiber quality traits are controlled by many genes and greatly affected by the environmental cues. Hence, selection based on only yield would not be effective. In order to improve the yield potential of the cotton cultivars, an understanding of the relationship among various traits is of more importance. The current research was aimed to estimate correlation and heritability in eight promising genotypes of upland cotton for eight quantitative and qualitative traits. Results depicted significant differences ($P \leq 0.05$) among the varieties for all the studied traits, exhibiting the availability of substantial genetic diversity among the cultivars for studied traits. Hence, these promising cultivars can further be exploited in various breeding programs to improve various quantitative and qualitative characters in cotton genotypes. Correlation analysis showed that sympodial branches plant⁻¹, boll weight and bolls plant⁻¹ made significant and positive associations with seed cotton yield plant⁻¹. Thus, selection for these traits will ultimately enhance the chances to increase seed cotton yield plant⁻¹. High heritability estimates were found for all studied traits, with the exception of monopodial branches plant⁻¹, indicating that these traits were primarily controlled by additive gene effects and direct selection may be proved useful for these traits.

Keywords: Correlations, heritability analysis, fiber traits, yield traits, *Gossypium hirsutum*

1. **INTRODUCTION**

Cotton, *Gossypium hirsutum* L., is a key fiber crop which is cultivated throughout world, and efforts are being taken for its high production in order to meet the needs of ever-increasing population of the world. The genotypes having good fiber quality are important for both, textile industry as well as for the farmers. Keeping aforementioned aspects, it is very important for the cotton researchers to evolve highly promising cotton genotypes for numerous agro-ecological zones of Pakistan. Realizing the importance of this crop in economy, various efforts have been made in order to boost its production round the country (Farooq *et al.*, 2013). To improve these traits, plant breeders should recognize the relationship between yield and its components. Polygenes control the seed cotton yield as well as the fiber quality, and these traits are also influenced by environment, thus the selection solely based on the yield is ineffective. To increase the production potential of cotton varieties it is important to understand the relationship among different characters (McCarty *et al.*, 2008). The analysis of correlation coefficient deals with the extent of association between several plant traits and finds out the component traits which help in selection for the enhancement in yield and improvement of fiber quality. Genetic variability is the key for the success of any breeding program in the population. A broader spectrum of variability will increase the chances of selection for a desire genotype.

For this reason, heritability is a good indicator of the transfer of traits from parents to their off spring.

2. **MATERIALS AND METHODS**

The present research was done at the experimental farm of Nuclear Institute of Agriculture, Tandojam during the year of 2013, in turn to observe the correlations and heritability analysis in yield and fiber traits in promising genotypes of upland cotton. The plant material was grown with three replications in Randomized Complete Block Design. The experimental materials composed of eight cotton elite genotypes, namely, Chandi-95, BT-A1, CRIS-342, NIA-Perkh, BT-008, IR-3701, Hari Dost and Malmal. The distance between row to row was maintained at 75cm and 30 cm spacing was kept between plant to plant. Observations were noted on five randomly selected plants of each variety in each replication for eight traits, the traits are mentioned in **Table-1**. The mean squares were determined as formulated by Gomez and Gomez (1980), whereas correlation coefficients (r) were determined according to statistical methods suggested by Raghav Rao (1983). The heritability analysis was carried out as suggested by Allard (1960).

3. **RESULTS AND DISCUSSION**

Mean squares were highly significant ($P \leq 0.05$) among the varieties for all the studied traits except monopodial branches plant⁻¹ (**Table 1**). This exhibits the availability of

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considerable genetic diversity among the genotypes for studied traits hence these promising genotypes can further be utilized in different breeding programs to improve yield and fiber quality in upland cotton. Considering the mean performances, the variety Malmal and Chandi demonstrated outstanding performance for majority of the studied traits, suggesting that these genotypes possess valuable genetic resources for various traits thus would be choice parents for the improvement of upland cotton genotypes (**Table 2**).

Association analysis offers useful knowledge regarding the nature and degree of relationships among various traits. Hence, a correlation study helps concurrent improvement of two or more traits. Information of the association among yield components is necessary for the designing of breeding programs meant at getting the desired combinations of various yield components.

In the current research, the association analysis was carried out in the promising genotypes of upland cotton among 08 yield and fiber quality- related characters with seed cotton yield plant⁻¹ (**Table 3**). Three characters such as sympodial branches plant⁻¹ ($r= 0.74^*$) bolls plant⁻¹ ($r= 0.94^{**}$) and boll weight ($r= 0.84^{**}$) established significant and positive correlations with seed cotton yield plant⁻¹. Consequently, selection for such traits will assist in selecting cultivars with greater seed cotton yield plant⁻¹. Similar results of significant and positive associations between yield and its related

traits were also reported by Islam *et al.* (2013), Farooq *et al.* (2014) and Pujer *et al.* (2014). The inter-correlation between the quantitative and qualitative traits such as plant height with monopodial branches plant⁻¹, GOT% and sympodial branches plant⁻¹ and sympodial branches plant⁻¹ with bolls plant⁻¹ and GOT% were positive and significant, thus providing the opportunities of simultaneous enhancement of these traits by concentrating on any of these Characters. The current findings are in agreement with those obtained by Yahaya *et al.* (2013) and Erande *et al.* (2014).

Heritability estimates are helpful in deciding the traits to be considered while selection is being made for a trait. High heritability estimates (**Table 4**) were found for plant height ($h^2=96.40\%$), sympodial branches plant⁻¹ ($h^2=79.17\%$), Bolls plant⁻¹ ($h^2=93.91\%$), boll weight ($h^2=93.58\%$), GOT% ($h^2=91.48\%$) and staple length ($h^2=97.89\%$) and seed cotton yield plant⁻¹ ($h^2=95.45\%$); however, low heritability ($h^2=8.69\%$) estimates was observed for monopodial branches plant⁻¹. High heritability values for these characters revealed that the variation detected was mainly under genetic control and was less affected by environment, signifying the influence of additive gene action for these characters. Thus, the direct phenotypic selection can be made for the improvement of these traits. These results are also supported by Dinakaran *et al.* (2012), Abbas *et al.* (2013), Farooq *et al.* (2013), Vinodhana *et al.* (2013) and Malagouda *et al.* (2014).

Table 1. Mean squares from analysis of variance (ANOVA) for yield and fiber traits in upland cotton (*Gossypium hirsutum* L.).

Source of variation	Degree of Freedom	Characters			
		Plant height	Monopodial branches plant ⁻¹	Sympodial branches plant ⁻¹	Bolls plant ⁻¹
Replications	2	3.562	0.02667	2.1067	0.555
Genotypes	7	324.293**	0.02667 ^{ns}	16.8798**	101.786**
Error	14	6.030	0.02095	1.3676	2.149
Source of variation	Degree of Freedom	Characters			
		Boll weight	Seed cotton yield plant ⁻¹	GOT%	Staple length
Replications	2	0.00455	1.18	0.04629	0.15732
Genotypes	7	0.22358**	1908.90**	4.00100**	2.82571**
Error	14	0.00478	29.85	0.12538	0.02370

Note: ** = Significant at 0.01 level of probability; ns = non-significant

Table 2. Mean performance for yield and fiber traits in eight cotton genotypes.

Genotypes	Characters							
	Plant height (cm)	Monopodial branches plant ⁻¹	Sympodial branches plant ⁻¹	Bolls plant ⁻¹	Boll weight (g)	Seed cotton yield plant ⁻¹ (g)	GOT%	Staple length (mm)
Chandi-95	123.73b	0.26b	21.40 a	36.60d	3.36a	122.87b	35.65d	29.26a
BT-A1	104.67d	0.33a	13.93d	29.93e	2.81bc	84.35d	38.14a	28.52b
CRIS-342	121.87bc	0.13c	17.73bc	39.73c	2.92b	115.94bc	37.95ab	28.14c
NIA-PERKH	118.40c	0.33a	19.40ab	45.73a	3.26a	149.15a	36.70c	28.06c
BT-008	120.00bc	0.13c	19.26b	31.33e	2.76c	86.61d	36.94bc	27.63d
IR-3701	119.20c	0.20bc	16.06c	31.33e	2.80bc	87.72d	37.52ab	28.03c
Haridost	129.40a	0.13c	18.33b	40.00bc	2.75c	110.26c	34.76e	26.31e
Malmal	97.87e	0.33a	15.93cd	42.53b	3.37a	142.65ab	37.31bc	29.39a

Means followed by similar alphabetic letters are not significantly different from each other according to DMR test.

Table 3. Correlation of coefficient (r) of yield and fiber traits traits in cotton genotypes.

Characters	Monopodial branches plant ⁻¹	Sympodial branches plant ⁻¹	Bolls plant ⁻¹	Boll weight	Seed cotton yield plant ⁻¹	GOT%	Staple length
Plant height	0.71*	0.67*	0.02 ^{ns}	-0.31 ^{ns}	0.13 ^{ns}	0.61*	-0.64*
Monopodial branches plant ⁻¹		-0.27 ^{ns}	0.23 ^{ns}	0.45 ^{ns}	0.47 ^{ns}	0.24 ^{ns}	0.46 ^{ns}
Sympodial branches plant ⁻¹			0.61*	-0.36 ^{ns}	0.74*	0.65*	-0.08 ^{ns}
Bolls plant ⁻¹				-0.62*	0.94**	0.31 ^{ns}	-0.02 ^{ns}
Boll weight					0.84**	-0.12 ^{ns}	0.41 ^{ns}
Seed cotton yield plant ⁻¹						-0.24 ^{ns}	-0.32 ^{ns}
GOT%							-0.43 ^{ns}

Note: ** = Significant at 0.01 level of probability; * = Significant at 0.05 level of probability; ns = non-significant

Table 4. Heritability estimates for various traits in upland cotton genotypes.

Characters studied	Phenotypic variance	Genotypic variance	Heritability % (Broad sense)
Plant height	112.11	106.08	96.40
Monopodial branches plant ⁻¹	0.023	0.002	8.69
Sympodial branches plant ⁻¹	6.53	5.17	79.17
Bolls plant ⁻¹	35.36	33.21	93.91
Boll weight	0.078	0.073	93.58
Seed cotton yield plant ⁻¹	656.19	626.35	95.45
GOT%	1.41	1.29	91.48
Staple length	0.95	0.93	97.89

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