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Association analysis of yield and fibre quality characters in upland cotton (*Gossypium hirsutum* L.)

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ABSTRACT: Correlation and path coefficient analysis have been worked out for 16 characters in 60 genotypes of upland cotton. Correlation studies indicated that plant height, monopodia/plant, sympodia/plant, bolls/plant, boll weight, seed index, lint index and lint yield/plant recorded significant positive association with seed cotton yield/plant. Further partitioning of correlation coefficients into direct and indirect effects showed that characters sympodia/plant, bolls/plant, boll weight, seed index and lint yield/plant had positive direct effect on seed cotton yield/plant. The correlation and path analysis therefore clearly indicated that direct selection based on sympodia/plant, bolls/plant, boll weight, seed index and lint yield/plant may be helpful in developing high seed cotton yield varieties in upland cotton.

Key words : Correlation, cotton, path analysis

Cotton being an important cash crop of India plays a distinguished role in energizing the economy of the country by fetching appreciable amount of foreign exchange annually. Seed cotton yield and fibre quality in cotton are controlled by polygenes and highly influenced by the environment. Hence, selection merely based on yield is not effective. In order to enhance the yield potential of the cotton varieties, an understanding of the relationship among different characters is of more importance. Correlation coefficient analysis measures the magnitude of relationship between various plant characters and determines the component character on which selection can be based for improvement in seed cotton yield and fibre quality. When more characters are involved in the correlation study, it becomes difficult to ascertain the characters which really contributed towards yield. Path coefficient analysis helps to partition the observed correlation coefficients into components of direct and indirect influences and provides perceptions for the characterizations of more complex traits. The present study is palnned in that direction and the information generated from it will be useful to understand the association of yield contributing and fibre quality characters, their direct contribution to yield, and indirect effects through other characters on yield of cotton.

The experiment was conducted during *kharif* 2007-2008 in randomized block design with 60 genotypes obtained from all over India in 3 replications following spacing of 120 x 60 cm at Agricultural College Farm, Bapatla, Andhra Pradesh. The soils are black cotton type with clay texture. Recommended doses of fertilizers 90:45:45 N, P_2O_5 and K_2O kg ha^{-1} were applied to get a good crop. Each genotype was sown in 2 rows of 6m length and observations were recorded on 10 randomly selected competitive plants from each genotype/replication for 16 characters *viz.,* plant height (cm), days to 50 per cent flowering, monopodia/plant, sympodia/plant, bolls/plant, boll weight (g), seed index (g), lint index (g), lint yield/plant (g), ginning outturn (%), 2.5 per cent span length (mm), micronaire (10^{-6}g/in), bundle strength (g/tex), uniformity ratio and fibre elongation (%) and seed cotton yield/plant. However, the data on days to 50 per cent flowering, ginning outturn (%), 2.5 per cent span length (mm), micronaire (10^{-6}g/in), bundle strength (g/tex), uniformity ratio and fibre elongation (%) were recorded on plot basis. A

Table 1. Phenotypic (above diagonal) and genotypic (below diagonal) correlation of 16 characters in 60 cotton (*Gossypium hirsutum* L.) genotypes

Characters	Days to 50 per cent flowering	Plant height	Monopodia/ plant	Sympodia/ plant	Bolls/ plant	Boll weight	Ginning outturn	Seed index	Lint index	2.5 per cent span length	Micronaire	Bundle strength	Uniformity ratio	Elon-gation	Lint yield/ plant	Seed cotton yield/ plant
Days to 50 per cent flowering	—	0.1761*	0.2288**	0.2186**	-0.1128	-0.0106	-0.0005	0.1202	0.1165	0.1367	0.0193	-0.0648	-0.0586	-0.0157	-0.1033	-0.1041
Plant height	0.1807*	—	0.4067**	0.4929**	0.3704**	0.0181	0.0605	0.2397**	0.2725**	0.0022	0.1103	0.1323	0.2413**	0.1398	0.3367**	0.3457**
Monopodia/ plant	0.2599**	0.4301**	—	0.2500**	0.4970**	-0.0717	0.0086	0.1268	0.1223	0.0545	0.0461	-0.0221	0.0272	0.1135	0.3916**	0.4203**
Sympodia/ plant	0.2932**	0.5286**	0.2776**	—	0.4772**	0.0860	0.1653*	0.1458	0.3076**	-0.1369	0.1720*	-0.0340	0.1647**	-0.0108	0.5033**	0.4959**
Bolls/ plant	-0.1540*	0.4064**	0.5506**	0.5487**	—	-0.1774*	0.1093	-0.0582	0.0699	-0.0949	-0.0138	0.0323	0.1354	0.0445	0.8064**	0.8370**
Boll weight	-0.0592	0.0189	-0.0836	0.1002	-0.1912*	—	-0.0896	0.5225**	0.4013**	0.0057	0.1102	0.1035	-0.0203	0.0988	0.3148**	0.3695**
Ginning outturn	-0.0014	0.0581	0.0077	0.2036**	0.1218	-0.0968	—	-0.3892**	0.5063**	-0.3020**	0.1527*	-0.3212**	0.2071**	-0.3013**	0.3815**	0.0621
Seed index	0.1415	0.2558**	0.1363	0.1512*	-0.0692	0.5881**	-0.4010**	—	0.5771**	0.2840**	-0.0409	0.2167**	-0.0742	0.2369**	0.1052	0.2356**
Lint index	0.1273	0.2871**	0.1375	0.3469**	0.0757	0.4658**	0.4736**	0.6085**	—	0.0002	0.0894	-0.0972	0.1270	-0.0520	0.4539**	0.2969**
2.5 per cent span length	0.1759*	0.0058	0.0745	-0.1674*	-0.1175	0.0569	-0.4028**	0.3331**	-0.0251	—	-0.4211**	0.4075**	-0.5424**	0.3925**	-0.1805*	-0.1016
Micronaire	-0.0121	0.1115	0.0451	0.1967**	0.0036	0.1614*	0.1971**	-0.0530	0.0936	-0.5852**	—	-0.2596**	0.4067**	-0.0151	0.0970	0.0677
Bundle strength	0.0103	0.2485**	0.0125	-0.0598	0.1064	0.2643**	-0.5167**	0.3672**	-0.1082	0.6262**	-0.4799**	—	-0.1207	0.5245**	-0.0235	0.0861
Uniformity ratio	-0.0846	0.3090**	0.0064	0.2444**	0.1998**	-0.0016	0.3099**	-0.0749	0.1860*	-0.7143**	0.5785**	-0.2714**	—	-0.0667	0.1813**	0.1233
Elongation	-0.0234	0.2169**	0.1828*	-0.0173	0.1341	0.2349**	-0.4538**	0.3429**	-0.0693	0.5744**	0.0278	0.6986**	-0.1832*	—	-0.0069	0.0940
Lint yield/ plant (g)	-0.1642*	0.3747**	0.4370**	0.5915**	0.8122**	0.2989**	0.3997**	0.1213	0.4867**	-0.2087**	0.1537*	0.0606	0.2812**	0.0841	—	0.9429**
Seed cotton yield/ plant (g)	-0.1691*	0.3915**	0.4722**	0.5800**	0.8446**	0.3569**	0.0731	0.2595**	0.3403**	-0.1025	0.1144	0.2440**	0.2015**	0.2570**	0.9412**	—

*=significant at 5%level **=significant at 1%level

Table 2. Direct and indirect effects (Phenotypic and genotypic) of yield components on seed cotton yield in 60 genotypes of cotton (*Gossypium hirsutum* L.)

Character		Days to 50 per cent flowering	Plant height (cm)	Mono-podia/ plant	Symp-odia/ plant	Bolls/ plant	Boll weight (g)	Ginning outturn (%)	Seed index (g)	Lint index (g)	2.5 per cent span length (mm)	Micro-naire (10^{-6} g/in)	Bundle strength (g/tex)	Uni-formity ratio	Fibre elon-gation (%)	Lint yield/ plant (g)
Days to 50 per cent flowering	P	**0.0110**	0.0019	0.0025	0.0024	-0.0012	-0.0001	0.0000	0.0013	0.0013	0.0015	0.0003	-0.0007	-0.0006	-0.0002	-0.0011
	G	0.0028	0.0005	0.0007	0.0008	-0.0004	-0.0002	0.0000	0.0004	0.0004	0.0005	0.0000	0.0000	-0.0002	-0.0001	-0.0005
Plant height (cm)	P	-0.0006	**-0.0033**	-0.0013	-0.0016	-0.0012	-0.0001	-0.0002	-0.0008	-0.0009	0.0000	-0.0004	-0.0004	-0.0008	-0.0005	-0.0011
	G	-0.0044	**-0.0244**	-0.0105	-0.0129	-0.0099	-0.0005	-0.0014	-0.0062	-0.0070	-0.0001	-0.0027	-0.0061	-0.0075	-0.0053	-0.0091
Monopodia/plant	P	-0.0013	-0.0022	**-0.0055**	-0.0014	-0.0027	0.0004	0.0000	-0.0007	-0.0007	-0.0003	-0.0003	0.0001	-0.0002	-0.0006	-0.0022
	G	0.0038	0.0063	**0.0145**	0.0040	0.0080	-0.0012	0.0001	0.0020	0.0020	0.0011	0.0007	0.0002	0.0001	0.0027	0.0064
Sympodia/plant	P	0.0017	0.0039	0.0020	**0.0079**	0.0038	0.0007	0.0013	0.0011	0.0024	-0.0011	0.0014	-0.0003	0.0013	-0.0001	0.0040
	G	0.0032	0.0058	0.0030	**0.0109**	0.0060	0.0011	0.0022	0.0017	0.0038	-0.0018	0.0021	-0.0007	0.0027	-0.0002	0.0065
Bolls/plant	P	-0.0240	0.0794	0.1066	0.1023	**0.2145**	-0.0380	0.0234	-0.0125	0.0150	-0.0204	-0.0030	0.0069	0.0290	0.0097	0.1728
	G	-0.0860	0.2269	0.3074	0.3063	**0.5583**	-0.1067	0.0680	-0.0386	0.0423	-0.0656	0.0020	0.0594	0.1116	0.0748	0.4534
Boll weight (g)	P	-0.0013	0.0023	-0.0086	0.0103	-0.0213	**0.1199**	-0.0107	0.0626	0.0481	0.0007	0.0133	0.0124	-0.0024	0.0118	0.0377
	G	-0.0166	0.0053	-0.0235	0.0282	-0.0538	**0.2813**	-0.0272	0.1654	0.1310	0.0160	0.0454	0.0743	-0.0004	0.0661	0.0841
Ginning outturn (%)	P	0.0001	-0.0134	-0.0019	-0.0366	-0.0242	0.0198	**-0.2213**	0.0862	-0.1121	0.0668	-0.0338	0.0711	-0.0458	0.0667	-0.0844
	G	0.0004	-0.0165	-0.0022	-0.0578	-0.0346	0.0275	**-0.2840**	0.1139	-0.1345	0.1144	-0.0560	0.1467	-0.0880	0.1289	-0.1135
Seed index (g)	P	0.0060	0.0120	0.0064	0.0073	-0.0029	0.0262	-0.0195	**0.0502**	0.0290	0.0143	-0.0021	0.0109	-0.0037	0.0119	0.0053
	G	-0.0243	-0.0439	-0.0234	-0.0259	0.0119	-0.1009	0.0688	**-0.1716**	-0.1044	-0.0572	0.0091	-0.0630	0.0128	-0.0589	-0.0208
Lint index (g)	P	-0.0077	-0.0180	-0.0081	-0.0203	-0.0046	-0.0265	-0.0334	-0.0381	**-0.0661**	0.0000	-0.0059	0.0064	-0.0084	0.0034	-0.0300
	G	0.0278	0.0627	0.0300	0.0758	0.0165	0.1018	0.1035	0.1329	**0.2185**	-0.0055	0.0205	-0.0236	0.0406	-0.0151	0.1063
2.5 per cent span length (mm)	P	-0.0017	0.0000	-0.0007	0.0017	0.0012	-0.0001	0.0037	-0.0035	0.0000	**-0.0122**	0.0051	-0.0050	0.0066	-0.0048	0.0022
	G	-0.0132	-0.0004	-0.0056	0.0126	0.0088	-0.0043	0.0302	-0.0250	0.0019	**-0.0750**	0.0439	-0.0470	0.0536	-0.0431	0.0157
Micronaire (10^{-6} g/in)	P	0.0004	0.0020	0.0008	0.0031	-0.0003	0.0020	0.0028	-0.0007	0.0017	-0.0077	**0.0183**	-0.0048	0.0074	-0.0003	0.0018
	G	-0.0008	0.0076	0.0031	0.0133	0.0002	0.0109	0.0134	-0.0036	0.0063	-0.0397	**0.0678**	-0.0325	0.0392	0.0019	0.0104
Bundle strength (g/tex)	P	-0.0006	0.0012	-0.0002	-0.0003	0.0003	0.0010	-0.0030	0.0020	-0.0009	0.0038	-0.0024	**0.0094**	-0.0011	0.0049	-0.0002
	G	0.0011	0.0264	0.0013	-0.0064	0.0113	0.0281	-0.0549	0.0390	-0.0115	0.0665	-0.0510	**0.1063**	-0.0288	0.0742	0.0064
Uniformity ratio	P	0.0006	-0.0025	-0.0003	-0.0017	-0.0014	0.0002	-0.0022	0.0008	-0.0013	0.0057	-0.0043	0.0013	**-0.0105**	0.0007	-0.0019
	G	0.0044	-0.0162	-0.0003	-0.0128	-0.0104	0.0001	-0.0162	0.0039	-0.0097	0.0373	-0.0302	0.0142	**-0.0523**	0.0096	-0.0147
Fibre elongation (%)	P	0.0000	-0.0004	-0.0003	0.0000	-0.0001	-0.0003	0.0008	-0.0007	0.0002	-0.0011	0.0000	-0.0015	0.0002	**-0.0028**	0.0000
	G	0.0003	-0.0028	-0.0024	0.0002	-0.0018	-0.0031	0.0059	-0.0045	0.0009	-0.0075	-0.0004	-0.0092	0.0024	**-0.0131**	-0.0011
Lint yield/plant (g))	P	-0.0867	0.2828	0.3289	0.4228	0.6771	0.2644	0.3204	0.0884	0.3812	-0.1516	0.0815	-0.0197	0.1523	-0.0058	**0.8400**
	G	-0.0676	0.1543	0.1799	0.2435	0.3344	0.1231	0.1646	0.0500	0.2004	-0.0859	0.0633	0.0250	0.1158	0.0346	**0.4118**
Correlation withseed	P	-0.1041	0.3457**	0.4203**	0.4959**	0.8370**	0.3695**	0.0621**	0.2356**	0.2969	-0.1016	0.0677	0.0861	0.1233	0.0940	0.9429**
cotton yield/plant (g)	G	-0.1691*	0.3915**	0.4722**	0.5800**	0.8446**	0.3569**	0.0731	0.2595**	0.3403**	-0.1025	0.1144	0.2440**	0.2015**	0.2570**	0.9412**

*=significant at 5%level **=significant at 1%level, Bold and diagonal values indicate direct effects, P=phenotypic G=genotypic, Residual effect = 0.0685(P), 0.0284(G)

sample of 50g lint in each genotype was taken for the fibre quality analysis using "High Volume Instrument" at Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh. The data was then statistically analyzed to estimate genotypic and phenotypic correlation coefficients following the procedure given by Falconer (1964).

At both genotypic and phenotypic levels, seed cotton yield/plant showed significant positive association with plant height, sympodia/plant, monopodia/plant, bolls/plant, boll weight, seed index, lint index and lint yield/plant (Table 1). These results are in conformity with earlier works of Tuteja *et al.,* (2006), Sambamurthy *et al.,* (2006) and Leelapratap *et al.,* (2007).

Days to 50 per cent flowering showed significant positive association with plant height, monopodia/plant and sympodia/plant at both genotypic and phenotypic levels and negative association with seed cotton yield/plant indicating that an increase in days to 50 per cent flowering would bring a decrease in seed cotton yield. These results were supported by Sambamurthy *et al.,* (2006) and Leelapratap *et al.,* (2007).

Plant height at both genotypic and phenotypic levels, showed significant positive association with seed cotton yield/plant, monopodia/plant, sympodia/plant, bolls/plant, seed index, lint index, uniformity ratio and lint yield/plant indicating that simultaneous improvement of these traits is possible. Monopodia/plant recorded significant positive association with seed cotton yield/plant, sympodia/plant, number of bolls/plant and lint yield/plant both at phenotypic and genotypic levels. These results are in conformity with Tuteja *et al.,* (2006) and Leelapratap *et al.,* (2007).

Boll weight at both genotypic and phenotypic levels, showed significant positive association with seed cotton yield/plant. Ginning outturn recorded significant positive association with lint index, micronaire, uniformity ratio and lint yield/plant both at genotypic and phenotypic levels. The results of the present study are in agreement with previous reports of Muthu *et al.,* (2004) and Leelapratap *et al.,* (2007). Seed index and lint index showed positive association with seed cotton yield/plant indicating usefulness of these traits in selection programmes. This was also supported by Sambamurthy *et al.*, (2006).

2.5 per cent span length and micronaire at both genotypic and phenotypic levels, showed significant positive association with bundle strength and uniformity ratio, respectively. Uniformity ratio showed significant positive association with lint yield/plant while lint yield/plant showed positive association with seed cotton yield/plant at both phenotypic and genotypic levels. This was supported by Neelima *et al.,* (2005).

The path analysis indicated that days to 50 per cent flowering, sympodia/plant, bolls/plant, boll weight, seed index, micronaire, bundle strength and lint yield/plant showed direct positive effects on seed cotton yield/plant (Table 2). This was supported by Tuteja *et al.,* (2006), Sambamurthy *et al.*, (2006) and Leelapratap *et al.,* (2007). The residual effect observed was very low both at phenotypic (0.0685) and genotypic (0.0284) levels, so the characters included in the study clearly explained the direct and indirect effects on the dependent variable.

Thus the correlation and path analysis put together indicated that bolls/plant, sympodia/plant, boll weight, seed index and lint yield/plant showed significant positive association and positive direct effects with seed cotton yield/plant indicating the existence of true relationship among these characters and their exploitation in selection programmes.

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