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ORIGINAL ARTICLE

Genetic variability, Correlation and Path coefficient analysis in cotton (*Gossypium hirsutum* L.)

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ABSTRACT
Forty genotypes of cotton (Gossypium hirsutum L.) were evaluated for seed cotton yield, fibre quality and bio chemical triats. The high genotypic and phenotypic coefficient of variation were obtained for number of sympodia per plant, number of boll per plant, seed cotton yield per plant, gossypol content, phenol content and reducing sugar content. Correlation study revealed that seed cotton yield per plant exhibited positive and highly significant correlation with number of sympodia per plant, number of bolls per plant and oil percentage at genotypic and phenotypic levels. On the contrary, it expressed negative and highly significant genotypic and phenotypic association with days to 50% flowering. Besides this, fiber quality traits, gossypol content, phenol content, leaves protein content, seed protein content and reducing sugar content were not significantly correlated with seed cotton yield. The path analysis revealed that number of bolls per plant and boll weight had high direct effect on seed cotton yield per plant. On other hand seed cotton yield per plant was not much affected by other component traits, fibre quality and bio chemical traits.
Key words: Gossypium hirsutum. L, Variability, Correlation, Fibre quality, Bio chemical, Path coefficient analysis

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INTRODUCTION

Cotton is one of the most important commercial crop and popularly known as the "White Gold". Cotton belongs to genus Gossypium under tribe *Gossypieae* of *Malvaceae* family which comprises 50 species. Out of these, four species are under commercial cultivation *G. herbaceum* (2n=26), *G. arboreum* (2n=26), *G. hirsutum* (2n=52) and *G. barbandense* (2n=52). Cotton is a fiber, oil and protein yielding crop of global significance. Cotton is a multipurpose crop that supplies five basic products seed, lint, oil, hulls and linters [1].

Seed cotton yield itself being a complex character, is dependent on component traits. These trait show different type of association among themselves, knowledge of inter relationship between yields, its components trait is necessary for simultaneously improvement in this characters. Further the relative contribution i.e., both direct and indirect effects of these traits on yield and inter relations and linkage between them can be examined by path coefficient analysis [2].

MATERIALS AND METHODS

The present investigation carried out during 2016-17 at Main Cotton Research Station, Navsari Agricultural University, Surat. The material consisted of forty *Gossypium hirsutum* genotypes from Main Cotton Research Station, Navsari Agricultural University, Surat. The material was evaluated in the field in a randomized block design with three replications. The observations were recorded for seventeen characters viz., days to 50% flowering, number of sympodia per plant, number of bolls per plant, plant height (cm), boll weight (g), seed index (g), seed cotton yield per plant (g) , ginning percentage (%), 2.5% span length (mm), fibre strength (g/tex). fibre fineness (mv).

Biochemical parameters *viz.* oil percentage was measure using by Near Infrared Spectrometer, gossypol content was estimated by standard methods of sadasivam [3], phenol content was measured by standard method of Malick [4], Leaves protein content was analysed by standard methods of Lowry [5] and reducing sugar content was estimated by methods of sadasivam [6].
The data was statistically analysed to estimate genotypic and phenotypic correlation coefficients and path coefficient analysis.

RESULT AND DISCUSSION

The variability available in breeding material is the prime requirement for the improvement and selection of elite cotton genotypes. The phenotypic co- efficient of variation which measures total variation was found to be greater than genotypic coefficient of variation for all the characters indicating some degree of environmental influence on the traits (Table 1). High GCV% and PCV% was observed for number of sympodia per plant (27.98 and 30.41), number of boll per plant (32.46 and 35.03), seed cotton yield per plant (31.86 and 33.78), gossypol content (38.98 and 39.15), phenol content (49.56 and 50.08) and reducing sugar content (67.10 and 67.18). Moderate to low GCV% and PCV% was reported for for boll weight (15.35 and 16.75), seed index (17.19 and 17.76), leaf protein content (19.52 and 19.70), seed protein content (15.53 and 15.62), plant height (8.65 and 10.72), days to 50% flowering (7.17 and 7.95), ginning percentage (6.73 and 9.08), 2.5% span length (5.69 and 5.91), fibre strength (6.44 and 6.71), fibre fineness (9.00 and 9.75) and oil percentage (2.96 and 2.96). Similar finding was obtained researcher [7-8]
The high heritability associated with high genetic advance (% of mean) was observed for reducing sugar content (99.80% and 138.06%), gossypol content (99.10% and 79.95%), seed protein content (98.80% and 31.80%), leaves protein content (98.10 % and 39.84 %), phenol content (98.00% and 101.06%), seed index (93.70% and 34.28%), seed cotton yield per plant (89.00% and 61.9%), number of boll per plant (85.90% and 61.97%), fibre fineness (85.3% and 17.14%), number of sympodia per plant (84.7% and 53.03%) and boll weight (84.00% and 28.99%). This result indicated predominance of additive gene action indicating scope of selection for the improvement through these characters. This finding was in accordance with previous reports of Pujer [9].
The high heritability associated with moderate genetic advance (% of mean) was observed for 2.5% span length (92.80% and 11.30%), fibre strength (92.20% and 12.74%), days to 50% flowering (81.30% and 13.32%), plant height (65.50% and 14.46%) indicating predominance of both additive and non-additive gene action. Vinodhana and group reported that high heritability accompanied by low genetic advance for plant height, fibre length, and fibre strength and micronaire value. The medium heritability associated with moderate genetic advance (% of mean) was found for ginning percentage (55.00% and 10.29%) indicating both additive and non-additive gene action controlling this trait [7]. while high heritability along with low genetic advance (% of mean) was expressed by oil percentage (99.90% and 6.08%) indicates the effect of non additive gene action in which heterosis breeding may be rewarding for these traits. High heritability for oil percentage is being exhibited due to favourable influence of environment rather than genotype and selection for such traits may not be rewarding. This finding was line with Manimaran and Raveendran and Khan and group finding [9-10].
The character association studies (Table 2) revealed that number of sympodia per plants, number of bolls per plants and oil percentage had highly significant and positive association with seed cotton yield per plant. These findings are in conformity with earlier work done by group of researcher [7-8; 11]. Days to 50% flowering reported negative and highly significant correlation with boll per, phenol content and seed cotton yield per plant at both genotypic and phenotypic level. Similar finding observed by Scientist [8; 11] while Ashokkumar and Ravikesavan reported positive correlation between 50% flowering and seed cotton yield [12]. Boll weight had highly positive and significant association was seen with seed index and 2.5% span length, whereas negative and highly significant association was seen with ginning percentage at genotypic level. The 2.5% span length had positive and highly significant association with fibre strength, while 2.5% span length and fibre strength negatively correlated with fibre fineness. Similar finding was reported by researcher [7; 13]. The oil percentage possessed positive and highly significant correlation withgossypol content, seed protein and seed cotton yield per plant. The oil percentage had significantly negative correlation observed with seed cotton yield by Mishra and Satpude [14]. The Gossypol conetent showed negative and significant correlation with reducing sugar. There is no significant correlation was observed between leaves protein content, seed protein content and reducing sugar.
The path analysis (Table 3) indicated that number of bolls per plant, boll weight had high direct effect on seed cotton yield per plant. The sympodia per plant showed positive indirect effects on seed cotton yield

per plant through a number of boll per plant, plant height, boll weight, seed index, 2.5% span length, fibre strength, fibre fineness, oil percentage, gossypol, seed protein content. Thus, significant correlation of sympodia per plant with seed cotton yield is due other positive indirect effect. Hence, selection based on this trait may be fruitful. Thiyagu and Dahiphale groups reported similar findings [13; 15]. Boll per plant depicted pronounced positive indirect effects on seed cotton yield per plant through sympodia per plant, plant height, oil percentage, leaves protein content, phenol content and reducing sugar content. Hence direct selection may be effective through these component traits. This result is lined with earlier workers [8; 12]. The direct effect of fibre fineness was negligible positive on seed cotton yield, but the correlation was negative. So that there was no association between fibre fineness and seed cotton yield per plant. Result was same as previous report of Ashokkumar and co-workers and Thiyagu and co-workers [12-13]. The direct effect of oil percentage was positive and correlation was also significantly positive with seed cotton yield. It reveals the true relationship between them and direct selection of oil percentage will be rewarding for seed cotton yield improvement. Positive inter correlations between seed cotton yield and seed oil content is a welcome feature for combined improvement of yield and seed oil content. Ashokkumar and Ravikesavan observed, contrary finding [12].

CONCLUSION

Correlation and Path coefficient studies disclosed that number of sympodia per plant, number of ball per plant, ball weight and oil percentage are the most important component traits for improving seed cotton yield in cotton (*Gossypium hirsutum* L.). The association between fibre fineness with 2.5% span length and fibre strength was negative. The bio chemical parameter not affect seed cotton yield significantly.

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

S. No.	Character	σ^2g	σ^2p	σ^2e	Coefficient of Variation		Heritability (%) Broad Sense	Genetic Advance (% mean)
					GCV (%)	PCV (%)		
1	Days to 50% flowering	16.50	20.30	3.79	7.17	7.95	81.30	13.32
2	No. of sympodia per plant	18.50	21.85	3.35	27.98	30.41	84.70	53.03
3	No. of bolls per plant	59.68	69.50	9.81	32.46	35.03	85.90	61.97
4	Plant height (cm)	158.25	241.74	83.48	8.65	10.72	65.50	14.46
5	Boll weight (g)	0.31	0.37	0.06	15.35	16.75	84.00	28.99
6	Seed index (g)	1.98	2.11	0.13	17.19	17.76	93.70	34.28
7	Seed cotton yield per plant (g)	739.66	831.44	91.77	31.86	33.78	89.00	61.90
8	Ginning percentage (%)	5.18	9.43	4.24	6.73	9.08	55.00	10.29
9	2.5% span length (mm)	2.31	2.49	0.18	5.69	5.91	92.80	11.30
10	Fibre strength (g/tex)	2.74	2.97	0.23	6.44	6.71	92.20	12.74
11	Fibre fineness (mv)	0.15	0.17	0.02	9.00	9.75	85.30	17.14
12	Oil percentage (%)	0.26	0.26	0.00	2.96	2.96	99.90	6.08
13	Gossypol content (%)	0.01	0.01	0.00	38.98	39.15	99.10	79.95
14	Phenol content (%)	0.65	0.66	0.01	49.56	50.08	98.00	101.06
15	Leaves protein content (%)	7.10	7.23	0.13	19.52	19.70	98.10	39.84
16	Seed protein content (%)	7.86	7.96	0.09	15.53	15.62	98.80	31.80
17	Reducing sugar content (%)	8.01	8.03	0.01	67.10	67.18	99.80	138.06

Where, σ2g, σ2p and σ2e are the genotypic, phenotypic and environmental variance, respectively.
GCV% and PCV% are genotypic and phenotypic coefficient of variation, respectively.

Table 2: Genotypic (rg) and phenotypic (rp) correlation coefficients of sixteen character in cotton

Character	SP/P		BP/P		PH		BW		SI		GP	
C	rg	rp	rg	rp	rg	rp	rg	rp	rg	rp	rg	rp
50% F	-0.1212	-0.0769	-0.3551**	-0.2921**	0.1583	0.0954	0.0656	0.0486	-0.1110	-0.0893	-0.1730	-0.1621
SP/P			0.0598	0.0498	0.1479	0.0711	0.2804**	0.2257*	0.4158**	0.3653**	-0.1763	-0.0967
BP/P					0.0859	0.0494	-0.2799**	-0.3227**	-0.1827*	-0.1667	0.3140**	0.1833*
PH							0.0158	0.0494	0.2545**	0.1925*	-0.0681	-0.0937
BW									0.2784**	0.2586**	-0.3226**	-0.2180*
SI											-0.5252**	-0.3659**
GP												
SL												
FS												
FF												
Oil												
Gos												
Phenol												
LP												
SP												
RS												

LP	Phenol		Gos		Oil		FF		FS		SL	
rg	rp	rg	rp	rg	rp	rg	rp	rg	rp	rg	rp	rg
-0.1001	-0.2015*	-0.2244**	0.0360	0.0409	-0.1451	-0.1563	0.1415	0.1661	0.0738	0.0736	-0.0367	-0.0268
-0.1308	-0.0830	-0.0915	0.1295	0.1458	0.2418**	0.2629**	0.2680**	0.3024**	0.0394	0.0537	0.0920	0.1091
0.1445	0.0103	0.0120	-0.1026	-0.110	0.2399**	0.2586**	-0.0722	-0.1120	0.0026	-0.0023	-0.0058	-0.0121
0.0851	0.0039	0.0053	-0.1282	-0.1560	0.1477	0.1809*	0.0060	0.0389	0.0516	0.0860	0.0344	0.0300
-0.1324	-0.3202**	-0.3460**	-0.0258	-0.0329	0.0679	0.0741	0.0217	0.0506	0.0014	-0.0120	0.3003**	0.3352**
-0.1553	-0.3514**	-0.3665**	0.4763**	0.4885**	0.4166**	0.4298**	0.1719	0.1665	0.2037*	0.2280*	-0.0864	-0.0906
0.2312	0.0955	0.1262	-0.3093**	-0.3961**	-0.2622**	-0.3564**	0.0968	0.1507	-0.3968**	-0.5411**	-0.2519**	-0.3822**
-0.0075	0.1933*	0.2104*	0.3453**	-0.3594**	0.1013	0.1061	-0.1610	-0.1883*	0.4327**	0.4729**		
-0.0004	0.0972	0.0929	0.0715	0.0772	0.1365	0.1420	-0.2255*	-0.2426**				
-0.1879*	-0.2115*	-0.2304*	0.0068	0.0040	0.2460**	0.2683**						
-0.2369**	-0.2119**	-0.2144*	0.3852**	0.3867**								
-0.1193	-0.3819**	-0.3884**										
0.1196												

	SCY		RS		SP			
	rp	rg	rp	rg	rp	rg	rp	
SCY		-0.3218**	-0.0036	-0.0046	0.2153*	0.2420**	-0.0914	
	-0.2723**		-0.2262**	-0.2494**	0.1297	0.1435	-0.1259	
	0.1741	0.2068**						
RS	0.8893**	0.9066**	0.0785	0.0887	-0.0756	-0.0788	0.1325	
	0.1063	0.1366	0.1147	0.1481	-0.0809	-0.0927	0.0644	
	0.1090	0.1288	-0.3297**	-0.3623**	0.1498	0.1591	-0.1257	
	-0.0210	-0.0289	-0.3473**	-0.3556**	0.1559	0.1617	-0.1463	
	0.0859	0.1568	0.2028*	0.2722**	-0.1663	-0.2318*	0.1553	
	0.1003	0.0996	-0.0312	-0.0315	-0.0380	-0.0406	-0.0090	
	0.0301	0.0203	-0.0947	-0.0967	-0.0264	-0.0207	-0.0002	
	-0.0466	-0.0655	-0.0116	-0.0100	0.3032**	0.3270**	-0.1686	
	0.3053**	0.3234**	0.0021	0.0019	0.3215**	0.3236**	-0.2349**	
	-0.1067	-0.1138	-0.2219*	-0.2226*	0.4399**	0.4440*	-0.1194	
	-0.1329	-0.1377	0.6062**	0.6132**	-0.3315**	-0.3373**	0.1170	
	0.0596	0.0637	-0.1016	-0.1033	-0.1717	-0.1736		
	-0.0237	-0.0271	-0.1022	-0.1029				
	-0.0686	-0.0694						

*,** Significant at P=0.05 level and P=0.01 level

Where, 50% DF= Days to 50% flowering, SP/P= Number of sympodia per plant, BP/P= Number of bolls per plant, PH= Plant height, BW=Boll weight, SI= Seed index, GP= Ginning percentage, SL= 2.5% span length, FS= Fibre strength, FF= Fibre fineness, Gos= Gossypol content, SP= Seed protein content, LP= Leaves protein content, RS= Reducing sugar, SCY= Seed cotton yield per plant

Table 3: Path coefficient analysis showing direct and indirect effects of sixteen characters on seed cotton yield per plant of cotton

Characters	50% F	SP/P	BP/P	PH	BW	SI	GP	SL	FS	FF	Oil	Gos	Phenol	LP	SP	RS
50% F	**0.0096**	-0.0012	-0.0034	0.0015	0.0006	-0.0011	-0.0017	-0.0003	0.0007	0.0016	-0.0015	0.0004	-0.0022	-0.0010	0.0023	0.0000
SP/P	-0.0009	**0.0073**	0.0004	0.0011	0.0020	0.0030	-0.0013	0.0008	0.0004	0.0022	0.0019	0.0011	-0.0007	-0.0010	0.0010	-0.0018
BP/P	-0.3693	0.0622	**1.0401**	0.0894	-0.2911	-0.1900	0.3266	-0.0126	-0.0024	-0.1165	0.2690	-0.1154	0.0125	0.1503	-0.0820	0.0923

PH	BW	SI	GP	SL	FS	FF	Oil	Gos	Phenol	SP	LP	RS	Correlation with SCY
0.0052	-0.1557	0.0047	-0.0106	0.0025	-0.0043	-0.0004	0.0000	0.0019	0.0200	0.0028	0.0034	**-0.0276**	**-0.0694**
-0.0032	0.0692	-0.0021	0.0090	0.0032	-0.0009	0.0121	0.0045	-0.0037	-0.0110	0.0047	**-0.0330**	0.0028	**-0.0271**
0.0030	-0.0576	0.0021	-0.0090	0.0006	0.0000	-0.0070	-0.0030	0.0010	0.0039	**-0.0268**	0.0057	0.0028	**0.0637**
0.0002	-0.1504	0.0049	-0.0049	-0.0166	0.0041	-0.0086	-0.0030	0.0033	**0.0327**	-0.0032	0.0111	-0.0169	**-0.1377**
-0.0054	-0.0143	-0.0065	0.0154	0.0284	0.0034	0.0001	0.0054	**-0.0084**	-0.0127	0.0032	-0.0147	0.0061	**-0.1138**
0.0063	0.0322	-0.0057	0.0139	-0.0084	0.0063	0.0100	**0.0140**	-0.0032	-0.0070	0.0064	-0.0170	-0.0001	**0.3234****
0.0014	0.0220	-0.0020	-0.0059	0.0149	-0.0108	**0.0371**	0.0038	0.0000	-0.0075	0.0050	-0.0108	0.0003	**-0.0655**
0.0030	-0.0052	-0.0030	0.0211	-0.0373	**0.0444**	-0.0090	0.0020	-0.0006	0.0030	0.0000	0.0007	0.0027	**0.0203**
0.0010	0.1457	0.0012	0.0149	**-0.0790**	0.0210	-0.0070	0.0015	0.0030	0.0069	0.0002	0.0013	0.0009	**0.0996**
-0.0024	-0.1407	0.0070	**-0.0389**	0.0302	-0.0240	0.0056	-0.0050	0.0033	0.0041	-0.0062	0.0077	-0.0075	**0.1568**
0.0089	0.1210	**-0.0132**	0.0204	0.0072	0.0101	0.0062	0.0060	-0.0041	-0.0120	0.0042	-0.0053	0.0098	**-0.0289**
0.0006	**0.4347**	-0.0037	0.0126	-0.0265	-0.0005	0.0019	0.0010	0.0003	-0.0113	0.0036	-0.0053	0.0100	**0.1288**
0.0349	0.0069	-0.0034	0.0026	-0.0024	0.0038	0.0014	0.0025	0.0013	0.0002	-0.0023	0.0031	-0.0041	**0.1366**
0.0030	-0.1216	0.0024	-0.0122	0.0010	-0.0001	-0.0042	0.0036	0.0009	0.0004	-0.0039	0.0026	-0.0024	**0.9066****
0.0052	0.1219	-0.0055	0.0069	-0.0086	0.0024	0.0112	0.0037	-0.0012	-0.0030	0.0035	-0.0047	0.0069	**0.2068****
0.0055	0.0285	0.0015	0.0067	0.0021	0.0033	0.0062	-0.0022	-0.0003	-0.0073	0.0027	-0.0080	0.0001	**-0.3218****

Residual effect= 0.1040
*,** Significant at P=0.05 level and P=0.01 level
50% DF= Days to 50% flowering, SP/P= Number of sympodia per plant, BP/P= Number of boll per plant, PH= Plant height, BW=Boll weight, SI= Seed index, GP= Ginning percentage, SL=

2.5% span length, FS= Fibre strength, FF= Fibre fineness, Gos= Gossypol content, SP= Seed protein content, LP= Leaves protein content, RS= Reducing sugar, SCY= Seed cotton yield per plant

REFERENCES

1. Annual Report (2016-17), All India Coordinated Research Project on cotton.
2. Wright, S. (1921). Correlation and Causation. J. Agric. Res., 20: 557-585.
3. Sadasivam, S. & Manickam, A. (1992). In: Biochemical Methods for Agriculture Science, Wiley Eastern Ltd, New Delhi, pp. 201-202.
4. Malick, C. P. & Singh, M. B. (1980). In: Plant Enzymology and Histo- enzymology, Kalyani Publication, New delhi, p.286.
5. Lowry , O. H., Rosebrough, N. J., Farr, A. L. & Randall, R. J. (1951). Protein measurement with the folin phenol reagent. J. Biol. Chem., 193(1), 265-267.
6. Sadasivam, S. & Manickam, A. (1992). In: Biochemical Methods for Agriculture Science, Wiley Eastern Ltd, New Delhi, pp. 5-6.
7. Vinodhana, N., Gunasekaran, M. & Vindhiyavarman, P. (2011). Genetic Studies of Variability, Correlation and Path Coefficient analysis in Cotton genotypes. Int. J. Pure App. Biosci., 1(5): 6-10.
8. Pujer, S., Siwach, S. S., Deshmukh, J., Sangwan, R. S. & Sangwan, O. (2014). Genetic variability, correlation and path analysis in upland cotton *(Gossypium hirsutum L.)*. Electronic Journal of Plant Breeding, 5(2): 284-289.
9. Manimaran, R. & Raveendran, T. S. (2004). Estimation of genetic parameters in cotton genotypes. Agric. Sci. Digest, 24 (3): 209-211.
10. Khan B. M., Khan, N. U. and Khan, I. (2010). Genetic variability and heritability in upland cotton, Pak. J. Bot., 41(4): 1695-1705.
11. Farooq, J., Anwar, M., Riaz, M., Farooq, A., Mahmood, A,, Shahid, M. T. H., Rafiq M. S. & Ilahi F. (2014). Correlation and path coefficient analysis of earliness, fiber quality and yield contributing traits in cotton *(Gossypium hirsutum* L.*)*. The J. Animal & Plant Sci., 24(3): 781-790.
12. Ashokkumar, K. & Ravikesavan, R. (2011). Morphological Diversity and *per se* Performance in Upland Cotton *(Gossypium hirsutum* L.). J. Agril. Sci., 3(2): 107-113.
13. Thiyagu, K., Nadarajan, N., Rajarathinam, S., Sudhakar D. & Rajendran, K. (2010). Association and Path analysis for seed cotton yield improvement in interspecific crosses of Cotton *(Gossypium spp*). Electronic J. Plant Breed., 1(4): 1001-1005.
14. Mishra, U. S. and Satpute, G. K. (2007). Quantitative improvement of seed-oil through desired traits association in rainfed cotton *(Gossypium arboreum L.),* J. Cotton Res. Dev., 21(1): 1-5.
15. Dahiphale, K. D., Deshmukh, J. D., Jadhav, A. B. & Bagade, A. B. (2015). Genetic variability, correlation and path coefficient analysis for yield and its attributing traits in Cotton *(Gossypium hirsutum L.)*. Inter. J. Tropical Agril., 33(1): 15-22.