



Genetic Variability, Character Association and Component Analysis in Inter-specific Cotton Hybrids (*G. hirsutum* L. × *G. barbadense* L.)

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ABSTRACT

Fifty nine genotypes comprised of 9 lines, 5 testers and their forty five hybrids produced in a line × tester fashion were evaluated for yield, yield contributing and fibre quality traits. The analysis of variance revealed that the sufficient variability was present in the material studied for all the characters. The estimates of PCV and GCV were high for number of monopodia plant⁻¹, lint yield plant⁻¹ and seed cotton yield plant⁻¹. High heritability estimates in narrow sense were recorded for fibre elongation, days to 50% flowering, bundle strength, 2.5% span length, uniformity ratio and boll weight. The character association analysis revealed that days to 50% flowering, number of bolls plant⁻¹, boll weight, ginning out-turn, 2.5% span length, bundle strength, uniformity ratio and lint yield plant⁻¹ were found to have significant positive association with seed cotton yield plant⁻¹. Path analysis indicated that lint yield per plant exhibited high direct positive effect on seed cotton yield plant⁻¹ signifying the importance of this trait while selecting for improvement of seed cotton yield of cotton.

Key words : Cotton, Correlation, Inter-specific crosses, Path analysis, Variability.

Cotton is an often cross pollinated crop in which large amount of variation is observed for many important traits. Seed cotton yield is a complex and polygenically inherited character resulting from multiplicative interaction of its contributing characters. 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 was conducted to obtain information on genetic variability, nature and magnitude of character association, direct and indirect effects of different attributes on seed cotton yield in inter-specific cotton hybrids.

MATERIAL AND METHODS

The present study was carried out with 14 parental genotypes and their 45 hybrids of cotton. The parents and their hybrids were evaluated in a randomized block design in three replications with spacing of 120cm × 60cm during *kharif* 2011-12 at RARS, Lam Farm, Guntur. Each plot consisted of one row of 6m length and observations were recorded on five randomly selected plants from each genotype per replication for characters *viz.*, days

to 50% flowering, plant height (cm), number of monopodia plant⁻¹, number of sympodia plant⁻¹, number of bolls plant⁻¹, boll weight (g), seed index (g), lint index (g), ginning out-turn (%), 2.5% span length (mm), micronaire value (10⁻⁶ g/inch), bundle strength (g/tex), uniformity ratio, fibre elongation (%), lint yield plant⁻¹ (g) and seed cotton yield plant⁻¹ (g). The fibre quality characters were analyzed at CIRCOT regional unit, Lam, Guntur. The phenotypic and genotypic coefficients of variability were computed according to the method suggested by Burton (1952). Heritability (narrow sense) and genetic advance were calculated as per Mather (1943). The phenotypic and genotypic correlations and path coefficient relationships were estimated as per methods of Falconer (1964) and Dewey and Lu (1959), respectively.

RESULTS AND DISCUSSION

Analysis of variance indicated highly significant differences among the genotypes with regard to all the characters under study indicating existence of sufficient amount of variability in the material. The phenotypic coefficient of variation (PCV) was slightly higher than in magnitude genotypic coefficient of variation (GCV) for all the

Table 1. Estimates of variability, heritability ($\%^2_{(ns)}$) and genetic advance as per cent of mean for seed cotton yield plant⁻¹ and its component characters for 59 genotypes (45 hybrids and 14 parents) of cotton.

Sl. No.	Character	Mean	Range		Coefficient of variation		Heritability (narrow sense)(%)	Genetic advance as per cent of mean
			Minimum	Maximum	PCV (%)	GCV (%)		
1	Days to 50% flowering	61.74	55.33	69.00	5.71	5.28	86.5	9.16
2	Plant height (cm)	124.88	86.07	148.10	11.42	9.51	46.8	7.98
3	No. of monopodia plant ⁻¹	1.31	0.22	2.60	47.47	44.44	34.7	30.87
4	No. of sympodia plant ⁻¹	16.28	13.53	20.53	12.39	9.48	33.1	5.70
5	No. of bolls plant ⁻¹	50.89	25.87	77.10	19.46	17.11	42.1	19.03
6	Boll weight(g)	3.49	2.56	4.75	14.48	13.87	65.1	17.74
7	seed index(g)	8.35	7.09	10.25	9.30	8.31	25.2	4.89
8	Lint index(g)	4.23	3.39	5.27	10.30	8.15	16.8	3.47
9	Ginning out- turn (%)	33.57	30.67	35.57	4.07	2.62	16.4	1.17
10	2.5% span length (mm)	31.41	26.20	36.87	9.25	8.53	77.0	13.01
11	Micronaire (10 ⁻⁶ g/ inch)	3.64	2.99	4.27	8.75	7.74	81.1	12.92
12	Bundle strength (g/tex)	25.02	21.13	33.10	10.45	9.55	86.3	14.58
13	Uniformity ratio	47.10	44.00	50.67	4.42	3.39	68.2	5.21
14	Fibre elongation (%)	5.83	5.36	6.27	4.75	4.48	89.9	9.34
15	Lint yield plant ⁻¹ (g)	59.88	32.10	102.87	29.74	26.51	50.1	33.32
16	Seed cotton yield plant ⁻¹ (g)	177.61	99.03	298.73	28.40	25.48	48.8	31.18

PCV = Phenotypic coefficient of variation

GCV = Genotypic coefficient of variation

characters indicating the influence of environment (Table 1). The estimates of PCV and GCV were observed to be high for number of monopodia plant⁻¹ (47.47 and 44.44%), lint yield plant⁻¹ (29.74 and 26.51%) and seed cotton yield plant⁻¹ (28.40 and 25.48%). These results are in agreement with the findings of Kulkarni *et al.* (2011).

High heritability estimates in narrow sense were recorded for fibre elongation (89.9%), days to 50% flowering (86.5%), bundle strength (86.3%), micronaire value (81.1%), 2.5% span length (77%), uniformity ratio (68.2%) and boll weight (65.1%) which indicated that selection was effective for these traits. These findings were in supportive of Muhammad Iqbal *et al.* (2011). Moderate heritability coupled with high genetic advance as per cent of mean was recorded for seed cotton yield plant⁻¹ indicating the operation of both additive and non-additive gene action in the inheritance of the trait. Similar kind of findings were also evident from the studies of Manzoor Hussain *et al.* (2009).

Genotypic correlation coefficients in general were higher than phenotypic correlation coefficients (Table 2). Days to 50% flowering (0.2578** and 0.218**), number of bolls per plant (0.8716** and 0.774**), boll weight (0.6452** and 0.581**), ginning out-turn (0.2779** and 0.201**), 2.5% span length (0.231** and 0.1872*), bundle strength (0.3068** and 0.255**), uniformity ratio (0.2897** and 0.1911*) and lint yield plant⁻¹ (0.9996** and 0.988**) showed significant positive correlation with seed cotton yield per plant at genotypic and phenotypic levels, respectively. Similar results were earlier reported by Rajanna *et al.* (2011). Seed index exhibited significant negative correlation with seed cotton yield plant⁻¹ at both phenotypic and genotypic levels, as also reported by Venkateswarlu *et al.* (2010).

Path coefficient analysis revealed that lint yield plant⁻¹ (1.0022 and 0.6052) exerted high positive direct effect on seed cotton yield plant⁻¹ followed by number of bolls plant⁻¹ (0.0255 and

Table 2. Phenotypic (above diagonal) and genotypic (below diagonal) correlations of 16 characters in 59 genotypes (45 hybrids & 14 parents) of cotton

Character	Days to 50% flowering	Plant height (cm)	No. of monopodia plant ⁻¹	No. of sympodia plant ⁻¹	No. of bolls plant ⁻¹	Boll weight (g)	Seed index (g)
Days to 50% flowering	—	0.3743**	-0.1584*	0.1572*	0.1503*	0.0695	-0.1286
Plant height (cm)	0.4703**	—	-0.0061	0.1669*	-0.0331	0.1372	-0.1367
Number of monopodia plant ⁻¹	-0.1908*	-0.0445	—	0.3505**	0.0015	0.0792	0.0862
Number of sympodia plant ⁻¹	0.1969**	0.3389**	0.5040**	—	0.0394	0.055	-0.217**
Number of bolls plant ⁻¹	0.1887*	0.0089	-0.0172	0.0545	—	0.1876*	-0.205**
Boll weight (g)	0.0852	0.1743*	0.0776	0.0657	0.222**	—	-0.110
Seed index(g)	-0.1533*	-0.1786*	0.1104	-0.3149**	-0.270**	-0.1413	—
Lint index (g)	-0.0930	-0.1524*	0.1608*	-0.2094**	-0.0360	0.1309	0.7990**
Ginning out turn (%)	-0.0206	-0.0729	0.0942	0.2372**	0.295**	0.2998**	-0.1418
2.5% span length (mm)	0.3219**	0.5187**	0.0555	0.1008	0.0548	0.2761**	0.0655
Micronaire (10 ⁻⁶ g / inch)	-0.2660**	-0.5305**	-0.0219	-0.0872	0.1660*	-0.2128**	-0.0065
Bundle strength (g / tex)	0.2200**	0.5115**	-0.0569	0.0561	0.1600*	0.2173**	-0.1949**
Uniformity ratio (%)	-0.0134	-0.0743	-0.4625**	-0.6650**	0.212**	0.1130	0.1524*
Fibre elongation (%)	-0.0167	0.1314	-0.4691**	-0.5662**	0.0291	0.0721	0.0425
Lintyield plant ⁻¹ (g)	0.2602**	0.1346	-0.1004	0.0371	0.879**	0.6507**	-0.2986**
Seed cottonyield plant ⁻¹ (g)	0.2578**	0.1464*	-0.1032	0.0215	0.8716**	0.6452**	-0.2958**

Table 2 Cont.....

Lint index (g)	Ginning out turn (%)	2.5% span length (mm)	Micronaire (10 ⁻⁶ g/inch)	Bundle strength (g/tex)	Uniformity ratio	Fibre elongation (%)	Lintyield plant ⁻¹ (g)	Seed cotton yield plant ⁻¹ (g)
-0.0664	0.0189	0.268**	-0.2556**	0.1715*	-0.0193	-0.0224	0.22**	0.218**
-0.0997	-0.0171	0.383**	-0.3425**	0.377**	0.005	0.1065	0.0801	0.0846
0.0905	0.0324	0.0773	-0.0072	-0.0410	-0.3371**	-0.413**	-0.0749	-0.0756
-0.2059**	0.0338	0.0317	-0.0924	0.0767	-0.4395**	-0.401**	0.0107	0.0167
-0.035	0.1670*	0.0479	0.1448	0.1302	0.1304	0.0076	0.769**	0.774**
0.0856	0.1650*	0.239**	-0.1745*	0.1898*	0.0975	0.0754	0.575**	0.581**
0.666**	-0.0765	0.050	-0.0052	-0.1892*	0.1011	0.0204	-0.243**	-0.226**
—	0.4632**	0.0720	-0.0558	-0.1644*	-0.0155	0.0231	0.0464	-0.0204
0.2819**	—	-0.0663	-0.0449	-0.0125	-0.0393	-0.0139	0.318**	0.201**
0.0751	-0.1091	—	-0.3572**	0.397**	0.1561*	0.278**	0.1785*	0.1872*
-0.0477	0.0199	-0.484**	—	-0.572**	-0.0656	-0.235**	-0.0279	-0.0268
-0.2318**	-0.0715	0.456**	-0.7132**	—	0.1709*	0.319**	0.245**	0.255**
0.0458	0.0065	0.235**	-0.0460	0.219**	—	0.565**	0.1742*	0.1911*
0.0611	-0.0512	0.336**	-0.2785**	0.376**	0.7661**	—	0.1140	0.1227
-0.0227	0.3373**	0.214**	-0.0296	0.285**	0.2798**	0.1468*	—	0.988**
-0.0363	0.2779**	0.231**	-0.0348	0.3068**	0.2897**	0.1561*	0.9996**	—

*, ** Significant at 5% and 1% level, respectively.

Table 3. Direct and indirect effects (phenotypic) of 15 traits on seed cotton yield per plant in 59 genotypes (45 hybrids and 14 parents) of cotton

Character	Days to 50% flowering	Plant height (cm)	No. of monopodia plant ⁻¹	No. of sympodia plant ⁻¹	No. of bolls plant ⁻¹	Boll weight (g)
Days to 50% flowering	-0.0026	-0.0010	0.0004	-0.0004	-0.0004	-0.0002
Plant height (cm)	0.0010	0.0026	0.0000	0.0004	-0.0001	0.0004
Number of monopodia plant ⁻¹	-0.0003	0.0000	0.0017	0.0006	0.0000	0.0001
Number of sympodia plant ⁻¹	0.0017	0.0018	0.0037	0.0106	0.0004	0.0006
Number of bolls plant ⁻¹	0.0038	-0.0008	0.0000	0.0010	0.0255	0.0048
Boll weight (g)	0.0020	0.0040	0.0023	0.0016	0.0054	0.0290
Seed index(g)	-0.0087	-0.0092	0.0058	-0.0147	-0.0138	-0.0074
Lint index (g)	0.0046	0.0070	-0.0063	0.0144	0.0025	-0.0060
Ginning out turn (%)	-0.0017	0.0016	-0.0029	-0.0031	-0.0152	-0.0150
2.5% span length (mm)	-0.0024	-0.0034	-0.0007	-0.0003	-0.0004	-0.0021
Micronaire (10 ⁻⁶ g / inch)	0.0017	0.0023	0.0000	0.0006	-0.0010	0.0011
Bundle strength (g / tex)	-0.0007	-0.0016	0.0002	-0.0003	-0.0006	-0.0008
Uniformity ratio (%)	0.0000	0.0000	0.0005	0.0006	-0.0002	-0.0001
Fibre elongation (%)	-0.0003	0.0014	-0.0053	-0.0051	0.0001	0.0010
Lintyield plant ⁻¹ (g)	0.2198	0.0803	-0.0751	0.0107	0.7713	0.5758
Seed cottonyield plant ⁻¹ (g)	0.2179**	0.0846	-0.0756	0.0167	0.7735**	0.5811**

Table 3 Cont.....

Seed index (g)	Lint index (g)	Ginning out turn (%)	2.5% span length (mm)	Micronaire (10 ⁻⁶ g/ inch)	Bundle strength (g/tex)	Uniformity ratio	Fibre elongation (%)	Lintyield plant ⁻¹ (g)
0.0003	0.0002	0.0000	-0.0007	0.0007	-0.0005	0.0001	0.0001	-0.0006
-0.0003	-0.0003	0.0000	0.0010	-0.0009	0.0010	0.0000	0.0003	0.0002
0.0001	0.0002	0.0001	0.0001	0.0000	-0.0001	-0.0006	-0.0007	-0.0001
-0.0023	-0.0022	0.0004	0.0003	-0.0010	0.0008	-0.0047	-0.0043	0.0001
-0.0052	-0.0009	0.0043	0.0012	0.0037	0.0033	0.0033	0.0002	0.0196
-0.0032	0.0025	0.0048	0.0069	-0.0051	0.0055	0.0028	0.0022	0.0167
0.0675	0.0450	-0.0052	0.0034	-0.0004	-0.0128	0.0068	0.0014	-0.0164
-0.0467	-0.0700	-0.0324	-0.0050	0.0039	0.0115	0.0011	-0.0016	-0.0032
0.0070	-0.0422	-0.0911	0.0060	0.0041	0.0011	0.0036	0.0013	-0.0290
-0.0004	-0.0006	0.0006	-0.0089	0.0032	-0.0035	-0.0014	-0.0025	-0.0016
0.0000	0.0004	0.0003	0.0024	-0.0066	0.0038	0.0004	0.0015	0.0002
0.0008	0.0007	0.0001	-0.0017	0.0025	-0.0043	-0.0007	-0.0014	-0.0011
-0.0001	0.0000	0.0001	-0.0002	0.0001	-0.0003	-0.0015	-0.0008	-0.0003
0.0003	0.0003	-0.0002	0.0035	-0.0030	0.0041	0.0072	0.0128	0.0015
-0.2439	0.0465	0.3194	0.1789	-0.0280	0.2454	0.1745	0.1142	1.0022
-0.2261**	-0.0204	0.2009**	0.1872*	-0.0268	0.2551**	0.1911*	0.1227	0.9881**

* = Significant at 5% level **=Significant at 1% level, Bold & diagonal values indicate direct effects, Residual effect = 0.0831

Table 4. Direct and indirect effects (Genotypic) of 15 traits on seed cotton yield per plant in 59 genotypes (45 hybrids and 14 parents) of cotton

Character	Days to 50% flowering	Plant height (cm)	No. of monopodia plant ⁻¹	No. of sympodia plant ⁻¹	No. of bolls plant ⁻¹	Boll weight (g)
Days to 50% flowering	0.0086	0.0041	-0.0016	0.0017	0.0016	0.0007
Plant height (cm)	-0.0041	-0.0087	0.0004	-0.0029	-0.0001	-0.0015
Number of monopodia plant ⁻¹	0.0081	0.0019	-0.0426	-0.0215	0.0007	-0.0033
Number of sympodia plant ⁻¹	0.0044	0.0076	0.0113	0.0224	0.0012	0.0015
Number of bolls plant ⁻¹	0.0587	0.0028	-0.0053	0.0169	0.3108	0.0689
Boll weight (g)	0.0172	0.0351	0.0156	0.0132	0.0446	0.2013
Seed index(g)	-0.0015	-0.0017	0.0011	-0.0031	-0.0026	-0.0014
Lint index (g)	0.0010	0.0017	-0.0018	0.0023	0.0004	-0.0014
Ginning out turn (%)	0.0015	0.0053	-0.0068	-0.0172	-0.0215	-0.0218
2.5% span length (mm)	0.0014	0.0022	0.0002	0.0004	0.0002	0.0012
Micronaire (10 ⁻⁶ g / inch)	0.0008	0.0015	0.0001	0.0002	-0.0005	0.0006
Bundle strength (g / tex)	0.0047	0.0108	-0.0012	0.0012	0.0034	0.0046
Uniformity ratio (%)	-0.0001	-0.0003	-0.0021	-0.0030	0.0010	0.0005
Fibre elongation (%)	-0.0003	0.0027	-0.0097	-0.0117	0.0006	0.0015
Lintyield plant ⁻¹ (g)	0.1575	0.0815	-0.0607	0.0224	0.5316	0.3938
Seed cottonyield plant ⁻¹ (g)	0.2578**	0.1464*	-0.1032	0.0215	0.8716**	0.6452**

Table 4 Cont.....

Seed index (g)	Lint index (g)	Ginning out turn (%)	2.5% span length (mm)	Micronaire (10 ⁻⁶ g/ inch)	Bundle strength (g/tex)	Uniformity ratio	Fibre elongation (%)	Lintyield plant ⁻¹ (g)
-0.0013	-0.0008	-0.0002	0.0028	-0.0023	0.0019	-0.0001	-0.0001	0.0022
0.0015	0.0013	0.0006	-0.0045	0.0046	-0.0044	0.0006	-0.0011	-0.0012
-0.0047	-0.0068	-0.0040	-0.0024	0.0009	0.0024	0.0197	0.0200	0.0043
-0.0071	-0.0047	0.0053	0.0023	-0.0020	0.0013	-0.0149	-0.0127	0.0008
-0.0840	-0.0112	0.0918	0.0170	0.0516	0.0497	0.0657	0.0090	0.2730
-0.0284	0.0263	0.0603	0.0556	-0.0428	0.0437	0.0227	0.0145	0.1310
0.0097	0.0078	-0.0014	0.0006	-0.0001	-0.0019	0.0015	0.0004	-0.0029
-0.0088	-0.0111	-0.0031	-0.0008	0.0005	0.0026	-0.0005	-0.0007	0.0003
0.0103	-0.0205	-0.0726	0.0079	-0.0014	0.0052	-0.0005	0.0037	-0.0245
0.0003	0.0003	-0.0005	0.0043	-0.0021	0.0020	0.0010	0.0014	0.0009
0.0000	0.0001	-0.0001	0.0014	-0.0028	0.0020	0.0001	0.0008	0.0001
-0.0041	-0.0049	-0.0015	0.0096	-0.0151	0.0212	0.0046	0.0079	0.0060
0.0007	0.0002	0.0000	0.0011	-0.0002	0.0010	0.0046	0.0035	0.0013
0.0009	0.0013	-0.0011	0.0069	-0.0057	0.0077	0.0158	0.0206	0.0030
-0.1807	-0.0137	0.2042	0.1292	-0.0179	0.1724	0.1694	0.0889	0.6052
-0.2958**	-0.0363	0.2779**	0.2310**	-0.0348	0.3068**	0.2897**	0.1561*	0.9996**

* = Significant at 5% level **=Significant at 1% level, Bold & diagonal values indicate direct effects, Residual effect = SQRT (1-1.0010)

0.3108), boll weight (0.0290 and 0.2013), seed index (0.0675 and 0.0097) and number of sympodia plant⁻¹ (0.0106 and 0.0224) at phenotypic and genotypic levels, respectively. These results are in consonance with the reports of Srinivasulu *et al.* (2010). Lint index, ginning out-turn, micronaire and plant height exerted negative direct effect on seed cotton yield plant⁻¹. These results are in agreement with the findings of Venkateswarlu *et al.* (2010).

It was evident from the present study that simultaneous selection based on boll weight, 2.5% span length, bundle strength and uniformity ratio may be promising to breakthrough in seed cotton yield plant⁻¹ under inter-specific hybridization as they exerted high heritability with significant positive correlations as well as direct effect on the seed cotton yield.

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(Received on 24.05.2012 and revised on 25.02.2012)