Genetic Variability, Character Association and Path Coefficient Analysis in *Gossypium hirsutum*

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ABSTRACT

Sixty genotypes of cotton (*Gossypium hirsutum* L.) of diverse origin were studied for their genetic variability, character association and path analysis. Wider variability was observed for number of monopodia plant[-1], plant height, number of bolls plant[-1] and seed cotton yield plant[-1] among 15 characters studied. High heritability coupled with high genetic advance was observed for plant height, number of monopodia plant[-1], number of bolls plant[-1], boll weight, lint index and seed cotton yield plant[-1]. The correlation and path coefficient analyses together indicated that number of monopodia plant[-1], number of bolls plant[-1], boll weight and ginning out turn had significant positive association with seed cotton yield plant[-1] and these traits may be given due weightage in selection programme for crop improvement.

Key words : Cotton, Correlation, Path Analysis.

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Cotton is an important commercial crop of the country and plays a key role in the national economy in terms of its contribution to trade, industrial activities, employment and foreign exchange earnings. Seed cotton yield is a complex polygenic character and is influenced by a number of components. Correlation studies provide an estimate on the degree of association between characters, where as path analysis helps to resolve the correlation into direct and indirect contribution of different component characters on yield.

MATERIAL AND METHODS

The present investigation was conducted at Agricultural College Farm, Bapatla with 60 genotypes of cotton during *kharif* 2009-10. The experiment was laid out in randomized block design in three replications with a spacing of 120x 60 cm. Ten competitive plants of each genotype in each replication were randomly tagged to record observations on plant height, number of monopodia plant[-1], number of sympodia plant[-1], number of bolls plant[-1], boll weight, seed index, lint index and seed cotton yield plant[-1] and mean values were used for statistical analysis.

Days to 50% flowering, ginning outturn, 2.5% span length, micronaire, bundle strength, uniformity ratio and fibre elongation (%) were recorded on plot basis.

Phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were worked out as per Burton (1952). Heritability was estimated

as per Allard (1960) and genetic advance was computed as per Johnson *et al*. (1955). Correlation and path coefficient analysis were worked out using Falconer (1964) and Dewey and Lu (1959), respectively.

RESULTS AND DISCUSSION

The study revealed high phenotypic and genotypic coefficients of variation (Table 1) for plant height (21.88 and 20.69), number of monopodia per plant (50.11 and 49.08), number of bolls per plant (22.03 and 18.61) and seed cotton yield per plant (22.42 and 20.30), indicating scope for genetic improvement of these traits through direct selection. High heritability coupled with high genetic advance as per cent of mean was observed for plant height, number of monopodia plant[-1], number of bolls plant[-1], boll weight, lint index and seed cotton yield plant[-1] indicating the possibility of improvement of these traits through selection simultaneously. These results are in conformity with Eswararao *et al.,* (2008).

Seed cotton yield was significantly and positively correlated with number of monopodia plant[-1] (r_p =0.2428** and r_g =0.2504**), number of sympodia plant[-1] (r_p =0.1653* and r_g =0.1786**), number of bolls plant[-1] (r_p = 0.4136** and r_g =0.5092**), boll weight (r_p =0.5670** and r_g =0.6599**), ginning outturn (r_p = 0.1605* and r_g =0.254**), lint index (r_p =0.1689* and r_g = 0.2318**) and uniformity ratio (r_p =0.2022** and r_g = 0.2158**) at both phenotypic and genotypic levels (Table 2).

Table 1. Mean, variability, heritability (broad sense) and genetic advance as per cent of mean for yield and yield components in cotton (*Gossypium hirsutum* L.*)

S No.	Characters	Mean	Range		Coefficient of variation		Heritability (%) (Broad sense)	Genetic advance as per cent of mean (at 5% level)
			Minimum	Maximum	PCV (%)	GCV (%)		
1	Days to 50% flowering	55.74	49.67	62.33	6.17	5.30	73.97	9.40
2	Plant height (cm)	102.12	58.18	157.90	21.88	20.69	89.35	40.28
3	No. of monopodia plant^{-1}	1.06	0.12	2.83	50.11	49.08	95.92	99.02
4	No. of sympodia plant^{-1}	14.77	9.11	18.80	16.28	12.57	59.68	20.01
5	No. of bolls plant^{-1}	32.67	17.28	51.18	22.03	18.61	71.33	32.37
6	Boll weight (g)	4.06	2.90	5.57	17.21	15.47	80.75	28.63
7	Ginning outturn (%)	34.63	27.05	43.48	11.84	9.69	66.96	16.33
8	Seed index (g)	9.34	7.10	11.33	11.92	10.31	74.84	18.37
9	Lint index (g)	4.96	3.30	6.87	16.40	14.33	76.37	25.80
10	2.5% span length (mm)	27.42	23.59	30.54	7.21	4.94	47.01	6.98
11	Micronaire (10^{-6} g/inch)	4.36	3.37	5.35	12.00	9.79	66.58	16.46
12	Bundle strength (g/tex)	21.34	18.77	24.07	5.54	4.13	55.56	6.34
13	Uniformity ratio (%)	48.69	42.77	53.63	6.57	4.60	48.97	6.63
14	Fibre elongation (%)	5.47	5.30	5.60	1.74	1.51	75.58	2.70
15.	Seed cotton yield plant^{-1} (g)	109.49	57.86	179.02	22.42	20.30	82.01	37.87

PCV = Phenotypic coefficient of variation   GCV = Genotypic coefficient of variation

The results obtained for direct and indirect effects of different characters are presented in Table 3. Path analysis indicated that number of monopodia plant^{-1}, number of bolls plant^{-1}, boll weight, ginning outturn and seed index exerted high and positive direct effect on seed cotton yield plant^{-1}. The correlation and path coefficient analyses together indicated that number of monopodia plant^{-1}, number of bolls plant^{-1}, boll weight and ginning out turn had significant positive association with seed cotton yield plant^{-1}. These studies confirmed the existence of true relationship between these characters with yield. These results are in accordance with Tuteja *et al.* (2006), Verma *et al.* (2006) and Eswararao *et al.* (2008).

Thus the present study revealed that the traits number of bolls plant^{-1}, boll weight and ginning outturn should be given importance in selection programme with desired fibre quality.

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Table 2. Phenotypic (above diagonal) and genotypic (below diagonal) correlation of 15 characters in 60 cotton (*Gossypium hirsutum* L.) genotypes.

Character	Days to 50% flowering	Plant height	No. of monopodia plant^{-1}	No. of sympodia plant^{-1}	No. of bolls plant^{-1}	Boll weight	Ginning outturn	Seed index	Lint index	2.5% span length	Micronaire	Bundle strength	Uniformity ratio	Fibre elongation	Seed cotton yield plant^{-1}
Days to 50% flowering	—	-0.0361	0.1308*	0.1344*	-0.0930	0.2113**	-0.1712**	0.1515**	-0.0882	-0.0322	0.0456	-0.0373	-0.1263	-0.1619**	0.1038
Plant height	-0.0379	—	-0.0311	0.5121**	0.0235	0.0890	-0.2363**	0.2856**	-0.0451	-0.0060	0.2797**	0.1812**	0.2289**	-0.0879	0.0803.
No. of monopodia plant^{-1}	0.1480*	-0.0362	—	-0.1095	0.0197	0.1987**	0.1221	0.0511	0.1721**	-0.0326	-0.0924	-0.0937	-0.1091	0.0941	0.2428**
No. of sympodia plant^{-1}	0.1338*	0.7191**	-0.1606**	—	0.0734	0.0821	-0.1137	0.2125**	0.0561	0.0150	0.2528**	0.1279	0.2464**	-0.1483*	0.1653**
No. of bolls plant^{-1}	-0.1623**	0.0049	0.0027	0.0976	—	-0.3110**	-0.0058	-0.2866**	-0.2063**	-0.0373	-0.0011	-0.1338*	0.1216	-0.0194	0.4136**
Boll weight	0.2548**	0.1050	0.2207**	0.1569**	-0.3894**	—	0.1521**	0.1863**	0.3153**	0.1462*	0.1318*	0.1513**	0.1552**	-0.2918**	0.5670**
Ginning outturn	-0.2514**	-0.3135**	0.1770**	-0.1456*	0.0294	0.2061**	—	-0.4432**	0.7534**	-0.0808	-0.0307	-0.1612**	-0.0719	-0.1387*	0.1605*
Seed index	0.2026**	0.3326**	0.0481	0.2364**	-0.3893**	0.2571**	-0.3851**	—	0.2435**	0.0832	0.1709**	0.1160	0.0691	-0.0940	-0.0277
Lint index	-0.1217	-0.0783	0.2162**	0.0580	-0.2466**	0.4081**	0.7368**	0.3318**	—	-0.0246	0.0860	-0.0791	-0.0236	-0.2130**	0.1689**
2.5% span length	0.0255	-0.0422	-0.0864	0.0347	-0.0952	0.2290**	-0.2197**	0.1577**	-0.0977	—	-0.1055	0.1548**	-0.1500**	0.0018	0.0861
Micronaire	0.0592	0.3338**	-0.1032	0.5245**	0.0079	0.1593**	-0.1190	0.2613**	0.0649	-0.2699*	—	-0.1166	0.5099**	-0.3365**	0.1194
Bundle strength	0.0390	0.2514**	-0.1126	0.2003**	-0.1839**	0.2450**	-0.2717**	0.2411**	-0.0813	0.2648**	-0.1093	—	-0.1331	0.1521**	0.0513
Uniformity ratio	-0.1893**	0.2877**	-0.1673**	0.4081**	0.1017	0.1897**	-0.0322	0.0214	-0.0096	-0.3956**	0.7912**	0.0229	—	-0.3020**	0.2022**
Fibre elongation	-0.1798**	-0.0958	0.1065	-0.1587**	0.0113	-0.3656**	-0.2178**	-0.1343	-0.3114**	-0.0690	-0.5363**	0.3192**	-0.5355**	—	-0.2834**
Seed cotton yield plant^{-1}	0.1036	0.1007	0.2504**	0.1786**	0.5092**	0.6599**	0.2540**	-0.0590	0.2318**	0.1526*	0.1376	0.0885	0.2158**	-0.3372**	—

* = Significant at 5% level ** = Significant at 1% level

Table 3. Direct and indirect effects (phenotypic) of yield components on seed cotton yield in 60 genotypes of cotton (*Gossypium hirsutum* L.).

Character	Days to 50% flowering	Plant height	No.of monopodia plant⁻¹	No.of sympodia plant⁻¹	No.of bolls plant⁻¹	Boll weight	Ginning outturn	Seed index	Lint index	2.5% span length	Micronaire	Bundle strength	Uniformity ratio	Fibre elongation	Correlation with seed cotton yield plant⁻¹
Days to 50% flowering	**-0.0215**	0.0020	0.0138	0.0118	-0.0595	0.1500	-0.0430	0.0244	0.0167	-0.0001	0.0006	-0.0020	0.0003	0.0104	**0.1038**
Plant height	0.0008	**-0.0542**	-0.0033	0.0450	0.0150	0.0632	-0.0594	0.0460	0.0085	0.0000	0.0036	0.0099	-0.0005	0.0056	**0.0803**
No.of monopodia plant⁻¹	-0.0028	0.0017	**0.1057**	-0.0096	0.0126	0.1410	0.0307	0.0082	-0.0326	-0.0001	-0.0012	-0.0051	0.0002	-0.0060	**0.2428****
No.of sympodia plant⁻¹	-0.0029	-0.0278	-0.0116	**0.0879**	0.0470	0.0583	-0.0286	0.0342	-0.0106	0.0000	0.0032	0.0070	-0.0005	0.0095	**0.1653****
No. of bolls plant⁻¹	0.0020	-0.0013	0.0021	0.0065	**0.6401**	-0.2208	-0.0015	-0.0461	0.0391	-0.0001	0.0000	-0.0073	-0.0003	0.0012	**0.4136****
Boll weight	-0.0045	-0.0048	0.0210	0.0072	-0.1990	**0.7100**	0.0382	0.0300	-0.0597	0.0003	0.0017	0.0083	-0.0003	0.0187	**0.5670****
Ginning outturn	0.0037	0.0128	0.0129	-0.0100	-0.0037	0.1080	**0.2513**	-0.0714	-0.1427	-0.0002	-0.0004	-0.0088	0.0001	0.0089	**0.1605****
Seed index	-0.0033	-0.0155	0.0054	0.0187	-0.1834	0.1323	-0.1114	**0.1610**	-0.0461	0.0002	0.0022	0.0063	-0.0001	0.0060	-0.0277
Lint index	0.0019	0.0024	0.0182	0.0049	-0.1320	0.2239	0.1893	0.0392	**-0.1894**	-0.0001	0.0011	-0.0043	0.0000	0.0136	**0.1689****
2.5% span length	0.0007	0.0003	0.0013	0.0013	-0.0239	0.1038	-0.0203	0.0134	0.0047	**0.0023**	-0.0013	-0.0085	0.0003	-0.0001	**0.0861**
Micronaire	-0.0010	-0.0152	-0.0098	0.0222	-0.0007	0.0936	-0.0077	0.0275	-0.0163	-0.0002	**0.0128**	-0.0064	-0.0010	0.0215	**0.1194**
Bundle strength	0.0008	-0.0098	-0.0099	0.0112	-0.0856	0.1075	-0.0405	0.0187	0.0150	0.0003	-0.0015	**0.0546**	-0.0003	-0.0097	**0.0513**
Uniformity ratio	0.0027	-0.0124	-0.0115	0.0217	0.0779	0.1102	-0.0181	0.0111	0.0045	-0.0003	0.0065	-0.0073	**-0.0021**	0.0193	**0.2022****
Fibre elongation	0.0035	0.0048	0.0099	-0.0130	-0.0124	-0.2072	-0.0348	-0.0151	0.0403	0.0000	-0.0043	0.0083	0.0006	**-0.0640**	**-0.2834****

* = Significant at 5% level   ** = Significant at 1% level,   Bold and diagonal values indicate direct effects, Residual effect= 0.5225

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