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Correlation studies between yield and fibre quality traits in desi cotton (*G. arboreum* L.)

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Abstract
In fifty genotypes, including six checks, the character relationships for yield and fiber quality parameters were studied. A few insights into the proportional importance of each element to the overall seed cotton production are provided by estimates from correlation studies, although it is well known that the kind and strength of associations will vary depending on the composition of the material. For fifty genotypes at the phenotypic and genotypic levels in the current study, simple correlation coefficients were determined. It was discovered that genotypes varied in the strength of the interaction. For the number of bolls per plant, plant height, number of sympodia per plant, ginning percentage, boll weight, and seed cotton yield per plant, positive and significant genotypic and phenotypic associations were discovered.

Keywords: Correlation, genotypes, phenotype and traits

Introduction
Cotton is the most significant natural fiber crop. It belongs to the Malvaceae family and the *Gossypium* genus, which includes around 50 species and a lot of phenotypic diversity (Campbell *et al*. 2009) [1]. Only four of the 50 species of *Gossypium* that exist today are grown in captivity (Percival and Kohel, 1990) [2]. The two allotetraploid *G. hirsutum* and *G. barbadense* cultivars are referred to as "New World Cotton" because they are 2n = 2x = 52, whereas *G. arboreum* and *G. herbaceum* are diploid (2n = 2x = 26) and are referred to as "Old World Cotton." The majority of the cotton grown worldwide is produced by two allotetraploid species, *G. hirsutum* and *G. barbadense* (Wendel *et al.* 1992) [3]. Upland cotton, also known as *Gossypium hirsutum*, is the source of 95% of all cotton fiber produced worldwide. Pima cotton, also known as *Gossypium barbadense*, produces around 3% of the world's cotton supply and is prized for its superior fibre quality. (Wendel *et al*. 1992) [3].
Only two species, *G. hirsutum* and *G. arboreum*, of the four cultivated *Gossypium* genera are grown in Maharashtra. Due to its poorer production and worse fibre characteristics when compared to tetraploid cotton in rainfed habitats, *Gossypium arboreum* cotton has seen a considerable decline in area over the past two decades, especially in Maharashtra. Correlation coefficient analysis in plant breeding evaluates the reciprocal link between several plant characteristics and identifies the component features that can be selected for in order to enhance yield genetically. Path coefficient analysis is essential since correlation does not provide information about both the direct and indirect effects of the independent variable on the dependent variable. The direction and strength of the relationship between yield and characteristics that contribute to yield must be for the purpose of choosing superior genotypes from the genetic population's diversity.

Materials and Methods
The current study, which consists of six checks, was conducted to study "Genetic Divergence Studies in Cotton (*Gossypium arboreum* L.)". During Kharif 2020–2021, forty-four genotypes of cotton, including six, were sown in the field at the Cotton Research Station, Mahboob Baugh Farm, V.N.M.K.V., Parbhani. At CIRCOT in Nagpur, the fiber quality characteristics were studied. Five plants are randomly chosen from each replication and placed in each entry, together with the prescribed cultural techniques and packages, and the following observations are documented for each. Days to 50% flowering, Plant height (cm), number of sympodia per plant, number of bolls per plant, Boll weight (gm), Seed cotton yield/plant (gm), Seed index, Lint index, Ginning percentage (%), Upper half mean length (mm), Fibre fineness/ Micronaire (µg/in), Fibre strength (g/tex) and Uniformity ratio (%).

The genotypic and phenotypic simple correlation coefficients were calculated using the appropriate variances and covariances to assess the level of relationship between various parameters. Simple correlation coefficients were calculated using the formulae proposed by Johnson *et al*. (1955) [4].

Results and Discussion

The results of the analysis of variance showed that all of the genotype-based mean squares for the characteristics were very significant. Indicating that the traits under investigation had a significant amount of variability. (Table 1).

To determine the relationship between yield and its constituent parts, the correlation coefficient was investigated at the genotypic and phenotypic levels. In 50 cotton genotypes, the genotypic and phenotypic relationships between thirteen characters and the seed cotton yield per plant were calculated. A complex attribute that is influenced by many different factors is seed cotton yield. As a result, crop development programs are increasingly relying on research into the connections between traits and seed cotton output. For appropriate evaluation during selection, it is crucial to assess the relative contribution of each component feature to yield.

Due to the relative stability of genotypes, as the majority of them had undergone some form of selection, genotypic correlation was typically greater than phenotypic correlation (Johnson *et al*. 1995) [4]. In accordance, Tables 2 and 3 present the genotypic and phenotypic correlation coefficients for thirteen characteristics across 50 cotton genotypes.

Days to 50 percent flowering: Days to 50% flowering revealed positive and notable connections to plant height, number of sympodia and number of bolls per plant at both the genotypic and phenotypic levels. However, there was a marginally positive correlation between seed cotton yield per plant, seed index, lint index, fibre fineness, upper half mean length, and fibre strength at both the genotypic and phenotypic levels. It had a negative and non-significant connection with ginning percentage, uniformity ratio and boll weight. Identical findings were found by Dahiphale *et al*. (2015) [5].

Plant height (cm): The number of sympodia per plant, number of bolls per plant, days to 50% flowering, seed index, lint index, ginning percentage and seed cotton yield per plant all traits showed positive and significant correlations with plant height at both the genotypic and phenotypic levels, but fiber strength showed a negative and significant correlation. It showed a positive but insignificant association with upper half mean length, uniformity ratio and boll weight at the genotypic and phenotypic levels. The results from this study are in agreement with those from Baloch *et al*. (2015) [7], Farooq *et al*. (2014) [6], and Satish *et al*. (2020) [9].

Number of sympodia per plant: The number of sympodia per plant showed a significant positive correlation with the genotypic and phenotypic traits of seed cotton yield per plant, number of bolls per plant, plant height, days to 50% flowering, boll weight, seed index, lint index and ginning percentage, as well as a significant positive non-significant correlation with fibre fineness. Both at the genotypic and phenotypic levels, it has a negative and significant relationship with uniformity ratio and a negative non-significant association with upper half mean length, fiber strength and boll weight. Similar findings were reported by Satish *et al*. (2020) [9], Bayyapu *et al*. (2015) [10], and Baloch *et al*. (2015) [7].

Number of bolls per plant: At the genotypic and phenotypic levels, the number of bolls per plant showed a significant and positive association with seed cotton yield per plant, days to 50% flowering, the number of sympodia per plant, plant height, boll weight, and ginning percentage and a significant and negative association with upper half mean length and fiber strength. For fiber fineness, the association was non-significantly positive and negative for uniformity ratio. Similar results were reported by Farooq *et al*. (2014) [6], Jangid *et al*. (2019) [12], and Satish *et al*. (2020) [9].

Boll weight (gm): Boll weight showed a positive and significant correlation with seed cotton yield per plant, number of sympodia per plant, number of bolls per plant, seed index, lint index, and uniformity ratio at both the phenotypic and genotypic levels, as well as a positive but non-significant correlation with upper half mean length and fiber strength. The genotypic and phenotypic data indicated a positive and non-significant relationship with upper half mean length and fiber strength, but fiber fineness, plant height, and days to 50% flowering showed a negative and non-significant connection between them. The results agree with studies conducted by Erande *et al*. (2014) [14] and Abbas *et al*. (2015) [13].

Seed index (g)

The character seed index showed positive and substantial associations with the lint index, boll weight, number of bolls per plant, number of sympodia per plant, plant height, ginning percentage and seed cotton yield per plant at both the genotypic and phenotypic levels. It showed a positive but moderate correlation with the number of days to 50% flowering, ginning percentage and fiber fineness at both the genotypic and phenotypic levels. It had a bad association with both the uniformity ratio and the fiber strength, both at the genotypic and phenotypic levels. The conclusions of this study are in agreement with those of Rasheed *et al*. (2009) [15], Rao *et al*. (2013) [16], and Erande *et al*. (2014) [14].

Lint index (g)

Both at the genotypic and phenotypic levels, the character lint index strongly and positively linked with parameters including fiber fineness, number of sympodia per plant, seed index, boll weight, plant height and number of bolls per plants. Days to 50% flowering and fibre fineness revealed a statistically positive relationship at both degrees of correlation. Whereas. It had a negative significant association with fiber strength, a negative non-significant correlation with upper half mean length and a negative correlation with uniformity ratio at both the genotypic and phenotypic levels. The results of the current study are in agreement with those from Rasheed *et al*. (2009) [15], Rao *et al*. (2013) [16], and Erande *et al*. (2014) [14].

Ginning percent (%)

At both genotypic and phenotypic levels, the character ginning % was positively and significantly correlated with fiber fineness, lint index, seed index, boll weight, number of bolls per plant, plant height and number of sympodia per

plant. A negative and substantial link between the uniformity ratio and fiber strength was discovered at both degrees of correlation. At both the genotypic and phenotypic levels, there was a weak negative association for upper half mean length and seed cotton yield per plant as well as a weak positive correlation for days to 50% flowering. Similar results were observed by Rao *et al*. (2013) [16].

Upper half mean length (mm): The upper half mean length was positively and significantly correlated with the uniformity ratio, fiber strength, and seed index. There was an adverse relationship between plant height, lint index and the number of sympodia per plant and a positive correlation between days to 50% flowering and boll weight at both the genotypic and phenotypic levels.

Fibre strength (g tex^{-1}): The upper half mean length was positively and significantly correlated with the uniformity ratio, fiber strength and seed index. There was a negative relationship between plant height, lint index and the number of sympodia per plant and a positive correlation between days to 50% flowering and boll weight at both the genotypic and phenotypic levels. However, both features showed a strong and unfavorable correlation with fiber fineness. The outcomes are consistent with Rao *et al*. (2013) [16], Vinodhana *et al*. (2013) [18], and Erande *et al*. (2014) [14].

Fibre fineness (µg/in): The relationship between the upper half mean length and the uniformity ratio, fiber strength and seed index was all positive and significant. There was a negative association between plant height, lint index and the number of sympodia per plant at both the genotypic and phenotypic levels and a positive correlation between days to 50% flowering and boll weight.

Uniformity ratio (%): All three variables-fiber strength, upper half mean length, and boll weight-displayed substantial and positive associations with uniformity ratio. Both at the genotypic and phenotypic levels, it has shown a negative and substantial connection with parameters including fiber fineness, ginning percentage, lint index and number of sympodia per plant. There was a non-significant and adverse relationship between the seed index the number of bolls per plant, and days to 50% flowering.

The fiber strength and upper half mean length both shown a favorable and significant relationship with the uniformity ratio. It strongly and unfavorably correlates with fiber fineness. Both Bayyapu *et al*. (2015) [10] and Erande *et al*. (2014) [14] reported the same result. The number of bolls per plant, number of sympodia per plant, boll weight, plant height, ginning percentage and seed index were all positively and substantially linked with seed cotton yield per plant at both the genotypic and phenotypic levels. This information is important for plant breeders to know since association studies would be very helpful in this situation. The use of all these features may be favorable for kinds of Desi cotton that produce better yields.

Table 1: Analysis of variance for morphological, yield contributing and fibre characters in cotton

Sr. No.	Traits	Mean sum of squares		
		Replication (1)	Treatment (49)	Error (49)
1	Days to 50% flowering	0.0900	14.5365**	0.4369
2	Plant height (cm)	0.4900	23.8088**	0.0244
3	No. of sympodia /plant	0.0256	3.2116**	0.0290
4	No. of bolls/plant	0.6400	23.811**	2.0277
5	Boll weight (gm)	0.0084	0.1217**	0.0488
6	Seed index (gm)	0.0156	0.6595**	0.0957
7	Lint index (gm)	0.0778	0.5159**	0.0301
8	Ginning percentage (%)	2.0880	6.3777**	2.3526
9	UHML (mm)	0.0121	9.4659**	0.0329
10	Fibre fineness (µg/in)	0.0299	0.4108**	0.0231
11	Fibre strength (g tex^{-1})	0.0003	9.8786**	0.1228
12	Uniformity ratio (%)	3.2400	8.8073**	2.9951
13	Seed cotton yield/plant (gm)	0.6400	72.3051**	13.12970

*, ** significant at 5 and 1 percent level, respectively.

Table 2: Genotypic correlation between morphological, yield contributing and fibre characters in cotton

Sr. No.	Traits	Days to 50% flowering	Plant height (cm)	Number of sympodia/plant	Number of bolls/plant	Boll weight (gm)	Seed index (gm)	Lint index (gm)
1	Days to 50% flowering	1.0000	0.3428***	0.2048*	0.2145*	-0.0363	0.1283	0.1485
2	Plant height (cm)		1.0000	0.8474***	0.6350***	-0.0700	0.1976*	0.2101*
3	No. of sympodia/plant			1.0000	0.5585***	0.2153*	0.2432*	0.2296*
4	No. of bolls/plant				1.0000	0.2146*	0.2182*	0.1967*
5	Boll weight (gm)					1.0000	0.3275***	0.2225*
6	Seed index (gm)						1.0000	0.2644**
7	Lint index (gm)							1.0000
8	Ginning percentage (%)							
9	Upper half mean length (mm)							
10	Fibre strength (g tex^{-1})							
11	Fibre fineness (µg/in)							
12	Uniformity ratio (%)							
13	Seed cotton yield per plant (gm)							

* Significant at 5% and** significant at 1%

Table 2: Cont….

Sr. No.	Traits	Ginning percentage (%)	Upper half mean length (mm)	Fibre strength (g tex^{-1})	Fibre fineness (µg/in)	Uniformity ratio (%)	Seed cotton yield per plant(gm)
1	Days to 50% flowering	-0.0122	0.0941	0.0414	0.1676	-0.1189	0.1807
2	Plant height (cm)	0.3247**	-0.1898	-0.2341*	0.0906	-0.1327	0.6934**
3	No. of sympodia/plant	0.2161*	-0.1174	-0.1362	0.0911	-0.3146**	0.6408**
4	No. of bolls/plant	0.2684**	-0.2505*	-0.2983**	0.1608	-0.0780	0.9667**
5	Boll weight (gm)	0.2685*	0.0526	0.0397	-0.0200	0.3225**	0.3849**
6	Seed index (gm)	02265*	0.2361*	-0.0940	0.1784	-0.0883	0.4775**
7	Lint index (gm)	0.2740*	-0.1812	-0.2089*	0.3616**	-0.3844***	0.0689
8	Ginning percentage (%)	1.0000	-0.4177**	-0.4347**	0.3819**	-0.4069**	0.4927**
9	Upper half mean length (mm)		1.0000	0.5256**	-0.5007**	0.6094***	-0.1756
10	Fibre strength (g tex^{-1})			1.0000	-0.5160**	0.5832**	-0.1926
11	Fibre fineness (µg/in)				1.0000	-0.4702**	0.1137
12	Uniformity ratio (%)					1.0000	-0.1734
13	Seed cotton yield per plant (gm)						1.0000

* Significant at 5% and ** significant at 1%

Table 3: Phenotypic correlation between morphological, yield contributing and fibre characters in cotton

Sr. No.	Traits	Days to 50% flowering	Plant height (cm)	Number of sympodia/plant	Number of bolls/plants	Boll weight (gm)	Seed index (gm)	Lint index (gm)
1	Days to 50% flowering	1.0000	0.2528*	0.1971*	0.2023*	0.0241	0.1148	0.1257
2	Plant height (cm)		1.0000	0.6204**	0.5216**	-0.1136	0.1985*	0.2293*
3	No. of sympodia/plant			1.0000	0.4998**	0.1997*	0.2647**	0.2356*
4	No. of bolls/plant				1.0000	0.1968*	0.2781**	0.2097*
5	Boll weight (gm)					1.0000	0.3426**	0.2750**
6	Seed index (gm)						1.0000	0.2520*
7	Lint index (gm)							1.0000
8	Ginning percentage (%)							
9	UHML (mm)							
10	Fibre strength (g tex^{-1})							
11	Fibre fineness (µg/in)							
12	Uniformity ratio (%)							
13	Seed cotton yield per plant (gm)							

* Significant at 5% and** significant at 1%

Table 3: Cont.….

Sr. No.	Traits	Ginning Percent Age (%)	Upper half mean length (mm)	Fibre strength (g tex^{-1})	Fibre fineness (µg/in)	Uniformity ratio (%)	Seed cotton yield per plant (gm)
1	Days to 50% flowering	-0.0352	0.0925	0.0334	0.1446	-0.1329	0.1635
2	Plant height (cm)	0.2718**	-0.1565	-0.1978*	0.0541	-0.1388	0.5564**
3	No. of sympodia/plant	0.1983*	-0.1139	-0.1323	0.0984	-0.2137*	0.5588**
4	No. of bolls/plant	0.2365*	-0.2472*	-0.2947**	0.1560	-0.0616	0.9441**
5	Boll weight (gm)	0.2371*	0.0411	0.0146	-0.0082	-0.3492**	0.5639**
6	Seed index (gm)	0.1983*	0.0034	-0.0742	0.1538	-0.0618	0.4276**
7	Lint index (gm)	0.2732**	0.2173**	-0.1967*	0.3241**	-0.2620**	-0.0541
8	Ginning percentage (%)	1.0000	-0.3143**	-0.2910**	0.2637**	-0.3187**	0.2896**
9	Upper half mean length (mm)		1.0000	0.9534***	-0.4708***	0.4227***	-0.1876
10	Fibre strength (g tex^{-1})			1.0000	-0.4893***	0.3771***	-0.1790
11	Fibre fineness (µg/in)				1.0000	-0.2936**	0.1222
12	Uniformity ratio (%)					1.0000	-0.1420
13	Seed cotton yield per plant (gm)						1.0000

* Significant at 5% and** significant at 1%

Conclusion

The investigations carried out in the present study revealed that the traits, *viz*., number of bolls per plant number of sympodia per plant boll weight, plant height, seed index, and ginning percent, are the most important characters for effective selection of superior genotypes of desi cotton as they expressed high heritability and significant positive correlation as well as high direct effect on seed cotton yield per plant.

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