Genetic Variability, Correleation and Path Analysis in the Selections Made from *Gossypium arboreum* Race *Cernuum* Collections of North-east India

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Genetic variability, character association and path analysis between yield and its contributing traits were studied in 29 single plant selection progeny of *Gossypium arboreum* race *cernuum* collections made from north-east region and two local checks RG-8 and LD-327. Highly significant differences between the selections were recorded for all the traits. High heritability coupled with high genetic advance for boll weight indicated predominance of additive gene effects controlling this trait and low heritability associated with low genetic advance for yield per plant and boll number per plant revealed high effect of environment on these traits. Correlation and path co-efficient analysis revealed that boll number per plant and boll weight were the most important characters for realizing improvement in seed cotton yield per plant.

Key Words: Character association, Cotton, North-east, Path analysis

North-eastern hill (NEH) in India is considered to be the important centre of *Gossypium* variability from where races *cernuum, sinense* and *bengalense* are supposed to have been derived from *Gossypium arboreum* race *burmanicum* (Paranjpe and Panigrahi, 1961). The *cernuum* cottons are suitable for upholstery, high absorbent cotton and mixing with wood and have a great export potential. These cottons have also been reported to be good donors for high boll weight, high ginning out-turn, high seed number per loculus and per boll and resistance to jassids and bollworms (Duhoon and Singh, 1980; Duhoon, 1981). Material of *Gossypium arboreum* race *cernuum*, collected from NEH region in 1992 were evaluated at CICR, Regional Station, Sirsa and single plant selections were made. For such types of collections, extent of association between yield and its components and relative importance of direct and indirect effect of yield contributing components is yet to be estimated. The present paper deals with the genetic constants and character association in 29 single plant selections made from collections in *Gossypium arboreum* race *cernuum.*

Material and Methods

Twenty nine genotypes (single plant selection progeny of *G. arboreum* race *cernuum* collections made in 1992 on the basis of difference in boll weight ginning out turn percent, mean fibre length and boll no./plant) from NEH regions, were grown with two local checks LD 327 and RG-8 in randomized block design with three replications at CICR Regional Station, Sirsa, Haryana during *kharif* 1997-98. These selections are denoted as CSA (Central Institute for Cotton Research, Sirsa *arboreum*). CSA11-1 and CSA11-2 are two single plant progenies different with respect to boll weight of collection No. 11 made from NEH region.

Each single plant progeny was evaluated in a plot of three rows of 5.4 m length. Observations were recorded on five random plants per selection in each replication for 6 quantitative characters namely, yield per plant (gm), boll weight, bolls per plant, ginning out turn percent (GOT), mean fibre length (mm) and seed index (g). Standard statistical procedures were followed for estimating phenotypic and genotypic coefficients of variation (Burton, 1952), heritability (Hanson *et al.*, 1956) and genetic advance (Johnson *et al.*, 1955). Genotypic and phenotypic correlation coefficients were calculated following Searle (1961) and path analysis following method of Dewey and Lu (1955).

Results and Discussion

The analysis of variance revealed highly significant differences between genotypes for all the characters studied. This indicated a considerable amount of variability in the selection made from *G. arboreum* race *cernuum* collections. The data on yield and its contributing traits, phenotypic (PCV) and genotypic (GCV) coefficient variation, heritability (H2) and genetic advance (GA) are presented in Tables 1 and 2. The variability estimates in general, revealed that the PCV was higher than the corresponding GCV for all the characters though the extent of difference between the two was relatively low. The estimates of PCV and GCV indicated the existence of fairly high degree of variability for seed cotton yield per plant. Moderate variability was observed for boll weight and boll no./plant. Relatively low PCV and GCV were recorded for GOT, mean fibre length and seed

index. The genotypic coefficient of variation ranged from a minimum of 7.63 per cent for seed index to a maximum of 20.06 per cent for seed cotton yield per plant. Seed cotton yield per plant showed the highest PCV value of 30.11 per cent in comparison to GCV of 20.06 suggesting more environmental influence on this character which was confirmed by its lowest heritability (44.41%). Similar was the case for boll no./plant. The difference between PCV and GCV was low for GOT followed by boll weight, mean fibre length and seed index. This observation draws support from very higher values of hertiability (>60%) recorded for these traits (Table 2).

Since broad sense hertiability includes both additive and epistatic effects, it will be reliable only when accompained by high genetic advance. Heritability estimates along with genetic advance are more useful than heritability alone in predicitingthe effectiveness of selection. High estimates of hertiability (>80%) and genetic advance (> 30%) were obtained for boll weight. Selection for this trait is likely to accumulate more additive genes leading to further improvement of their performance and hence may be used as selection criteria.

Table 1. Mean performance of *G. arboreum* race *cernuum* selections

S.No.	Selection	Seed cotton	Boll wt.	Boll no.	GOT	Halo length	Seed index
1	CSA 5-92	126.93	3.60	56.23	38.5	16.20	5.73
2	CSA592-1	108.13	2.80	43.20	39.83	17.00	5.23
3	CSA 592-2	89.60	2.93	39.33	42.00	18.40	5.23
4	CSA 593-3	61.23	3.30	43.00	40.0	16.87	5.90
5	CSA 493-1	78.43	3.57	49.10	46.83	15.17	5.03
6	CSA 893-1	88.80	3.03	41.10	43017	18.50	5.60
7	CSA 1213-1	112.13	3.70	42.10	38.33	17.13	5.97
8	CSA 1293-1	86.90	4.07	40.33	41.00	20.43	5.80
9	CSA 1393-1	93.27	3.93	41.23	43.67	17.70	5.97
10	CSA 1793-1	119.37	3.20	49.23	38.17	17.13	6.20
11	CSA 2393-1	63.10	3.70	36.23	40.83	18.60	6.07
12	CSA 5	82.43	3.27	53.43	35.83	22/23	6.43
13	CSA 17A	80.50	3.53	37.43	37.33	17.67	6.03
14	CSA 8	95.10	3.70	54.10	39.17	20.07	6.27
15	CSA 11-1	63.57	4.60	36.67	45.33	20.23	5.20
16	CSA 13-1	62.33	3.57	38.77	42.17	20.00	5.27
17	CSA 11-2	64.77	3.63	42.70	42.43	20.43	5.10
18	CSA 13-2	61.57	3.63	33.33	40.23	18.57	6.00
19	CSA 9-22	84.17	3.47	47.57	38.40	19.67	5.73
20	CSA 913	58.90	3.17	28.67	41.67	17.90	5.50
21	CSG 24	86.60	2.43	48.23	30.40	18.70	5.77
22	CSG 18	62.60	2.67	[illegible]	32.83	18.00	6.13
23	CSG 27	103.63	2.93	40.5	32.33	22.83	6.30
24	CSA 9-10	127.37	2.67	40.87	36.20	19.40	5.03
25	CSA-98	86.40	2.43	46.77	36.97	18.70	5.50
26	CSA 41	86.50	2.10	44.00	41.53	18.97	5.50
27	CSA 9-3	114.03	2.77	37.57	36.87	20.53	5.50
28	CSA 17	98.27	2.80	38.23	34.40	18.83	5.07
29	CSA 40	121.43	2.83	40.67	41.47	17.77	5.53
30	RG-8	100.30	2.73	41.00	36.67	16.00	6.00
31	LD 327	97.10	3.43	48.00	39.77	19.67	5.17

Table 2. Analysis of variance for seed cotton yield and its component traits in *G. arboreum* race *cernuum* selections

SOV	d.f.	Yield per plan	Boll wt	Boll no.	GOT	Halo length	Seed index
Replication	2	3838.79	0.14	227.42	3.07	0.66	0.31
Genotypes	30	1371.55*	0.90*	113.69*	41.54*	8.87*	0.67*
Error	60	403.85	0.05	47.50	0.98	0.80	0.10
H2(g)		44.41	83.92	31.72	93.25	77.19	65.76
G.A. (% of mean)		27.54	31.02	12.71	18.67	15.89	12.74
GCV (%)		20.06	16.44	10.96	9.39	8.78	7.63
PCV (%)		30.11	17.94	19.46	9.72	9.99	9.41

** Significant at 1% level, * Significant at 5% level

Simple selection procedures like mass selection and family selection would be effective for improvement of this trait. Low heritability with low genetic advance was found in respect of yield per plant and boll no./ plant indicating that this character is highly influenced by environmental effects and simple selection would be ineffective. Thus expression of these traits can be modified through hybridization followed by selection.The heritability of GOT, mean fibre length and seed index though high (65 to 93%) yet had low genetic advance (12.7% to 18.7). High heritability and low genetic gain for seed index was also reported by Mehla *et al.* (1988).

Yield of a crop is the result of interaction of a number of interrelated characters. Therefore selection should be based on the component characters after assessing correlation with yield. Character associations reveal the mutual relationship between two characters and it is an important parameter for taking a decision regarding the nature of selection to be followed for improvement in the crop. In the present study, seed cotton yield was found to be significantly and positively correlated with boll no. at genetic level. Therefore, this character should be kept in mind while making selection for seed cotton yield improvement in *G. arboreum* race *cernuum*. The association of seed cotton yield was negative with boll weight, GOT and mean fibre length at genotypic and phenotypic levels (Table 3). Boll no./ plant also showed positive and significant association with GOT both at genotypic and phenotypic levels. Tomar and Singh (1992) also reported positive association of seed cotton yield with boll no./plant and negative association with boll weight.

Seed cotton yield is the sum total of several component characters which directly or indirectly contribute to it. The information derived from the correlation studies indicates only mutual association among the characters.

Table 3. Correlation coefficient among yield components in *G. arboreum* selections

S.No.	Character	Yield per plant	Boll wt.	Boll no.	GOT	Halo length	Seed Index
1	G	1.00	- 0.3859*	0.5214**	- 0.3215	- 0.1426	0.0764
	P	1.00	- 0.2090	0.1661	- 0.1962	- 0.1054	- 0.082
	E	1.00	0.0888	0.0480	0.0548	- 0.0615	- 0.282
2	G		1.000	-0.1056	0.5493**	0.0739	0.0830
	P		1.000	-0.0848	0.5089**	0.0622	0.0723
	E		1.000	-0.0913	0.2201	0.0144	0.0452
3	G			1.000	-0.3202*	- 0.0519	0.1653
	P			1.000	-0.1594	- 0.0746	0.1669
	E			1.000	0.0686	- 0.1240	0.1891
4	G				1.000	- 0.2488	- 0.398
	P				1.000	- 0.2391	- 0.333
	E				1.000	- 0.2261	- 0.154
5	G					1.000	0.0345
	P					1.000	0.0674
	E					1.000	0.1532
6	G						1.000
	P						1.000
	E						1.000

** Significant at 1% level, * Significant at 5% level
G: Genotypic level
P: Phenotypic level

Table 4. Direct and indirect effects (Genotypic) keeping yield per plant as dependent variable and other characters as independent

Character	Boll Wt.	Boll No.	GOT	Halo Length	Seed Index	Genotypic Correlation with Yield/Plant
Boll wt.	(-0.332)	- 0.051	0.001	-0.006	0.002	- 0.39
Boll no.	0.035	(0.477)	- 0.001	0.005	0.005	0.52
GOT	- 0.182	- 0.153	(0.002)	0.023	- 0.011	- 0.32
Halo length	- 0.025	-0.024	- 0.001	(-0.093)	0.001	- 0.14
Seed index	- 0.027	0.079	- 0.001	-0.003	(0.03)	- 0.07

In parentheses are given values for direct effect
Residual effect = 0.608

Whereas, path-coefficient analysis gives the magnitude of direct and indirect contribution of each character, on the dependent character like seed cotton yield. The results of the present investigation on path coefficient analysis (Table 4) revealed that character boll no./plant had maximum positive direct effect on seed cotton yield while boll weight has maximum direct but negative effect. Dhoon (1989) and Samabamurthy (1995) also reported boll no./plant as primary component of yield. Low positive direct effect were estimated from characters GOT and seed index. Mean fibre length recorded low direct effect. On the other hand none of the characters indicated high positive or negative indirect effect on seed cotton yield via other characters.

In the light of the above findings it may be concluded that improvement in character like boll weight and boll number per plant both directly and indirectly will help in improving seed cotton yield. Therefore, these characters should be considered for yield improvement in *G. arboreum* race *cernuum* breeding programme.

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