



Correlation and Path Analysis for Morpho-physiological Traits in American Cotton

T Haritha, Lal Ahamed M, V Satyanarayana Rao, Y Ashoka Rani and D Ratna Babu

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

ABSTRACT

Correlation and path coefficient analysis have been worked out for 21 morpho-physiological characters in 40 genotypes of upland cotton during *kharif* 2010. Correlation studies indicated that number of bolls plant⁻¹, boll weight, lint index, ginning out turn and harvest index had positive significant association with seed cotton yield plant⁻¹. Further partitioning of correlation coefficients into direct and indirect pathways of influences showed that characters number of bolls plant⁻¹, boll weight, lint index, ginning out-turn and harvest index had positive direct effect on seed cotton yield plant⁻¹. The correlation and path analysis clearly indicated that direct selection based on these attributes may be helpful in evolving high yielding varieties of upland cotton.

Key words : Correlation, Cotton, Morpho-physiological traits, Path analysis.

Cotton (*Gossypium spp.*) popularly called "White Gold" is the most important renewable natural fibre crop of global importance and continues to be the predominant and sustainable fiber in the Indian textile scene, despite stiff competition from the man-made synthetic fibres. Yield is a complex quantitative trait, considerably affected by environment making selection of genotypes based on yield ineffective. Genetic correlation measures the magnitude of cause-effect relationship between various plant characters that determines the component characters on which selection can be made for improvement in yield. Further, path coefficient analysis, which splits the correlation coefficients, provides precise information on the direct and indirect effects in order to perceive the most influencing characters to be utilized as selection criteria in cotton breeding programme.

MATERIAL AND METHODS

The experiment was conducted during *kharif* 2010-11 in randomized block design with 40 germplasm lines obtained from all over India with three 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, P₂O₅ and K₂O kg ha⁻¹ were applied in split doses. Each plot consisted of two rows of 6m length and observations were recorded on five randomly selected plants from each genotype per replication for 21 characters *viz.*, plant height (cm), number of sympodia plant⁻¹, number of bolls plant⁻¹, boll weight

(g), seed index (g), lint index (g), ginning out turn (%), specific leaf weight (mg cm⁻²), relative water content (%), leaf area index, crop growth rate (g m⁻² day⁻¹). The data on days to 50 per cent flowering, ginning out turn (%), bundle strength (g tex⁻¹), uniformity ratio, 2.5 per cent span length (mm), micronaire (10⁻⁶g/in), uniformity ratio and fibre elongation (%) were recorded on plot basis. The data was statistically analyzed to estimate genotypic and phenotypic correlation coefficients following the procedure given by Falconer (1964) and Wright (1921), respectively.

RESULTS AND DISCUSSION

At both genotypic and phenotypic levels seed cotton yield plant⁻¹ showed significant positive association with number of bolls plant⁻¹, boll weight, ginning out-turn and lint index (Table 1). These results are in conformity with earlier works of Eswara Rao *et al.*, (2009) and Mahantesh *et al.*, (2010).

Genotypic correlations revealed that days to 50 per cent flowering showed significant positive association with number of sympodia plant⁻¹, crop growth rate at 60-120 days, relative water content at 60 DAS, seed index, specific leaf weight at 60 and 120 DAS, respectively and plant height showed significant positive association with only relative water content at 120 DAS indicating masking effect of environment on this trait and significant negative association with number of bolls plant⁻¹, harvest index and seed cotton yield plant⁻¹ at genotypic level (Table 1). These results are in agreement with Vijaya Lakshmi *et al.*, (2008) and Venkateswarulu *et al.*, (2010)

Table 1. Phenotypic and genotypic correlation of 21 characters in 40 cotton (*Gossypium hirsutum* L.) genotypes

Character		Days to 50% flowering	Plant height (cm)	No. of sympodia plant ⁻¹	No. of bolls plant ⁻¹	Boll weight (g)	Ginning out turn (%)	Seed index (g)	Lint index (g)	2.5% span length (mm)	Micronaire (10 ⁻⁶ g/in)	Bundle strength (g tex ⁻¹)
Days to 50% flowering	P	1.000	0.1500	0.2235*	0.0002	-0.0767	-0.0834	0.1571	-0.0266	-0.0273	-0.2307*	0.0129
	G	0.1830*	0.2455**	-0.0056	-0.0983	-0.0986	0.2098*	-0.0317	0.0403	-0.2527**	0.0474	
Plant height (cm)	P	1.000	1.000	0.4960**	-0.1307	-0.0725	0.0171	-0.0412	-0.0237	0.051	-0.1409	0.3515**
	G		0.7439**	-0.2130*	-0.0942	0.0018	-0.0373	-0.0533	-0.0035	-0.2028*	0.4941**	
No. of sympodia plant ⁻¹	P		1.000	1.000	-0.0843	0.0836	0.1349	0.0973	0.1616	0.012	-0.0981	0.2569**
	G			-0.0232	0.1407	0.2701	0.116	0.2826**	0.108	-0.0696	0.3701**	
No. of bolls plant ⁻¹	P			1.000	1.000	-0.2872**	0.2353**	-0.1077	0.2006*	0.0335	0.0612	0.0172
	G				-0.3929**	0.3172**	-0.0768	0.3319**	-0.1449	0.0783	-0.0514	
Boll weight (g)	P				1.000	1.000	0.1293	0.1255	0.1696	-0.0525	0.0544	-0.1619
	G					0.1422	0.1526	0.1847*	-0.0741	0.0712	-0.2018*	
Ginning out-turn (%)	P					1.000	1.000	-0.3639**	0.8760**	-0.0400	-0.0773	-0.0114
	G						-0.3387**	0.9007**	-0.2061*	-0.1717	-0.0051	
Seed index (g)	P						1.000	1.000	0.1016	0.1917*	-0.0877	-0.1068
	G							0.0975	0.3607**	-0.0619	-0.1273	
Lint index (g)	P							1.000	1.000	0.0245	-0.1128	-0.0599
	G								-0.0874	-0.1696	-0.0627	
2.5% span length (mm)	P								1.000	1.000	-0.1153	0.0388
	G									-0.3718**	0.1363	
Micronaire (10 ⁻⁶ g/in)	P										1.000	-0.0311
	G											-0.059
Bundle strength (g tex ⁻¹)	P											1.000
	G											
Uniformity ratio	P											
	G											
Fibre elongation (%)	P											
	G											
CGR at 60-120 days (g m ⁻² day ⁻¹)	P											
	G											
RWC at 60 DAS (%)	P											
	G											
RWC at 120 DAS (%)	P											
	G											
SLW at 60 DAS (mg cm ⁻²)	P											
	G											
SLW at 120 DAS (mg/cm ²)	P											
	G											
LAI at 120 DAS	P											
	G											
Harvest index	P											
	G											
Correlation with seed cotton yield plant ⁻¹ (g)												

*=significant at 5% level **=significant at 1% level, Bold and diagonal values indicate direct effects, P=phenotypic G=genotypic, Residual effect = 0.1650(P), SQRT (1-1.0046)(G)

Table 1 Cont.....

Character		Unifor mity ratio	Fibre elongation (%)	CGR at 60-120 days (g m ⁻² day ⁻¹)	RWC at 60 DAS (%)	RWC at 120 DAS (%)	SLW at 60 DAS (mg cm ⁻²)	SLW at 120 DAS (mg cm ⁻²)	LAI at 120 DAS	Harvest index	Seed cotton yield per plant(g ⁻¹)
Days to 50% flowering	P	-0.148	0.0999	0.3213*	0.3161**	-0.0327	0.1531	0.1189	0.0577	-0.091	-0.0836
	G	-0.1975*	0.1158	0.3481**	0.4865**	0.0491	0.2238*	0.2308*	0.0647	-0.1201	-0.1126
Plant height (cm)	P	0.0201	0.2284*	0.1042	0.0372	0.1521	-0.0797	-0.0438	0.0785	-0.1735	-0.1663
	G	-0.0058	0.2640**	0.1234	0.1651	0.3535**	-0.1638	-0.0248	0.0714	-0.2641**	-0.2238*
No. of sympodia plant ⁻¹	P	0.0946	0.3134**	0.0478	0.2728**	0.0519	-0.0831	0.0913	0.0047	0.0602	0.0127
	G	0.1312	0.4172**	0.0548	0.4534**	0.143	-0.0766	0.1531	-0.0218	0.0901	0.1315
No. of bolls plant ⁻¹	P	-0.1625	-0.0748	0.1906*	0.0564	0.1045	0.0287	-0.0301	-0.0242	0.2473**	0.4544**
	G	-0.3581**	-0.0733	0.2497**	0.0956	0.3179**	-0.0822	0.1477	-0.0855	0.4286**	0.2328*
Boll weight (g)	P	0.0202	0.0366	-0.1194	0.082	-0.1108	0.1741	-0.0158	-0.0537	0.5658**	0.7043**
	G	0.0026	0.0431	-0.1231	0.1842*	-0.1343	0.1938*	-0.0094	-0.0544	0.8017**	0.7977**
Ginning out-turn (%)	P	-0.0026	-0.021	0.1138	-0.1031	0.0268	-0.2968**	-0.1768	-0.1351	0.2798**	0.2966**
	G	0.0031	-0.0206	0.1169	-0.1721	0.1426	-0.4239**	-0.316	-0.1637	0.4513**	0.3569**
Seed index (g)	P	0.0293	0.2472**	0.0669	0.1887*	-0.0424	0.13	0.1278	-0.0310	0.0712	0.013
	G	0.0863	0.2842**	0.0837	0.2449**	-0.0619	0.2464**	0.2542**	-0.0309	0.1013	0.0814
Lint index (g)	P	-0.0198	0.089	0.1815*	-0.0619	-0.0183	-0.2771**	-0.1555	-0.1510	0.3155**	0.2976**
	G	-0.0123	0.0917	0.1920*	-0.1442	0.1294	-0.3796**	-0.2374**	-0.1664	0.5001**	0.3927**
2.5% span length (mm)	P	-0.0323	0.1639	-0.0478	0.1149	-0.038	0.0638	0.0954	0.0406	-0.0044	-0.0268
	G	-0.0139	0.3387**	-0.1206	0.2739**	0.3379**	0.1896*	0.0126	0.1338	0.0549	-0.1526
Micronaire (10 ⁻⁶ g/ in)	P	-0.1393	-0.1993*	-0.1552	-0.0428	-0.101	-0.0007	0.0771	-0.0692	0.0767	0.0659
	G	-0.0479	-0.2227*	-0.1814*	-0.1124	-0.1825*	0.0778	-0.0317	-0.1535	0.0988	0.0991
Bundle strength (g tex ⁻¹)	P	0.1072	0.1412	0.1261	0.0565	-0.0108	-0.075	-0.0624	-0.1598	-0.1784	-0.152
	G	0.122	0.1946*	0.1989*	0.2611**	-0.0778	-0.0807	-0.1165	-0.2454**	0.3112**	-0.2687**
Uniformity ratio	P	1.000	-0.1121	-0.2248*	-0.0249	0.0451	0.1006	0.0455	-0.0787	-0.2164*	-0.0847
	G		-0.1292	-0.2684**	0.0537	0.1629	0.0347	0.1023	-0.1017	-0.2138*	-0.2081
Fibre elongation (%)	P		1.000	-0.0186	-0.0112	0.04	0.0554	-0.0507	-0.1838*	0.0199	-0.0307
	G			-0.0142	-0.0656	0.0589	0.0501	-0.0782	-0.2320*	0.0378	-0.0198
CGR at 60-120 days (g m ⁻² day ⁻¹)	P			1.000	0.0612	0.0531	-0.0876	0.0229	0.3526**	0.001	0.0181
	G				0.1026	0.1008	-0.1266	0.0331	0.4159**	0.0304	0.017
RWC at 60 DAS (%)	P				1.000	-0.0919	0.0484	0.3100**	0.0326	0.1009	0.1375
	G					0.0245	0.1264	0.5897**	-0.0387	0.2635**	0.2828**
RWC at 120 DAS (%)	P					1.000	-0.0123	0.102	0.2518**	0.0158	-0.0297
	G						-0.0655	0.1558	0.4674**	0.0483	0.0912
SLW at 60 DAS (mg cm ⁻²)	P						1.000	0.1043	-0.0148	0.1133	0.2071*
	G							0.1731	-0.0462	0.145	0.1735
SLW at 120 DAS (mg cm ⁻²)	P							1.000	0.0727	-0.0951	-0.0498
	G								0.0496	-0.0241	0.0793
LAI at 120 DAS	P								1.000	-0.0686	-0.0715
	G									-0.1593	-0.1142
Harvest index	P									1.000	0.7164**
	G										1.1110**
Correlation with seed cotton yield plant ⁻¹ (g)											1.000

*=significant at 5% level **=significant at 1% level, Bold and diagonal values indicate direct effects, P=phenotypic G=genotypic, Residual effect = 0.1650(P), SQRT (1-1.0046)(G)

Table 2. Direct and indirect effects (Phenotypic) of yield components on seed cotton yield in 40 genotypes of cotton (*Gossypium hirsutum* L.)

Character		Days to 50% flowering	Plant height (cm)	No. of sympodia plant ⁻¹	No. of bolts plant ⁻¹	Boll weight (g)	Ginning out turn (%)	Seed index (g)	Lint index (g)	2.5% span length (mm)	Micronaire (10 ⁻⁶ g/ in)
Days to 50% flowering	P	-0.0332	-0.0050	-0.0074	0.0000	0.0025	0.0028	-0.0052	0.0009	0.0009	0.0077
	G	-0.1017	0.0020	-0.0036	-0.0011	-0.0010	-0.1010	0.0023	-0.1003	0.0007	-0.0022
Plant height (cm)	P	0.0010	0.0066	0.0033	-0.0009	-0.0005	0.0001	-0.0003	-0.0002	0.0003	-0.0009
	G	0.0056	-0.1272	-0.0002	-0.0063	-0.0024	0.0000	-0.1010	-0.1015	-0.0001	-0.0058
No. of sympodia plant ⁻¹	P	0.0003	0.0007	0.0014	-0.0001	0.0001	0.0002	0.0001	0.0002	0.0000	-0.0001
	G	0.0002	0.0000	0.1525	0.0011	0.0001	0.0002	-0.0002	0.0001	-0.0012	0.0007
No. of bolls plant ⁻¹	P	0.0001	-0.0896	-0.0578	0.6852	-0.1968	0.1612	-0.0738	0.1375	0.0229	0.0419
	G	-0.0266	-0.1216	-0.0001	0.5857	-0.2256	0.1917	-0.0604	0.0932	-0.0337	0.0490
Boll weight (g)	P	-0.0663	-0.0626	0.0722	-0.2482	0.8642	0.1117	0.1085	0.1466	-0.0453	0.0470
	G	-0.0937	-0.0302	0.0176	-0.3735	0.9680	0.1372	0.1472	0.1781	-0.0238	0.0591
Ginning out-turn (%)	P	0.0084	-0.0017	-0.0136	-0.0237	-0.0130	-0.1006	0.0366	-0.0881	0.0040	0.0078
	G	-0.0044	0.0001	-0.0018	0.0161	0.0070	0.5492	-0.0167	0.0443	-0.0101	-0.0095
Seed index (g)	P	-0.0132	0.0035	-0.0082	0.0090	-0.0105	0.0305	-0.0838	-0.0085	-0.0161	0.0073
	G	-0.0008	0.0203	-0.0037	0.0007	-0.0010	0.0023	0.1067	-0.0007	-0.0024	0.0003
Lint index (g)	P	-0.0026	-0.0023	0.0159	0.0197	0.0167	0.0861	0.0100	0.0983	0.0024	-0.0111
	G	0.0098	0.0233	-0.0016	-0.0212	-0.0115	-0.0562	-0.0061	0.4377	0.0055	-0.0114
2.5% span length (mm)	P	0.0001	-0.0002	0.0000	-0.0001	0.0002	0.0001	-0.0006	-0.0001	-0.0031	0.0004
	G	0.0025	-0.0001	-0.0107	-0.0059	-0.0028	-0.1075	0.0001	-0.0032	-0.1005	-0.0138
Micronaire (10 ⁻⁶ g/ in)	P	0.0080	0.0049	0.0034	-0.0021	-0.0019	0.0027	0.0030	0.0039	0.0040	-0.0347
	G	0.0025	0.0024	-0.0019	-0.0017	-0.0007	0.0021	0.0005	0.0020	0.0042	0.0114
Bundle strength (g tex ⁻¹)	P	-0.0003	-0.0094	-0.0069	-0.0005	0.0043	0.0003	0.0029	0.0016	-0.0010	0.0008
	G	-0.0001	-0.0230	-0.0037	0.0031	0.0022	0.0002	0.0059	0.0029	-0.0064	0.0030
Uniformity ratio	P	-0.0021	0.0003	0.0013	-0.0023	0.0003	0.0000	0.0004	-0.0003	-0.0005	-0.0019
	G	-0.0016	-0.0001	-0.0001	-0.0049	0.0000	0.0000	0.0010	-0.0501	-0.0272	-0.0006
Fibre elongation (%)	P	-0.0007	-0.0016	-0.0021	0.0005	-0.0003	0.0001	-0.0017	-0.0006	-0.0011	0.0014
	G	-0.0001	-0.0095	-0.0034	0.0024	-0.0010	0.0012	-0.0105	-0.0530	-0.0121	0.0075
CGR at 60-120 days (g m ⁻² day ⁻¹)	P	0.0021	0.0007	0.0003	0.0013	-0.0008	0.0008	0.0004	0.0012	-0.0003	-0.0010
	G	0.0007	-0.0001	0.0000	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000
RWC at 60 DAS (%)	P	0.0152	0.0018	0.0131	0.0027	0.0039	-0.0050	0.0091	-0.0030	0.0055	-0.0021
	G	0.0031	-0.0051	-0.0066	0.0060	-0.0008	-0.1032	-0.0010	-0.0536	-0.0003	0.0034
RWC at 120 DAS (%)	P	0.0001	-0.0003	-0.0001	-0.0002	0.0002	-0.0001	0.0001	0.0000	0.0001	0.0002
	G	0.0004	0.0226	0.0016	-0.0015	0.0025	-0.1012	0.0021	-0.0505	-0.0035	-0.0001
SLW at 60 DAS (mg cm ⁻²)	P	0.0065	-0.0034	-0.0035	0.0012	0.0074	-0.0126	0.0055	-0.0117	0.0027	0.0000
	G	0.1008	0.0206	-0.0037	0.0002	-0.0009	0.0009	-0.1001	0.0009	0.0640	-0.0009
SLW at 120 DAS (mg cm ⁻²)	P	-0.0020	0.0007	-0.0015	0.0005	0.0003	0.0029	-0.0021	0.0026	-0.0016	-0.0013
	G	0.0029	0.0264	-0.0003	-0.0043	-0.0029	-0.1001	0.0028	0.0017	-0.0045	-0.0031
LAI at 120 DAS	P	-0.0008	-0.0011	-0.0001	0.0003	0.0007	0.0018	0.0004	0.0020	-0.0005	0.0009
	G	-0.0001	-0.0029	-0.0022	0.0022	0.0022	0.0038	0.0006	0.0034	-0.0058	0.0049
Harvest index	P	-0.0044	-0.0083	0.0029	0.0119	0.0272	0.0134	0.0034	0.0152	-0.0002	0.0037
	G	-0.0120	-0.0217	0.0033	0.0357	0.0662	0.0372	0.1083	0.0412	0.0045	0.0072
Correlation with seed cotton yield plant ⁻¹ (g)	P	-0.0836	-0.1663	0.0127	0.4544*	0.7043**	0.2966**	0.0130	0.2976**	-0.0268	0.0659
	G	-0.1126	-0.2238*	0.1315	0.2328*	0.7977**	0.3569**	0.0814	0.3927**	-0.1526	0.0991

*=significant at 5% level **=significant at 1% level, Bold and diagonal values indicate direct effects, P=phenotypic
G=genotypic, Residual effect = 0.1650(P), SQRT (1-1.0046)(G)

Table 2 Cont.....

Character		Bundle strength (g tex ⁻¹)	Uniformity ratio	Fibre elongation (%)	CGR at 60-120 days (g m ⁻² day ⁻¹)	RWC at 60 DAS (%)	RWC at 120 DAS (%)	SLW at 60 DAS (mg cm ⁻²)	SLW at 120 DAS (mg cm ⁻²)	LAI at 120 DAS	Harvest index
Days to 50% flowering	P	-0.0004	0.0049	-0.0033	-0.0107	-0.0105	0.0011	-0.0051	-0.0039	-0.0019	0.0030
	G	0.0002	-0.0020	0.0011	0.0552	-0.0376	-0.0002	-0.0016	-0.0222	0.0002	-0.1015
Plant height (cm)	P	0.0023	0.0001	0.0015	0.0007	0.0002	0.0010	-0.0005	-0.0003	0.0005	-0.0011
	G	0.0135	-0.0002	0.0074	-0.0048	0.0037	0.0009	-0.0032	-0.0285	0.0023	-0.1072
No. of sympodia plant ⁻¹	P	0.0004	0.0001	0.0004	0.0001	0.0004	0.0001	-0.0001	0.0001	0.0000	0.0001
	G	0.0000	0.0000	-0.0001	-0.0001	0.0007	-0.0019	-0.0004	-0.0216	0.0003	0.0004
No. of bolls plant ⁻¹	P	0.0118	-0.1113	-0.0512	0.1306	0.0386	0.0716	0.0197	-0.0206	-0.0166	0.1694
	G	-0.0387	0.0120	-0.0256	0.0004	-0.0389	-0.0301	-0.0247	0.0946	-0.0377	0.2536
Boll weight (g)	P	-0.1399	0.0174	0.0317	-0.1032	0.0708	-0.0958	0.1505	-0.0137	-0.0464	0.4889
	G	-0.0466	-0.0004	0.0271	0.2386	0.0217	0.1442	-0.0049	0.1255	-0.0618	0.2584
Ginning out-turn (%)	P	0.0012	0.0003	0.0021	-0.0114	0.0104	-0.0027	0.0299	0.0178	0.0136	-0.0281
	G	-0.0003	0.0002	-0.0017	-0.0481	0.0041	-0.0036	-0.0090	0.0001	-0.0046	0.2222
Seed index (g)	P	0.0090	-0.0025	-0.0207	-0.0056	-0.0158	0.0036	-0.0109	-0.0107	0.0026	-0.0060
	G	0.0009	-0.0006	-0.0020	-0.0011	0.0339	-0.0009	-0.0001	0.0008	0.0001	-0.1007
Lint index (g)	P	-0.0059	-0.0019	0.0087	0.0178	-0.0061	-0.0018	-0.0272	-0.0153	-0.0148	0.0310
	G	0.0039	0.0008	-0.0053	-0.0095	0.0282	-0.0013	0.0134	0.0047	0.0063	-0.1312
2.5% span length (mm)	P	-0.0001	0.0001	-0.0005	0.0001	-0.0004	0.0001	-0.0002	-0.0003	-0.0001	0.0000
	G	0.0050	-0.0005	0.0126	-0.0434	0.0003	-0.0076	-0.0005	0.0072	0.0064	0.0020
Micronaire (10 ⁻⁶ g/in)	P	0.0011	0.0048	0.0069	0.0054	0.0015	0.0035	0.0000	-0.0027	0.0024	-0.0027
	G	0.0007	0.0006	0.0024	-0.0525	0.0010	-0.0033	-0.0021	-0.0242	0.0016	-0.0010
Bundle strength (g tex ⁻¹)	P	-0.0269	-0.0029	-0.0038	-0.0034	-0.0015	0.0003	0.0020	0.0017	0.0043	0.0048
	G	-0.1907	-0.0057	-0.0089	-0.0371	0.0004	0.0068	0.0051	0.0189	0.0114	0.0145
Uniformity ratio	P	0.0015	0.0140	-0.0016	-0.0031	-0.0003	0.0006	0.0014	0.0006	-0.0011	-0.0030
	G	0.0015	-0.2045	-0.0016	-0.0005	0.0316	-0.0028	0.0030	0.0013	-0.0005	-0.1026
Fibre elongation (%)	P	-0.0010	0.0008	-0.0068	0.0001	0.0001	-0.0003	-0.0004	0.0003	0.0013	-0.0001
	G	-0.0067	0.0046	-0.0351	-0.0011	0.0267	-0.0033	0.0161	0.0084	0.0067	-0.1010
CGR at 60-120 days (g m ⁻² day ⁻¹)	P	0.0008	-0.0015	-0.0001	0.0066	0.0004	0.0004	-0.0006	0.0002	0.0023	0.0000
	G	-0.0002	0.0000	0.0000	0.0982	0.0006	-0.0034	0.0020	0.0002	0.0009	0.0002
RWC at 60 DAS (%)	P	0.0027	-0.0012	-0.0005	0.0029	0.0482	-0.0044	0.0023	0.0149	0.0016	0.0049
	G	0.0003	0.0077	-0.0079	-0.0014	0.1533	-0.0276	0.0115	-0.0226	0.0035	0.0013
RWC at 120 DAS (%)	P	0.0000	-0.0001	-0.0001	-0.0001	0.0002	-0.0022	0.0000	-0.0002	-0.0005	0.0000
	G	-0.0036	-0.0038	0.0016	-0.0514	0.0121	0.0165	-0.0013	-0.0435	-0.0021	0.1021
SLW at 60 DAS (mg cm ⁻²)	P	-0.0032	0.0043	0.0023	-0.0037	0.0021	-0.0005	0.0424	0.0044	-0.0006	0.0048
	G	0.0004	-0.0004	0.0020	-0.0529	0.0012	-0.0029	0.1731	-0.0228	0.0002	-0.1006
SLW at 120 DAS (mg cm ⁻²)	P	0.0010	-0.0008	0.0008	-0.0004	-0.0051	-0.0017	-0.0017	-0.0166	-0.0012	0.0016
	G	0.0092	-0.0025	0.0054	-0.0095	0.0054	0.0015	-0.0086	0.0089	-0.0022	-0.1054
LAI at 120 DAS	P	0.0021	0.0011	0.0025	-0.0047	-0.0004	-0.0034	0.0002	-0.0010	-0.0134	0.0009
	G	0.0082	0.0043	0.0064	-0.0467	0.0032	0.0031	-0.0056	-0.0256	-0.0336	0.1051
Harvest index	P	-0.0086	-0.0104	0.0010	0.0000	0.0048	0.0008	0.0054	-0.0046	-0.0033	0.0481
	G	-0.0256	-0.0176	0.0024	-0.0153	0.0312	0.0069	0.0113	0.0195	-0.0115	0.6824
Correlation with seed cotton yield plant ⁻¹ (g)	P	-0.1520	-0.0847	-0.0307	0.0181	0.1375	-0.0297	0.2071*	-0.0498	-0.0715	0.7164**
	G	-0.2687**	-0.2081*	-0.0198	0.0170	0.2828**	0.0912	0.1735	0.0793	-0.1142	0.7910**

*=significant at 5%level **=significant at 1%level, Bold and diagonal values indicate direct effects, P=phenotypic G=genotypic, Residual effect = 0.1650(P), SQRT (1-1.0046)(G)

Number of sympodia plant⁻¹ showed significant positive association with bundle strength, fibre elongation and relative water content at 60 DAS at both phenotypic and genotypic levels indicating simultaneous improvement of these traits. Number of bolls plant⁻¹ showed significant positive association with crop growth rate at 60-120 days, harvest index, seed cotton yield plant⁻¹ at both phenotypic and genotypic levels indicating that selection for high seed cotton yield plant⁻¹ based on number of bolls plant⁻¹ is beneficial whereas boll weight showed significant positive association with lint index, relative water content at 60 DAS and specific leaf weight at 60 DAS. The above results are in conformity with reports of Mahantesh *et al.*, (2010), Venkateswarulu *et al.*, (2010).

Ginning out-turn at both genotypic and phenotypic levels, showed significant negative association with specific leaf weight at 60 DAS and seed index. At genotypic level, this trait showed highly significant positive association with specific leaf weight at 60 and 120 DAS respectively whereas lint index showed significant association with number of sympodia plant⁻¹, ginning out-turn and specific leaf weight at 60 DAS. This was supported by Vijaya Lakshmi *et al.*, (2008) and Mahantesh *et al.*, (2010).

Micronaire at phenotypic and genotypic levels showed significant negative association with fibre elongation. At genotypic level, this trait showed highly significant positive association with relative water content at 60 DAS, crop growth rate at 60-120 DAS, fibre elongation and significant negative association with leaf area index at 120 DAS, harvest index. Uniformity ratio showed significant negative association with crop growth rate at 60-120 days and harvest index and at genotypic and phenotypic levels fibre elongation showed significant negative association with leaf area index at 120 DAS. This was supported by Vijaya Lakshmi *et al.*, (2008).

Most of the physiological parameters like crop growth rate at 60-120 days, relative water content at 60 and 120 days, specific leaf weight at 60-120 days recorded negative and non-significant association with seed cotton yield plant⁻¹. This was supported by Narisireddy and Ratnakumari (2004) and Preetha and Raveendran (2008).

The path analysis indicated that days to 50 per cent flowering, number of sympodia plant⁻¹, number of bolls plant⁻¹, boll weight, lint index, bundle strength and relative water content at 60 DAS, specific leaf weight at 60 DAS and harvest index showed direct positive effects on seed cotton yield

plant⁻¹ (Table 2). This was supported by Vijaya Lakshmi *et al.*, (2008) and Mahantesh *et al.*, (2010). The residual effect observed was low both at phenotypic (0.1650) and genotypic SQRT (1-1.0046) levels, so the characters included in the study clearly explains extent of the direct and indirect effects on the dependent variable. From this we can infer that due weightage should be given on selection process with more number of bolls plant⁻¹ and boll weight and there should be economic balance among these traits to get higher seed cotton yield plant⁻¹.

LITERATURE CITED

- Eswara Rao G, Chenga Reddy V, Lal Ahamed M, Srinivasa Rao V, Panduranga Rao C and Bali Reddy V 2009** Correlation and path coefficient analysis in cotton (*Gossypium hirsutum* L.). *The Andhra Agricultural Journal*, 56: 192-195.
- Falconer D S 1964** - An Introduction to Quantitative Genetics, Second edition, Oliver and Boyd, Edinburgh, London, 312-324.
- Mahantesh, Lal Ahamed M, Panduranga Rao C and Samba Murthy J S V 2010** Character association and path coefficient analysis in upland cotton (*Gossypium hirsutum* L.). *The Andhra Agricultural Journal*, 57:230-233.
- Narisireddy A and Ratnakumari S 2004** Association of physiological parameters with yield and yield components in American cotton (*Gossypium hirsutum* L.). *Madras Agricultural Journal* 91: 515-518.
- Preetha S and Raveendran T S 2008** Characterization of cotton (*Gossypium hirsutum* L.) genotypes and evaluation of genetic divergence. *Australian Journal of Basic and Applied Sciences*, 2: 343-349.
- Venkateswarulu K, Chenga Reddy V, Samba Murthy J S V, Srinivasa Rao V, Panduranga Rao C, Siva Reddy K V and Sateesh Babu J 2010** Character association and path coefficient analysis for yield and component traits in upland cotton (*Gossypium hirsutum* L.). *The Andhra Agricultural Journal*, 57: 173-176.
- Vijaya Lakshmi G, Chenga Reddy V, Panduranga Rao C, Satish Babu J and Srinivasulu R 2008** Character association and path coefficient analysis in cotton (*Gossypium hirsutum* L.). *The Andhra Agricultural Journal*, 55: 156-160.
- Wright S 1921** Correlation and causation - *Journal of Agricultural Research* 20: 557-585.