Electronic Journal of Plant Breeding, 5(2): 284-289 (June 2014)
ISSN 0975-928X

Research Note

Genetic variability, correlation and path analysis in upland cotton (*Gossypium hirsutum* L.)

Santoshkumar Pujer*, S.S. Siwach, Jagadeesh Deshmukh, R.S. Sangwan and O. Sangwan

Department of Genetics and Plant Breeding,
CCS Haryana Agricultural University, Hisar- 125 004, India.
*Email: pujer_851@rediffmail.com

(Received: 04 Apr 2014; Accepted:25 Apr 2014)

Abstract
Sixty eight diverse genotypes of American cotton *Gossypium hirsutum* L. were evaluated for 13 quantitative and fibre quality traits. The variability studies indicated that high PCV and GCV was observed in case of seed cotton yield/ plant and number of bolls/plant while moderate PCV and GCV was observed in case of days to first flower, plant height and boll weight. Seed cotton yield /plant, days to first flower, plant height, number of bolls/plant and boll weight shows high heritability with high genetic advance over mean. The correlation study revealed that seed cotton yield was found to be positively and significantly correlated with traits like days to first flower, plant height, number of monopodial branches, number of bolls/plant, seed index, lint index, ginning out turn, and uniformity ratio, whereas it had negative association with boll weight, 2.5% span length, fibre fineness, and bundle strength. Path analysis revealed that days to first flower, number of monopodial branches, number of bolls/plant, boll weight, seed index, lint index, ginning out turn and uniformity ratio showed positive direct effect on seed cotton yield. Hence selection for these traits would be quite effective to improve the seed cotton yield in upland cotton.

Key words: *Gossypium hirsutum*. L, Variability, Correlation, Fibre quality, path coefficient analysis.

Cotton is one of the most important commercial crops and popularly known as the "White Gold". Cotton is the most precious gift of nature to the mankind, contributed by the genus "*Gossypium*" to clothe the people all over the world. India has been the traditional home of cotton and cotton textiles. The cotton seed coat extends into tubular fibre which is spun into yarn. Four out of the 50 recognized cotton species in the world are cultivated. In India, all the four cultivated cotton species *viz*., *Gossypium arboreum*, *G. herbaceum*, *G. hirsutum* and *G. barbadense* are grown on a commercial scale. India is the only country where all the cultivated species and some of their hybrid combinations are commercially grown. Germplasm, which is a prerequisite for any breeding programme, serves as a valuable source material as it provides scope for building of genetic variability. Study of variability, heritability and genetic advance in the germplasm will help to ascertain the real potential value of the genotype. Further, efficiency of selection in any breeding programme mainly depends upon the knowledge of association of the characters. Phenotypic correlation indicates the extent of the observation having relation between two characters while genotypic correlation provides an estimate of inherent association between the genes controlling any two characters. The cause negative effect of the trait is very essential for formulating selection indices for genetic improvement of yield and can be done by path analysis (Sambamurthy *et al.*, 1995; Amudha *et al.*, 1996; Sambamurthy and Rao, 1998; Rao, *et al.*, 2001; Kaushik, *et al.*, 2003; Gururajan and Sunder, 2004; Gite *et al.*, 2006). Hence this present study was planned to assess the variability, correlation and path analysis for various yield and fibre quality characters in a set of genotypes.

Sixty eight diverse genotypes American cotton were grown at Cotton Section, Department of Genetics & Plant Breeding, CCS HAU, Hisar and CCS Haryana Agricultural University, Cotton Research Station, Sirsa during *kharif*, 2011-2012 and 2012-2013 in randomized block design with

three replications having row length 4.2 m with row-to-row 67.5 cm and plant-to-plant 30 cm. The observations were recorded on five competitive plants for thirteen characters, *viz*, days to first flowering, plant height (cm), number of monopods per plant, number of bolls per plant, boll weight (g), seed index (g), lint index (g), ginning out turn (%), 2.5% span length (mm), fibre fineness (micronaire value), bundle strength (g/tex), uniformity ratio (%) and seed cotton yield per plant (g). The lint quality parameters were analyzed in Central Institute for Research on Cotton Technology (CIRCOT), Regional Research Station, Sirsa through High Volume Instrument. Genotypic and phenotypic coefficient of variation was calculated using the method suggested by Burton and Devane (1953). Heritability in broad sense was calculated by the method of Hanson *et al*. (1956) and genetic advance was categorized based on reports of Johanson *et al*. (1955). The analysis of correlation coefficient and path analysis were carried out as suggested by Pearson **(**1902) and Wright (1921) respectively.

The analysis of variance revealed significant differences among the materials for all the 10 characters under study. Estimates of genetic variability (Table 1) revealed that the GCV and PCV were comparatively high for seed cotton yield/plant (20.42 and 21.08%) and number of bolls/plant (32.08 and 32.46%). Moderate values for GCV and PCV were observed for days to first flower (17.85 and 18.58%), plant height (10.59 and 11.01%) and boll weight (10.71 and 10.84%). Low GCV and PCV ratio in number of monopods per plant (8.21 and 8.66%), seed index (5.10 and 5.39%), lint index (8.75 and 9.12%), ginning percentage (6.00 and 6.01), 2.5% span length (5.08 and 5.13%), fibre fineness (6.30 and 6.46%) bundle strength (7.08 and 7.10%) and uniformity ratio (4.52 and 4.89%) indicated that characters were highly influenced by environmental factors. 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. Selection for improvement of such traits may sometimes be misleading. This result was also supported by Krishna Doss and Kadambavanasundaram (1993). High heritability value was recorded for all the characters which indicated that selection was effective in these characters. These findings are in accordance with previous reports Joshi *et al.*, (2006), Patnaik and Sial (2010). A high estimate of heritability coupled with high genetic advance as per cent mean recorded for seed cotton yield/plant (93.50 and 38.67%), days to first flower(92.30 and 35.35%), plant height (92.40 and 20.97%), number of bolls/plant (97.70 and 65.33%) and boll weight (97.60 and 21.80%) revealed the influence of additive gene action for these traits. Hence the improvement of these traits can be made through direct phenotypic selection. Heritability estimates along with genetic advance would be more useful in predicting yield under phenotypic selection than heritability estimates alone as suggested by Johanson *et al.* (1955). The traits such as seed index (89.60 and 9.95%) and uniformity ratio (85.40 and 8.61%) in which high heritability accompanied by low genetic advance was recorded indicates the effect of non additive gene action and hence heterosis breeding may be rewarding for these traits.

The genotypic and phenotypic correlation co-efficient between yield and yield components are presented in Table 2. Seed cotton yield was significantly and positively correlated with days to first flower, plant height, number of monopodial branches, number of bolls per plant, seed index, lint index, ginning out turn and uniformity ratio. It indicated that increase in one trait will cause increase in the other. Such positive association of seed cotton yield per plant with these traits was also observed by Masande *et al*. (1981), Alam and Islam (1991) and Yadav *et al.* (2000). However seed cotton yield had significant and negative association with 2.5% span length and fibre fineness. Boll weight and bundle strength showed non significant correlation with seed cotton yield per plant. Among the yield attributes plant height had positive significant correlation with boll weight, seed index and lint index. Number of bolls per plant had positive significant correlation with boll weight. Boll weight had positive significant association with lint index, ginning out tern and bundle strength. Lint index, 2.5% span length and fibre fineness had significant positive association with seed index both at genotypic and phenotypic level. Fibre fineness had positive association with uniformity ratio. Ginning out turn had positive correlation with bundle strength. In the present study, genotypic correlation coefficient is higher than phenotypic correlation co efficient, which revealed that there was strong association between these two characters genetically but the phenotypic value is lessened by the significant interaction of environment.

The genotypic correlation coefficients of seed cotton yield with other yield and fibre quality traits was further partitioned into direct and indirect effects and the results are presented in Table 3. The component of residual effect of path analysis in yield and fibre quality traits was 0.105. Path coefficient analysis revealed that days to first flower, number of monopods per plants, number of bolls/plant, boll weight, seed index, lint index, ginning out turn and uniformity ratio exerted high and positive direct effect on seed cotton yield. Similar findings were also reported by Joshi *et al*. (2006) and Sakthi *et al.* (2007). Indirect effects of plant height influenced the seed cotton yield

through lint index, boll weight, ginning out turn, bundle strength, number of bolls/plant, number of monopods per plant and seed index. The indirect effect of uniformity ratio was positive through fibre fineness, number of monopods per plant and days to first flower. Fibre fineness influenced the seed cotton yield indirectly through number of bolls/plant, boll weight and lint index. 2.5% span length and bundle strength influenced the seed cotton yield positively through days to first flower. The result of this study indicated that seed index, days to first flower, number of monopods per plant, lint index, number of bolls per plant, ginning out tern, boll weight and uniformity ratio played a major role in seed cotton yield improvement of cotton. Similar findings were also reported by Kumari Vinodhana *et al.* (2013). The character should be considered as significant selection criteria for seed cotton improvement in cotton.

The results discussed above indicate that high PCV and GCV was observed in case of seed cotton yield per plant and number of bolls per plant. Seed cotton yield per plant, days to first flower, plant height, number of bolls per plant and boll weight shows high heritability with high genetic advance over mean. Correlation and direct and indirect effect estimates vary for different traits with variation in genetic material based on seed cotton yield/plant and fibre properties. Hence, correlations and direct and indirect effect estimation would provide useful information for planning a successful breeding programme.

Reference:

Alam, A.K. M. R. and Islam, H. 1991. Correlation and path analysis of yield and yield attributing characters in upland cotton (*Gossypium hirsutim*.L). *Ann. Bangladesh Agric***., 1**:87-90.

Amudha, K., Raveenderan, T.S. and Krishadas, D. 1996. Path analysis in coloured linted cotton varieties. *Madras Agric. J*., **83**: 693-696.

Burton, G. W. and DeVane, E. W. 1953. Estimating heritability in tall fescue (*Feetuca circuhinoceae*) from replicated clonal material. *Agron. J.*, **45**: 478-481.

Gite, V.K., Misal, M.B. and Kalpande. H.V. 2006. Correlation and path analysis in cotton (*Gossypium hirsutum* L.). *J. Cotton Res. Dev*., **20**: 51-54.

Gururajan, K.N. and Sunder. S. 2004. Yield component analysis in American cotton (*Gossypium barbadense* L.). In: International Symposium on Strategies for Sustainable Cotton Production–A Global Vision. Crop Improvement, *J. Indian Soc. Cotton Improv.*, **25**: 17-22. 3-25 Nov., University of Agricultural Sciences, Dharwad, Karnataka (India). pp-201-204.

Hanson, C. H., Robinson, H. F. and Comstock, R. E., 1956. Biometrical studies of yield and segregating populations of Korean lespedza. *Agron. J.*, **47** : 313-318.

Johanson H.W., Robinson H.F., and Comstock R.E., 1955. Estimates of genetic and environmental variability in soybean. *Agron. J.*, 47*:* 314 – 318

Joshi H.J., Chovatia P.K., and Metha D.R., 2006. Genetic variability, character association and component analysis in upland cotton. *Indian J. Agric. Res.*, 40*:* 302 – 305

Kaushik, S.K., Kapoor, C.J. and Koli, N.R. 2003. Association and path analysis in American cotton (Gossypium hirsutum L.). *J. Cotton. Res. Dev*., **17**: 24-26.

Krishna Doss, D. and Kadambavanasundaram, M. 1993. Genetic variability, heritability and genetic advance in tetraploid species of cotton. *Indian J. Genet.*, **53**: 55-59

Kumari Vinodhana, N., Gunasekaran, M. and Vindhiyavarman, P. 2013. Genetic Studies of Variability, Correlation and Path Coefficient analysis in Cotton genotypes. *Int. J. Pure App. Biosci.*, **1** (5): 6-10

Masande, V.G., Chavan, B. N., Sondge, V. D. and Borulkar, D. N. 1981. Simple correlation and regression studies between seed cotton yield and yield attribution characters in cotton. *J. Maharashtra agric Univ*. **6**:163-65.

Patnaik, R.K, and Sial, P. 2010. Genetic variability, character association and component analysis in upland cotton (*Gossypium hirsutum* L.) under rainfed condition. *J. Cotton Res. Dev.*, **24***:* 155-159

Pearson, K. 1902. Tables for statisticians and biometricians**.** *Statistical J. **b**iometrics, Pp*.335-345

Rao, G.N., Reddy, M.S.S. and Shanthi, P. 2001. Correlation and path analysis of seed cotton yield and its components in cotton. *J. Cotton Res. Dev.*, **15**: 81-83.

Sakthi, A.R., Kumar, M. and Ravikesavan, R. 2007. Variability and association analysis using morphological and quality traits in cotton (*Gossypium hirsutum* L.). *J. Cotton Res. Dev*., **21**: 148–152.

Sambamurthy, J.S.V. and Rao, B. R. 1998**.** Genetic variability and association analysis in parents and hybrids of American cotton. *J. Cotton Res. Dev.*, **12**: 236-241.

Sambamurthy, J.S.V., Reddy, D.M. and Reddy, K.H.G. 1995**.** Genetic variability, correlation and path analysis in cotton. *J. Indian Soc. Cotton Improv*., **20**: 133-137.

Wright, S. 1921. Correlation and causation. *J. Agric. Res*., **20**: 257-287

Yadav, O. P., Lather, B. P. S. and Dahiya, B. N. 2000. Studies on variability, correlation and path analysis in desi cotton (*Gossypium arboreum* .L). *J. Cotton Res. Dev*., **14**: 143-46.

Table 1. Genetic component of variance for seed cotton yield and important yield components

Characters	GCV (%)	PCV (%)	h^2 (%)	GAM (%)
Seed Yield per plant (g)	20.42	21.08	93.50	38.67
Days to first flower	17.85	18.58	92.30	35.34
Plant Height (cm)	10.59	11.01	92.40	20.97
Number of monopods per plant	8.21	8.66	89.80	16.02
Number of bolls per plant	32.08	32.46	97.70	65.33
Boll weight (g)	10.71	10.84	97.60	21.80
Seed index (g)	5.10	5.39	89.60	9.95
Lint index (g)	8.75	9.12	92.20	17.32
Ginning out tern (%)	6.00	6.01	99.50	12.33
2.5% span length (mm)	5.08	5.13	98.20	10.38
Fibre fineness (micronaire value)	6.30	6.46	95.10	12.66
Bundle strength (g/tex)	7.08	7.10	99.40	14.54
Uniformity ratio (%)	4.52	4.89	85.40	8.61

Table 2. Genotypic (G) and Phenotypic (P) correlation of Seed cotton yield and important yield components

Characters		Plant Height (cm)	Number monopods/ plant	Number bolls/plant	Boll weight (g)	Seed index (g)	Lint index (g)	Ginning out tern (%)	2.5% span length (mm)	Fibre fineness (micronaire value),	Bundle strength (g/tex)	Uniformity ratio (%)	Seed cotton Yield/ plant
	G	-0.163	0.203	0.070	-0.075	-0.271*	-0.318**	-0.054	-0.164	0.155	-0.271*	0.345**	0.371**
Days to first flower	P	-0.181	0.195	0.074	-0.070	-0.261*	-0.304**	0.051	-0.150	0.149	-0.256*	0.309**	0.320**
	G		0.114	0.087	0.366**	0.230*	0.614*	0.188	-0.030	-0.213	0.149	-0.118	0.293**
Plant Height (cm)	P		0.107	0.072	0.350**	0.216*	0.574*	0.180	-0.029	-0.198	0.134	-0.119	0.284**
Number of monopods	G			-0.267*	-0.302**	0.527**	0.100	-0.031	0.229*	0.197	0.160	0.406**	0.515**
/plant	P			-0.257*	-0.283**	0.473**	0.095	-0.030	0.212*	0.200	0.156	0.338**	0.478**
Number of bolls per	G				0.319**	-0.267*	0.158	0.006	-0.185	-0.303**	0.187	-0.275*	0.767**
plant	P				0.311**	-0.251*	0.147	0.006	-0.179	-0.297**	0.1863	-0.243*	0.750**
	G					-0.544**	0.676**	0.451**	-0.184	-0.462**	0.297**	-0.383**	-0.162
Boll weight (g)	P					-0.530**	0.652**	0.445**	-0.176	-0.448**	0.292**	-0.355**	-0.135
	G						0.247**	-0.338**	0.374**	0.283**	-0.180	0.195	0.906**
Seed index (g)	P						0.294**	-0.317**	0.353**	0.266**	-0.171	0.186	0.876**
	G							0.198	0.106	-0.291**	0.183	-0.262*	0.896**
Lint index (g)	P							0.192	0.109	-0.270**	0.174	-0.231*	0.865**
	G								-0.260*	-0.155	0.495**	-0.306*	0.370**
Ginning out tern (%)	P								-0.256*	0.152	0.494**	-0.283*	0.348**
2.5% span length	G									-0.060	0.140	0.007	-0.103**
(mm)	P									-0.069	0.138	0.004	-0.086**
Fibre fineness	G										-0.272*	0.901**	-0.276**
(micronaire value)	P										-0.261*	0.806**	-0.252**
Bundle strength	G											-0.187	-0.029
(g/tex)	P											-0.171	-0.018
	G												0.491**
Uniformity ratio (%)	p												0.451**

*,** significant at 5 and 1 % respectively

Table 3. Direct (diagonal) and Indirect (off diagonal) of important yield components and fibre quality traits at genotypic level

Characters	Days to first flower	Plant Height (cm)	Number monopods/ plant	Number bolls/ plant	Boll weight (g)	Seed index (g)	Lint index (g)	Ginning out tern (%)	2.5% span length (mm)	Fibre fineness (micronaire value),	Bundle strength (g/tex)	Uniformity ratio (%)	Seed Yield/ plant (g)
Days to first flower	**0.811**	-0.132	0.165	0.057	-0.061	-0.221	-0.258	-0.044	-0.133	0.126	-0.220	0.281	0.371**
Plant Height (cm)	-0.068	**-0.221**	0.048	0.034	0.154	0.097	0.259	0.079	-0.012	-0.090	0.063	-0.05	0.293**
Number of monopods/ plant	-0.004	-0.003	**0.521**	0.006	0.028	-0.011	-0.002	0.001	-0.005	-0.004	-0.003	-0.009	0.515**
Number of bolls/ plant	-0.002	-0.002	0.108	**0.390**	-0.009	0.108	-0.005	0.100	0.005	0.071	-0.005	0.008	0.767**
Boll weight (g)	0.137	-0.670	0.552	-0.584	**0.230**	0.597	-0.238	-0.827	0.337	0.547	-0.545	0.302	-0.162
Seed index (g)	0.330	-0.280	-0.342	0.325	0.364	**1.218**	-0.301	0.211	-0.256	-0.345	0.219	-0.237	0.906**
Lint index (g)	-0.448	0.267	0.142	0.223	0.255	0.149	**0.412**	0.280	0.150	-0.412	0.249	-0.371	0.896**
Ginning out tern (%)	-0.016	0.058	-0.010	0.002	0.140	-0.104	0.061	**0.309**	-0.08	-0.048	0.153	-0.095	0.370**
2.5% span length (mm)	0.017	0.003	-0.024	0.020	0.020	-0.040	-0.011	0.028	**-0.106**	0.006	-0.015	-0.001	-0.103**
Fibre fineness	-0.055	0.076	-0.070	0.108	0.165	-0.101	0.104	0.055	0.021	**-0.356**	0.097	-0.320	-0.276**
Bundle strength (g/tex)	0.004	-0.003	-0.003	-0.003	-0.005	0.003	-0.003	-0.008	-0.002	0.005	**-0.017**	0.003	-0.029
Uniformity ratio (%)	0.128	-0.044	0.151	-0.102	-0.143	0.073	-0.098	-0.114	0.003	0.335	-0.070	**0.372**	0.491

Residual effect: 0.105

*,** significant at 5 and 1% respectively