



## Character Association and Path Coefficient Analysis in Cotton (*Gossypium hirsutum* L.)

G Vijaya Lakshmi, V Chenga Reddy, C Panduranga Rao, J Satish Babu and  
R Srinivasulu

Department of Genetics & Plant Breeding, Agricultural College, Bapatla - 522 101, Andhra Pradesh

### ABSTRACT

Correlation and path coefficient analysis were carried out in 72 genotypes of cotton that were collected from all the three cotton growing zones of India for different agronomical and fibre quality traits. The character association studies revealed that number of bolls per plant, boll weight and lint yield per plant had significant positive association with seed cotton yield per plant. The path coefficient analysis revealed that number of bolls per plant, plant height number of sympodia per plant, ginning out turn, seed index, 2.5% span length, bundle strength, uniformity ratio, count strength product and lint yield per plant exerted direct positive effect on seed cotton yield per plant.

**Key words :** Character Association, Cotton and Path Analysis

Seed cotton yield is a complex polygenic character and it 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 correlations into direct and indirect contribution of different component characters to yield. Hence the present investigation in cotton is an attempt made in this direction.

### MATERIAL AND METHODS

The present study was carried out with 72 genotypes of cotton (*Gossypium hirsutum*) obtained from different cotton growing zones of India. The experiment was conducted in randomized complete block design with three replications during *kharif* 2006. The inter and intra-row spacing adapted was 120cm x 60 cm. Each plot consisted of two rows of 6m length and observations were recorded on five competitive plants from each genotype per replication for characters *viz.*, plant height (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight (g), seed index (g), lint index (g) elongation (%), fibre quality index, count strength product, lint yield per plant (g) and seed cotton yield per plant. Days to 50% flowering, ginning out turn (%), 2.5% span length (mm), micronaire ( $10^{-6}$  g/in), bundle strength (g/tex) and uniformity ratio were recorded on plot basis. The fibre quality characters were analyzed at CIRCOT regional unit at RARS Lam, Guntur. The data were statistically analyzed to estimate genotypic and phenotypic correlation coefficients and path coefficient relationships following the procedure of Falconer (1964) and Wright (1921), respectively.

### RESULTS AND DISCUSSION

The seed cotton yield per plant exhibited (Table 1) positive genotypic correlation with number of bolls per plant, boll weight and lint yield per plant in conformity with Alther and Singh (2006) Karunakar Raju (2005) and Leela Pratap (2006), while Muthuswamy and Vivekanandan (2004) noticed that ginning out turn had significant negative association with seed cotton yield per plant. Boll weight was significantly and positively associated with seed index, lint index and 2.5% span length in accordance with Guruarajan and Sundar (2004), Karunakar Raju (2005) and Verma *et al.* (2006).

Seed index was positively and significantly associated with lint index, 2.5% span length and micronaire. While, it was significantly and negatively correlated with lint yield per plant in agreement with Karunakar. (2005) and Leela Pratap (2006). Ginning out turn showed significantly negative association with seed index and micronaire in agreement with Leela Pratap (2006). Number of bolls per plant, boll weight and lint yield per plant had strong association with seed cotton yield per plant hence maximum emphasis should be given for these characters to increase seed cotton yield per plant. Boll weight, seed index lint, 2.5% span length, micronaire, elongation, fibre quality index and count strength product were interrelated among themselves and would bring in simultaneous improvement in addition to seed cotton yield. Lint yield per plant significantly and positively associated with number of bolls per plant and fibre quality index showed significant positive association with count strength product as reported by Leela Pratap (2006).

Table 1. Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients of 18 characters in 72 cotton genotypes

Character	Days to 50% flowering	Plant height (cm)	No.of monopodia plant <sup>-1</sup>	No.of sympodia plant <sup>-1</sup>	No.of bolls plant <sup>-1</sup>	Boll weight (g)	Ginning out-turn (%)	Seed index (g)
Days to 50% flowering	-	-0.0934	0.3125**	-0.1577*	0.2388**	-0.1372*	0.0660	-0.1853**
Plant height (cm)	-0.2266**	-	-0.0023	0.1971**	0.1387*	0.0003	0.0104	0.0400
No.of monopodia plant <sup>-1</sup>	0.7719**	-0.0083	-	-0.2447**	0.2931**	-0.0866	0.2114**	-0.2500**
No.of sympodia plant <sup>-1</sup>	-0.3014**	0.2486**	-0.2904**	-	-0.1161	0.0476	-0.0705	0.0557
No.of bolls plant <sup>-1</sup>	0.5702**	0.1551*	0.3342**	-0.1397*	-	-0.2584**	0.0439	-0.3465**
Boll weight (g)	-0.2955**	-0.0269	-0.0932	0.0718	-0.2859**	-	-0.0357	0.6415**
Ginning outturn (%)	0.3764**	-0.0287	0.3382**	-0.0447	0.0338	-0.1019	-	-0.2901**
Seed index (g)	-0.3720**	0.0606	-0.3228**	0.0496	-0.4123**	0.7545**	-0.3998**	-
Lint index (g)	-0.3760**	0.1082	-0.1173	0.1126	-0.4801**	0.6561**	0.3123**	0.6928**
2.5% spanlength (mm)	-0.0089	0.0381	0.0159	-0.1480*	-0.0258	0.1787**	-0.1177	0.2955**
Micronaire (10 <sup>-6</sup> g in <sup>-1</sup> )	-0.8608**	0.0976	-0.4183**	0.3569**	-0.3191**	-0.0740	-0.4570**	0.1499*
Bundle strength (g tex <sup>-1</sup> )	0.4860**	0.3101**	0.3060**	-0.1628*	0.0487	0.1273	0.3099**	0.1169
Unioformity ration (%)	-0.5277**	0.0469	-0.5504**	0.2606**	-0.5669**	0.0158	0.1811**	0.0375
Elongation (%)	-0.3910**	0.2826**	-0.3566**	0.1180	-0.3092**	0.1697*	-0.1796**	0.4519**
Fibre quality index	0.4408**	0.0745	0.2441**	-0.2450**	0.1207	0.1142	0.1598*	0.1166
Count strength product	0.4521**	0.0582	0.2764**	-0.2895**	0.1024	0.1124	0.1681*	0.1197
Lint yield plant <sup>-1</sup> (g)	0.0814	-0.0178	0.2004**	0.1062	0.2064**	-0.0139	0.0920	-0.1335*
Seed cotton yield plant <sup>-1</sup> (g)	-0.0488	-0.0032	0.0869	0.1226	0.1820**	0.1411*	-0.2687**	0.0029

Lint index (g)	2.5% Spanlength (mm)	Micronaire (10 <sup>-6</sup> g in <sup>-1</sup> )	Bundle strength (g tex <sup>-1</sup> )	Uniformity ratio(%)	Elongation (%)	Fibre quality index	Count strength product	Lint yield plant <sup>-1</sup> (g)	Seed cotton yield plant <sup>-1</sup> (g)
-0.1148	0.0253	-0.3097**	0.1538*	-0.1264	-0.1362*	0.2009**	0.2097**	-0.0063	-0.0318
0.0808	0.0281	0.0425	0.1362*	-0.0252	0.2100**	0.0694	0.0557	-0.0059	-0.0029
-0.0938	-0.0185	-0.3468**	0.1045	-0.2724**	-0.1894**	0.1684*	0.1857**	0.1406*	0.0568
0.0723	-0.0894	0.2814**	-0.0983	0.1685*	0.0684	-0.1930**	-0.2097**	0.0736	0.1164
-0.3814**	-0.0086	-0.2516**	0.0457	-0.3165**	-0.2172**	0.1094	0.0918	0.1665*	0.1512*
0.5207**	0.1466*	-0.0137	0.0251	-0.0009	0.1681*	0.0680	0.0723	0.0104	0.0239
0.2644**	-0.0443	-0.2168**	0.0525	-0.0778	-0.0412	0.0688	0.0699	0.2946**	-0.0917
0.6210**	0.2801**	0.1497*	-0.0160	0.0802	0.3223**	0.0731	0.0738	-0.0912	0.0258
-	0.1957**	0.0865	0.0785	0.0650	0.2999**	0.0863	0.0949	0.1052	0.0051
0.2572**	-	-0.3020**	0.2595**	-0.2758**	0.5423**	0.7667**	0.7388**	0.0603	-0.0382
0.0164	-0.4515**	-	-0.3752**	0.3533**	0.0112	-0.6824**	-0.6703**	-0.0798	0.0112
0.2577**	0.7647**	-0.7136**	-	-0.2612**	0.4805**	0.7312**	0.6992**	0.0146	-0.0029
0.1076	-0.5258**	0.6354**	-0.5346**	-	-0.0762	-0.3989**	-0.4004**	-0.1928**	-0.1651*
0.3978**	0.7153**	0.0173	0.6418**	0.1358*	-	0.5126**	0.4866**	-0.0887	-0.0719
0.1668*	0.9013**	-0.7755**	0.9164**	-0.6494**	0.5500**	-	0.9621**	-0.0040	-0.0296
0.1937**	0.8964**	-0.7838**	0.9202**	-0.6625**	0.5427**	1.0004**	-	0.0233	-0.0013
0.0993	-0.0849	-0.1701*	0.0525	-0.2231**	-0.1792**	0.0093	0.0479	-	0.9105**
-0.0130	-0.0450	-0.0178	-0.0409	-0.2659**	-0.1183	-0.0402	-0.0039	0.9419**	-

\* Significant at 5% level \*\* Significant at 1% level

Table 2. Direct and indirect effects (genotypic) between yield and yield components in 72 cotton genotypes

Character	Days to 50% flowering	Plant height (cm)	No. of monopodia plant <sup>-1</sup>	No. of sympodia plant <sup>-1</sup>	No. of bolls plant <sup>-1</sup>	Boll weight (g)	Ginning out-turn (%)	Seed index (g)
Days to 50% flowering	<b>-0.0189</b>	0.0043	-0.0146	0.0057	-0.0108	0.0056	-0.071	0.0070
Plant height (cm)	0.0028	<b>-0.0122</b>	0.0001	-0.5030	-0.0019	0.0003	0.0003	-0.0007
No. of monopodia plant <sup>-1</sup>	-0.0202	0.0002	<b>-0.0261</b>	0.0076	-0.0087	0.0024	-0.0088	0.0084
No. of sympodia plant <sup>-1</sup>	0.0069	-0.0057	0.0067	<b>-0.0229</b>	0.0032	-0.0016	0.0010	-0.0011
No. of bolls plant <sup>-1</sup>	-0.0318	-0.0086	-0.0186	0.0078	<b>-0.0557</b>	0.0159	-0.0019	0.0230
Boll weight (g)	-0.0246	-0.0022	-0.0078	0.0060	-0.0238	<b>0.0834</b>	-0.0085	0.0629
Ginning outturn (%)	-0.1115	0.0085	-0.1002	0.0132	-0.0100	0.0302	<b>-0.2963</b>	0.1155
Seed index (g)	0.0138	-0.0023	0.0120	-0.0018	0.0153	-0.0281	0.0145	<b>-0.0372</b>
Lint index (g)	0.0165	-0.0048	0.0052	-0.0050	0.0211	-0.0289	-0.0137	-0.0305
2.5% spanlength (mm)	0.0054	-0.0172	-0.0097	0.0907	0.0158	-0.1095	0.0721	-0.1811
Micronaire (10 <sup>-6</sup> g in <sup>-1</sup> )	-0.2717	0.0308	-0.1320	0.1127	-0.1007	-0.0234	-0.1443	0.0473
Bundle strength (g tex <sup>-1</sup> )	-0.1051	-0.0671	-0.0662	0.0352	-0.0105	-0.0275	-0.0670	-0.0253
Uniformity ratio (%)	0.0625	-0.0056	0.0652	-0.0309	0.0672	-0.0019	-0.0215	-0.0044
Elongation (%)	-0.0399	0.0288	-0.0363	0.0120	-0.0315	0.0173	-0.0183	0.0461
Fibre quality index	0.4410	0.0745	0.2442	-0.2451	0.1207	0.1142	0.1599	0.1166
Count strength product	-0.0548	-0.0071	-0.0335	0.0351	-0.0124	-0.0136	-0.0204	-0.0145
Lint yield plant <sup>-1</sup> (g)	0.0807	-0.0177	0.1987	0.1053	0.2047	-0.0138	0.0913	-0.1291

Lint index (g)	2.5% Spanlength (mm)	Micronaire (10 <sup>-6</sup> g in <sup>-1</sup> )	Bundle strength (g tex <sup>-1</sup> )	Uniformity ratio (%)	Elongation (%)	Fibre quality index	Count strength product	Lint yield plant <sup>-1</sup> (g)	Seed cotton yield plant <sup>-1</sup> (g)
0.0071	0.0002	0.0163	-0.0092	0.0100	0.0074	-0.0083	-0.0086	-0.0015	-0.0488
-0.0013	-0.0003	-0.0012	-0.0038	-0.0006	-0.0034	-0.0009	-0.0007	0.0002	-0.0032
0.0031	-0.0004	0.0109	-0.0080	0.0144	0.0093	-0.0064	-0.0072	-0.0052	0.0869
-0.0026	0.0034	-0.0082	0.0037	-0.0060	-0.0027	0.0054	0.0066	-0.0024	0.1226
0.0267	0.0014	0.0178	-0.0027	0.0316	0.0172	-0.0067	-0.0057	-0.0115	0.1820**
0.0547	0.0149	-0.0062	0.0106	0.0013	0.0142	0.0095	0.0094	-0.0012	0.0211
-0.0925	0.0349	0.1354	-0.0918	-0.0536	0.0532	-0.0473	-0.0498	-0.0273	-0.2687**
-0.0258	-0.0110	-0.0056	-0.0043	-0.0014	-0.0168	-0.0043	-0.0045	0.0048	0.0029
<b>-0.0440</b>	-0.0113	-0.0007	-0.0113	-0.0047	-0.0175	-0.0073	-0.0085	-0.0044	-0.0130
-0.1576	<b>-0.6129</b>	0.2767	-0.4687	0.3222	-0.4384	-0.5524	-0.5494	0.0520	-0.0450
0.0052	-0.1425	<b>0.3156</b>	-0.2253	0.2006	0.0054	-0.2448	-0.2474	-0.0537	-0.0178
-0.0557	-0.1654	0.1544	<b>-0.2163</b>	0.1156	-0.1388	-0.1982	-0.1990	-0.0114	-0.0409
-0.0127	0.0623	-0.0753	0.0633	<b>-0.1185</b>	-0.1061	0.0769	0.0785	0.0264	-0.2659**
0.0405	0.0729	0.0018	0.0654	0.0138	<b>0.1091</b>	0.0561	0.0553	-0.0183	-0.1183
0.1669	0.9017	-0.7758	0.9168	-0.6497	0.5503	<b>1.0004</b>	1.0008	0.0093	-0.0402
-0.0239	-0.1087	0.0950	-0.1116	0.0803	-0.0658	-0.1213	<b>-0.1212</b>	-0.0058	-0.0039
0.0985	-0.0842	-0.1687	0.0521	-0.2213	-0.1777	0.0093	0.0475	<b>0.9916</b>	0.9419**

\* Significant at 5% level \*\* Significant at 1% level

Residual effect SQRT (1.0121)

Table 3. Direct and indirect effects (Phenotypic) between yield and yield components in 72 cotton genotypes of cotton

Character	Days to 50% flowering	Plant height (cm)	No. of monopodia plant <sup>-1</sup>	No. of sympodia plant <sup>-1</sup>	No. of bolls plant <sup>-1</sup>	Boll weight (g)	Ginning out-turn (%)	Seed index (g)
Days to 50% flowering	<b>-0.0048</b>	-0.0004	0.0015	-0.0008	0.0011	-0.0007	0.0003	-0.0009
Plant height (cm)	-0.0006	<b>0.0065</b>	0.0012	0.0013	0.0009	-0.000	0.0001	0.0003
No. of monopodia plant <sup>-1</sup>	0.0002	0.0000	<b>-0.0006</b>	-0.0001	-0.0062	-0.0001	-0.4661	-0.0001
No. of sympodia plant <sup>-1</sup>	0.0020	0.0025	-0.0031	<b>0.0128</b>	-0.0015	0.0006	0.3009	0.0007
No. of bolls plant <sup>-1</sup>	-0.0008	-0.0004	-0.0009	0.0004	<b>0.0032</b>	0.0008	-0.0001	0.0011
Boll weight (g)	0.0009	0.0000	0.0005	-0.0003	0.0016	<b>-0.0062</b>	0.0002	-0.0040
Ginning outturn (%)	-0.0253	-0.0040	-0.0810	0.0270	-0.0168	0.0137	<b>0.3831</b>	0.1111
Seed index (g)	-0.0030	0.0006	-0.0040	0.0009	-0.0056	0.0104	-0.0047	<b>0.0162</b>
Lint index (g)	0.0015	-0.0011	0.0012	-0.0010	0.0051	-0.0069	-0.0035	-0.0082
2.5% spanlength (mm)	0.0010	0.0011	-0.0008	-0.0036	-0.0004	0.0060	-0.0018	0.0114
Micronaire (10 <sup>-6</sup> g in <sup>-1</sup> )	0.0006	-0.0001	0.0007	-0.0006	0.0005	0.0000	0.0004	-0.0003
Bundle strength (g tex <sup>-1</sup> )	0.0147	0.0045	0.0035	-0.0033	0.0015	0.0008	0.0017	-0.0005
Uniformity ratio (%)	-0.0002	0.0000	-0.0004	0.0002	-0.0004	0.0000	-0.0001	0.0001
Elongation (%)	0.0017	-0.0026	0.0024	-0.0009	0.0027	-0.0021	0.0005	-0.0040
Fibre quality index	-0.0124	-0.0043	-0.0104	0.0119	-0.0067	-0.0042	-0.0042	-0.0045
Count strength product	0.0031	0.0008	0.0028	-0.0031	0.0014	0.0011	0.0010	0.0011
Lint yield plant <sup>-1</sup> (g)	-0.0065	-0.0061	0.1443	0.0755	0.1708	0.0107	0.3023	-0.0936

Lint index (g)	2.5% Spanlength (mm)	Micronaire (10 <sup>-6</sup> g in <sup>-1</sup> )	Bundle strength (g tex <sup>-1</sup> )	Uniformity ration (%)	Elongation (%)	Fibre quality index	Count strength product	Lint yield plant <sup>-1</sup> (g)	Seed cotton yield plant <sup>-1</sup> (g)
-0.0005	0.0001	-0.0015	0.0007	-0.0006	-0.0006	0.0010	0.0010	0.0000	-0.0318
0.0005	0.0002	0.0003	0.0009	-0.0002	0.0014	0.0005	0.0004	0.0000	-0.0029
-0.0001	0.0000	-0.0002	0.0001	-0.0002	-0.0001	0.0001	0.0001	0.0001	0.0568
0.0009	-0.0011	0.0036	-0.0013	0.0022	0.0009	-0.0025	-0.0027	0.0009	0.1164
0.0012	0.0000	0.0008	-0.0001	0.0010	0.0007	-0.0004	-0.0003	-0.0005	0.1512*
-0.0032	-0.0009	0.0001	-0.0002	0.0000	-0.0010	-0.0004	-0.0004	-0.0001	0.0239
-0.1013	0.0170	0.0831	-0.0201	0.0298	0.0158	-0.0264	-0.0268	-0.1128	-0.0917
0.0100	0.0045	0.0024	-0.0003	0.0013	0.0052	0.0012	0.0012	-0.0015	0.0258
<b>-0.0133</b>	-0.0026	-0.0011	-0.0010	-0.0009	-0.0040	-0.0011	-0.0013	-0.0014	0.0051
0.0080	<b>0.0427</b>	-0.1023	0.0106	-0.0112	0.0221	0.0312	0.0301	-0.0025	-0.0382
-0.0002	0.0006	<b>-0.0020</b>	0.0008	-0.0007	0.0000	0.0014	0.0014	0.0002	0.0112
0.0026	0.0086	-0.0124	<b>0.0331</b>	-0.0086	0.0159	0.0242	0.0231	0.0005	-0.0029
0.0001	-0.0004	0.0005	-0.0004	<b>0.0014</b>	-0.0001	-0.0006	-0.0006	-0.0003	-0.1651*
-0.0038	-0.0068	-0.0001	-0.0060	0.0010	<b>-0.0125</b>	-0.0064	-0.0061	0.0011	-0.0719
-0.0053	-0.0473	0.0421	-0.0451	0.0246	-0.0316	<b>-0.0616</b>	-0.0593	0.0002	-0.0296
0.0014	0.0110	-0.0100	0.0104	-0.0060	0.0073	0.0144	<b>0.0149</b>	0.0003	-0.0013
0.1079	-0.0619	-0.0818	0.0150	-0.1979	-0.0911	-0.0041	0.0239	<b>1.0262</b>	0.9105*

\* Significant at 5% level \*\* Significant at 1% level

Residual effect 0.169

The path analysis (Table 2 and 3) indicated that plant height, number of sympodia per plant, number bolls per plant, ginning outturn, seed index, 2.5% span length, bundle strength, uniformity ratio, count strength product and lint yield per plant showed positive direct on seed cotton yield and these are in agreement with Alther and Singh (2003), Muthu *et al.* (2004) and Leela Pratap (2006) and for these traits direct selection can be made to improve the yield. Number of bolls per plant had positive and greater indirect effect on yield via, boll weight, lint index, bundle strength, elongation and lint yield per plant hence selection through these characters may bring about seed cotton yield in agreement with Neelima *et al.* (2005), Gururajan and Sundar (2004).

Boll weight exhibited positive indirect effect on yield through, seed index, 2.5% span length and lint yield per plant. Results are similar to Verma *et al.* (2006), Karunakar Raju (2005) and Leela Pratap (2006).

Lint index had positive indirect effect on yield via, plant height, number bolls per plant, seed index, 2.5% span length, bundle strength, count strength product and lint yield per plant. While it has negative indirect effect due to ginning outturn in complete accordance with Leela Pratap (2006). The trait, elongation had positive indirect effect through number of sympodia per plant, number of bolls per plant, ginning outturn, seed index, 2.5% span length and bundle strength as reported by Muraleedhar (2005).

Fibre quality index and positive indirect effect on yield via, 2.5% span length, micronaire and bundle strength which is similar to Leela Pratap (2006).

Seed cotton yield can be improved through plant height number of sympodia per plant, number of bolls per plant, ginning outturn, seed index, 2.5% span length, bundle strength, count strength product and lint yield per plant and these characters showed positive association with two or three fibre quality parameters like micronaire, ginning outturn, uniformity ratio and elongation. Thus, major emphasis should be laid on selection process with increased plant height, more number of sympodia per plant with high number of bolls per plant ginning outturn, seed index and lint yield per plant for better genotypes with superior fibre quality and for realizing higher seed cotton yield.

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