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Studies on genetic variability for yield and fibre quality traits in desi cotton (*Gossypium arboreum* L.)

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Abstract
Any crop's genetic diversity is a requirement for choosing genotypes that are superior to the cultivars already in use. Knowing the yield's heritability, variability and contributory factors aids in choosing the best strategy for a breeding program aimed at creating superior varieties. As a result, the current experiment was carried out to evaluate the degree of variability in cotton for factors related to yield and fiber quality. Analysis of variance in the current investigation demonstrated the presence of significant genetic variability in the experimental materials, indicating significant variations for every characteristic among genotypes. The number of bolls per plant, plant height, lint index, seed index, and boll weight had moderate GCV and PCV whereas the seed cotton yield per plant had high GCV and PCV. The characters seed cotton yield per plant, number of bolls per plant, number of sympodia per plant, plant height and lint index showed high heritability estimates along with high genetic advance as percent mean, indicating the presence of additive gene action and suggesting that phenotypic selection may be more effective and efficient for desired genetic improvement.

Keywords: Cotton, gene action, variability and heritability

Introduction
For India's economy to remain stable and to ensure the welfare of the Indian cotton farming community, cotton is a vital crop. approximately the Indus River Valley, cotton was initially grown for use as fabric approximately 3000 B.C. The Arabic word "quotn" from which the word "cotton" is derived, is related to the Gossypium variety, which was also derived from the Arabic word "goz" (Gledhill 2008) [4], which refers to a delicate material. It is cultivated all throughout the world, primarily for its fiber. The "white gold" priming cash and fiber crop is so named. The king of fiber crops is also referred to as cotton. The primary non-food agricultural product used to make textiles, cotton is utilized by almost 60 million people worldwide and is the most significant non-food agricultural commodity. Cotton production, marketing, processing, and export are major sources of income for these individuals. Millions of people, including farmers and those involved in the production, processing, shipping, etc. of cotton, are finding work as a result. Variability is necessary for both varietal adaptability and resistance to biotic and abiotic factors. When there is a lot of genetic variation among the population members, selection is still effective. Therefore, for a plant breeder to begin a useful breeding program, genetic variety present in a population is of the greatest significance.

Materials and Methods
The current study, which consists of six checks, was conducted to study "Genetic Divergence Studies in Cotton (*Gossypium arboretum* L.)". During Kharif 2020–2021, forty-four genotypes of cotton, including six checks, were sown in the field at the Cotton Research Station, Mahboob Baugh Farm, VNMKV, Parbhani. At CIRCOT in Nagpur, the fiber quality features were examined. All the recommended cultural practices and packages were applied for growing healthy and good crop, in each entry, five plants are randomly selected from each replication and following observations were recorded for Days to 50% flowering, plant height (cm), Number of sympodia per plant, Number of bolls per plant, Boll weight (gm), Seed cotton yield per plant (gm), Seed index, Lint index, Ginning percentage, Upper half mean length (mm), Fibre fineness/micronaire value (µg/in), Fibre strength (g/tex) and Uniformity ratio.

Following is an estimation of the variability parameters, According to Panse and Sukhatme (1978) [6], the formulas provided by Burton (1952) [2] were used to determine the co-efficient of variation. Johnson *et al*. (1955) [5] and Allard (1960) [1], respectively, used the following formula to assess heritability in the broad sense and genetic advancement.

Results and Discussion

Every breeding program must have variation and genetic diversity in order to choose remarkable genotypes. While genotypic and phenotypic coefficients of variation allow assessing the level of variability present in the population for a character, heritability indicates the relative importance of genetic variables in the generation of phenotypes (Falconer, 1960) [3]. It serves as a character index for its progeny as well. On the other hand, understanding heritability together with genetic advancement will help in identifying the probable genetic control for any given feature.

There was a lot of variability for the traits under assessment, as shown by the high significance of the mean of squares owing to genotypes for all the traits in the analysis of variance. (Table 1).

The majority of the yield-contributing features showed a large range of variability. The range of variation on the basis of the mean was greater for the traits such as plant height (123.10-149.30 cm), seed cotton yield per plant (31.29-56.44 g), number of bolls per plant (12.90-26.20), uniformity ratio (73.00-84.00), fibre strength (21.50-31.80 g tex-1), days to 50% flowering (66.50-76.50 days), upper half mean length (21.90-31.50 mm), ginning percent (Similar findings with a wide range for features that contribute to yield and fiber quality were reported by Dahiphale *et al*. (2015) [10], Latif *et al*. (2015) [18], Kumar *et al*. (2017) [17] and Joshi *et al*. (2018) [16].

Phenotypic and genotypic coefficient of variation

The estimation of the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) according to Sivasubramanian and Menon's (1973) [7] recommendations are shown in Table 2.

The highest estimates of the phenotypic and genotypic coefficients of variation were found in the seed cotton yield per plant (23.013 and 21.718%, respectively). These results concur with those published by Joshi *et al*. (2018) [16], Kumar *et al*. (2017) [17], and Abbas *et al*. (2015) [8].

The number of bolls per plant (19.006 and 17.451 percent) had the moderate estimate of phenotypic coefficient and genotypic coefficient of variation, followed by plant height (18.354 and 13.895 percent), seed index (13.261 and 10.865 percent), lint index (11.902 and 11.226 percent) and boll weight (11.472 and 10.503 percent).Number of bolls per plant, plant height, seed index, lint index, and boll weight all showed moderate values for GCV and PCV. Pujer *et al*. (2014) [21], Dahiphale *et al*. (2015) [10] and Kumar *et al*. (2017) [17] all reported findings of a similar nature.

The number of sympodia per plant (9.387 and 9.303%), fiber strength (8.706 and 8.229%), fiber fineness (8.635 and 8.531%), upper half mean length (8.265 and 8.236%), days to 50% of flowering (3.887 and 3.772%), ginning percentage (5.332 and 3.756%) and uniformity ratio (3.013 and 2.115%) were found to have the lowest PCV and GCV.

Fiber strength, fibre fineness, Upper half mean length, days to 50% flowering, ginning percent and uniformity ratio showed the lowest genotypic and phenotypic coefficient of variance. Both Jangid *et al*. (2019) [15] and Vinodhana *et al*. (2013) [22] reported comparable findings.

Heritability and genetic advance as percent mean

In the current study, it was discovered that several traits had strong heritabilities, including days to 50% blooming, plant height, number of sympodia per plant, number of bolls per plant, boll weight, seed index, lint index, ginning percentage, upper half mean length, fibre fineness, fibre strength and uniformity. High heritability means that a trait's high value is the result of favorable environmental influences, that a trait's characteristics were under genotypic control, that selection was easy, and that employing selective breeding techniques for these traits, improvement was possible. As a result, appropriate selection for these qualities should be based on phenotypic performance. High heritability means that genotypic variance accounts for the majority of phenotypic variance.

Elagno *et al*. (2012) [12] reported high heritability values for all of the investigated features, including those related to the number of bolls per plant, seed cotton production per plant, micronaire value, uniformity ratio, and the proportion of bolls to plants. Vinodhana *et al*. (2013) [22] measured seed cotton yield, fiber length, fiber strength, plant height, and number of bolls per plant; Erande *et al*. (2014) [13] measured number of sympodia per plant, plant height, number of bolls, boll weight, harvest index, seed cotton yield per plant, and micronaire value; Amanu *et al*. (2018) [9] for fiber strength, upper half mean length, boll weight, ginning percent, and boll number per plant, and Monisha *et al*. (2018) [19] for number of sympodia per plant and number of boll per plant.

The range of genetic advancement as a percentage of the mean was 5.06 to 43.03. High genetic advance was seen in the number of sympodia per plant, fibre strength, upper half mean length, fiber fineness, seed index, and boll weight as a percent of the mean, whereas low genetic advance was seen in the number of bolls per plant, seed yield per plant, lint index, and plant height. Days to 50% flowering, ginning percentage and uniformity ratio had the lowest values of genetic advance as a percentage of mean in this study.

These results are consistent with studies by Gnanasekaran *et al*. (2020) [14] for number of bolls per plant and seed cotton yield per plant, Jangid *et al*. (2019) [15] who recorded high genetic advance as a percentage of mean for number of bolls per plant, lint index, and seed cotton yield per plant, and Amanu *et al*. (2018) [9] for number of bolls per plants. For seed cotton yield per plant, plant height, and number of bolls per plant, Pujer*et al*. (2014) [21]; Elango *et al*. (2012) [12]; for fiber fineness/micronaire value and uniformity ratio; Dhivya*et al*. (2014) [11]; for boll weight; Patil *et al*. (2014) [20]; and for seed index.

It was recommended that, rather than taking each feature into account separately, it is vital to examine both heritability and genetic advance as a percent mean of attributes when determining how much progress may be made by selection. For estimating yield under phenotypic selection, genetic advance-associated heritability expressed as a percentage of the mean is more informative than heritability assessments alone. High genetic progress as a percentage of mean and high heritability indicate that selection may be effective and that the heritability is likely caused by additive gene effect.

Selection for these characters in genetically diverse material would be effective for achieving desired genetic improvement because the traits seed cotton yield per plant, number of bolls per plant, lint index, and plant height show high estimates of heritability along with high genetic advance as a percentage of mean.

Similar findings were reported by Dahiphale *et al*. (2015) [10] for seed cotton yield per plant, Pujer *et al*. (2014) [21] for plant height, Erande *et al*. (2014) [13] for plant height, number of bolls per plant, and seed cotton yield per plant, and Gnanasakeran *et al*. (2020) [14] for boll number per plant and seed cotton yield per plant.

The presence of non-additive action of genes is shown by the high heritability and moderate genetic progress expressed as a percentage of the mean. Characteristics including the number of sympodia per plant, the fibre strength, the fibre fifineness, the seed index, and the boll weight all displayed strong heritability with moderate genetic advance.

Similar findings for boll weight, uniformity ratio, fibre strength, and seed index were reported by Dhivya *et al*. (2014) [11], Pujer*et al*. (2014) [21], Patil *et al*. (2014) [20], and Dahiphale *et al*. (2015) [10].

The presence of non-additive gene activity is shown by the high heritability and low genetic progress as a percentage of mean. The qualities with high heritability and modest genetic progress as a percentage mean are the days to 50% flowering, ginning percentage and uniformity ratio. Elango *et al*. (2012) [12] noted a similar outcome.

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

Sr. no.	Characters	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	0.0156	0.6595**	0.0957
7	Lint index	0.0778	0.5159**	0.0301
8	Ginning %	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	0.6400	72.3051**	13.12970

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

Table 2: parameter of genetic variability for morphological, yield contributing and fibre characters in cotton

Sr. No.	Characters	Range	Mean	GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM
1	Days to 50 percent flowering	66.50-76.50	70.60	7.05	7.49	3.77	3.89	94.2	5.31	7.55
2	Plant height (cm)	123.10-155.00	132.72	258.47	450.99	13.89	18.35	65.3	25.07	21.67
3	No. of sympodia /plant	11.10-16.80	13.36	1.59	1.62	9.30	9.39	98.2	2.57	20.99
4	No. of bolls/plant	12.90-26.20	19.34	10.89	12.92	17.45	19.01	84.3	6.24	33.07
5	Boll weight (g)	2.16-.2.96	2.59	0.03	0.08	10.50	11.47	68.4	0.26	12.11
6	Seed index (g)	5.03-6.09	5.26	0.28	0.38	10.86	13.26	74.6	0.94	15.78
7	Lint index (g)	3.23-5.33	4.39	0.24	0.27	11.23	11.90	89.0	0.96	21.81
8	Ginning percent (%)	34.88-41.95	37.77	2.01	4.36	3.76	5.53	61.0	1.98	7.25
9	UHML (mm)	21.90-31.50	26.37	4.72	4.75	8.24	8.26	92.3	4.46	16.91
10	Fibre fineness (µg/in)	4.70-6.30	25.97	0.19	0.22	8.23	8.71	89.3	0.86	16.02
11	Fibre strength (g tex^{-1})	21.50-31.80	5.35	4.88	5.00	8.53	8.64	90.5	4.49	17.39
12	Uniformity ratio (%)	73.00-84.00	80.62	2.91	5.90	2.11	3.01	63.2	2.46	5.06
13	Seed cotton yield/plant (g)	31.29-56.44	40.48	29.59	42.72	21.72	22.01	96.1	9.33	43.03

GV- Genotypic variance
PV- Phenotypic Variance
GCV- Genotypic co-efficient of variation (%)
PCV- Phenotypic co-efficient of variation (%)
h^2-Heretability (%) GA- Genetic advance
GAM- Genetic advance as % mean

Conclusion

The characters seed cotton yield per plant, number of bolls per plant, number of sympodia per plant, plant height and lint index showed high heritability estimates along with high genetic advance as percent mean, indicating the presence of additive gene action and suggesting that phenotypic selection may be more effective and efficient for desired genetic improvement.

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