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Character association and path coefficient analysis for yield and component traits in upland cotton

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ABSTRACT: Correlation and path coefficient analysis have been worked out for 15 characters in 40 genotypes of upland cotton. Correlation studies indicated that plant height, sympodia and bolls/plant, boll weight, bundle strength and fibre elongation recorded significant positive association with seed cotton yield/plant. Further partitioning of correlation coefficients into direct and indirect effects showed that characters days to 50 per cent flowering, bolls/ plant and boll weight had positive direct effect on seed cotton yield/plant. The correlation and path analysis therefore clearly indicated that direct selection based on bolls/ plant and boll weight may be helpful in developing high seed cotton yield varieties in upland cotton.

Key words: Correlation, cotton, 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 fibre 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 in effective. 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.

The experiment was conducted during *kharif,* 2011 to 2012 in randomized block design with 40 germplasm lines obtained from all over India with 3 replications following a spacing of 120 x 60 cm at Agricultural College Farm, Bapatla. The soils are black cotton type with clay texture. Recommended doses of fertilizers were applied in split doses. Each plot consisted of 2 rows of 6m length and observations were recorded on 10 randomly selected competitive plants from each genotype/replication for 14 characters *viz.,* plant height (cm), days to 50 per cent flowering, monopodia, sympodia and bolls/ plant, boll weight (g), seed index (g), lint index (g), ginning outturn (%), 2.5 per cent span length (mm), micronaire (10^{-6}g/in), bundle strength (g/ tex), uniformity ratio and fibre elongation (%). However, the data on days to 50 per cent flowering, ginning outturn (%), 2.5 per cent span length (mm), micronaire (10^{-6}g/in), bundle strength (g/tex), uniformity ratio and fibre elongation (%) were recorded on plot basis. The data was collected at boll maturity stage. But to estimate fibre quality parameters composite sample of *kapas* was obtained from each genotype/replication and ginned for seed and lint and the lint sample was used for estimating the fibre properties using "High Volume Instrument" at Regional Agricultural Research Station, Lam, Guntur. The data was then statistically analyzed to estimate genotypic and phenotypic correlation coefficients.

At both genotypic and phenotypic levels, seed cotton yield/ plant showed significant positive association with plant height, sympodia and bolls /plant, boll weight, bundle strength and fibre elongation (Table 1). These results are in conformity with earlier works of Eswara Rao *et al.,* (2009), Mahantesh *et al.,* (2010) and Magadum *et al.,* (2012) indicating that as most of the

important morphological parameters are showing strong significant positive association with seed cotton yield/ plant, rational improvement in yield is possible through simultaneous selection for these component characters under hybridization programmes in cotton.

Genotypic correlations revealed that days to 50 per cent flowering showed significant positive association with boll weight indicating masking effect of environment on this trait and significant negative association with sympodia and bolls /plant at both genotypic level and phenotypic levels (Table 1). These results are in agreement with Vijaya Lakshmi (2008) and Venkateswarulu *et al.,* (2010).

Plant height showed significant positive association with monopodia/plant, sympodia and bolls/ plant, 2.5 per cent span length, bundle strength and seed cotton yield/ plant at both genotypic and phenotypic levels indicating the usefulness of these traits in simultaneous improvement of seed cotton yield/ plant.

The monopodia/plant showed significant positive association with sympodia /plant and boll weight at genotypic level. The sympodia/plant showed significant positive association with bolls/ plant, micronaire and seed cotton yield/ plant at both phenotypic and genotypic levels indicating simultaneous improvement of these traits. The above results were supported by Annapurve *et al.,* (2006) suggesting that selection programmes based on sympodia/plant will help to increase cotton yields.

The bolls/plant and boll weight showed significant positive association with seed cotton yield/ plant at both phenotypic and genotypic levels indicating the usefulness of these traits in selection programmes. But bolls/plant showed significant negative association with boll weight at both genotypic and phenotypic levels. The above results are in conformity with reports of Muthu *et al.,* (2004) and Rajanna *et al.,* (2011) suggesting that in order to maintain economic balance continuous crossing followed by recurrent selection schemes may help in simultaneous improvement of both the characters.

Ginning outturn had showed significant positive association with lint index and uniformity ratio at genotypic and phenotypic levels indicating strong association between these characters both. Seed index showed highly significant positive association with lint index where as lint index showed significant association with 2.5 per cent span length at both genotypic and phenotypic levels. This was supported by Vijaya Lakshmi (2008) and Rajanna *et al.,* (2011) They further suggested that as these characters are showing significant positive association, it will help in simultaneous improvement of traits by concentrating on any of these traits.

2.5 per cent span length and bundle strength showed significant positive association with fibre elongation and seed cotton yield/plant but at genotypic level, while micronaire showed significant negative association with bundle strength at both genotypic and phenotypic levels. Bundle strength showed significant positive association with fibre elongation and seed cotton yield/plant. At genotypic and phenotypic levels uniformity ratio showed significant positive association with fibre elongation whereas fibre elongation showed significant positive association with seed cotton yield/ plant. This was supported by Vijaya Lakshmi (2008) and Neelima *et al.,* (2005) suggesting that enough care should be taken while selecting genotypes for micronaire, as if there is significant negative association increase in one variable cause decrease in another variable.

The estimation of path analysis indicated that due emphasis should be given to days to 50 per cent flowering, sympodia, bolls/ plant and boll weight as they showed direct positive effects on seed cotton yield/ plant (Table 2). The above results are in conformity with reports of Vijaya Lakshmi (2008) and Mahantesh *et al.*, (2010) suggesting that the direct contribution of the above different characters to yield would be highly important for formulating an appropriate selection programme as cotton breeding includes several agronomic and fibre traits, whose association may interfere in the selection

Table 1. Phenotypic (above diagonal) and genotypic (below diagonal) correlation of 15 characters in 40 cotton (*Gossypium hirsutum* L.) genotypes

	Plant height (cm)	Days to 50 per cent flowering	Mon-opoda/ plant	Sym-podia/ plant	Bolls/ plant	Boll weight (g)	Ginning outturn (%)	Seed index (g)	Lint index (g)	2.5 per cent span length (mm)	Micro-niare (10^{-6} g/in)	Bundle strength (g/tex)	Uni-formity ratio	Fibre elon-gation (%)	Seed cotton yield/ plant (g)
Plant height (cm)	**1.00**	-0.24**	0.24 **	0.23*	0.38**	0.03	0.09	0.02	0.06	0.21 *	-0.05	0.24 **	0.13	0.12	**0.37 ** **
Days to 50 per cent flowering	-0.26 **	**1.00**	-0.14	-0.22*	-0.29**	0.16	-0.17	0.07	-0.07	-0.01	-0.05	0.02	0.05	0.10	**-0.11**
Monopodia/plant	0.27**	-0.15	**1.00**	0.26**	0.04	0.18	-0.10	-0.20*	0.26**	-0.05	0.02	0.14	0.12	-0.26**	**0.16**
Sympodia/plant	0.28**	-0.28**	0.34 **	**1.00**	0.49**	0.07	0.09	-0.15	-0.05	0.05	0.34**	0.11	-0.05	-0.08	**0.48****
Bolls/plant	0.43**	-0.32**	0.05	0.67**	**1.00**	-0.34 **	0.00	-0.04	-0.05	-0.10	0.22*	-0.10	-0.12	0.13	**0.61****
Boll weight (g)	0.05	0.19*	0.18 *	0.06	-0.40**	**1.00**	0.07	-0.12	-0.06	0.34 **	-0.12	0.45**	0.25**	0.04	**0.35****
Ginning outturn (%)	0.13	-0.23*	-0.15	0.12	-0.01	0.09	**1.00**	-0.31 **	0.53 **	0.13	0.04	0.10	0.21*	0.07	**0.12**
Seed index (g)	0.02	0.07	-0.18 *	-0.18*	-0.03	-0.13	-0.28**	**1.00**	0.64 **	0.14	-0.12	0.04	-0.32**	0.06	**-0.13**
Lint index (g)	0.07	-0.10	-0.30 **	-0.08	-0.05	-0.07	0.44**	0.73 **	**1.00**	0.2217*	-0.04	0.11	-0.13	0.09	**-0.05**
2.5 per cent span length (mm)	0.25**	-0.02	-0.04	0.05	-0.08	0.40 **	0.17	0.16	0.26 **	**1.00**	-0.17	0.78**	-0.26**	0.17	**0.17**
Microniare (10^{-6}g/in)	-0.05	-0.04	0.00	0.47**	0.29**	-0.13	0.06	-0.12	-0.04	-0.21*	**1.00**	-0.22 *	0.01	0.07	**0.10**
Bundle strength (g/tex)	0.30**	0.00	0.17	0.16	-0.07	0.53 **	0.16	0.02	0.12	0.86 **	0.25**	**1.00**	0.00	0.21 *	**0.24 ** **
Uniformity ratio	0.14	0.04	0.15	0.01	-0.14	0.32**	0.30**	-0.38 **	-0.17	-0.36**	0.09	-0.05	**1.00**	0.30**	**0.07**
Fibre elongation (%)	0.22 *	0.13	-0.37 **	-0.13	0.25**	0.07	-0.02	0.09	0.05	0.20 *	0.09	0.20*	0.32**	**1.00**	**0.22***
Seed cotton yield/ plant (g)	**0.45****	**-0.13**	**0.17**	**0.63 ** **	**0.75****	**0.40****	**0.08**	**-0.12**	**-0.08**	**0.19 ***	**0.15**	**0.26 ** **	**0.09**	**0.28 ** **	1.00

*= significant at 5 per cent level **= significant at 1 per cent level

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

Character		Days to 50 per cent flowering	Plant height (cm)	Mono-podia/ plant	Sym-podia/ plant	Bolls/ plant	Boll weight (g)	Ginning outturn (%)	Seed index (g)	Lint index (g)	2.5 per cent span length (%)	Micro-naire (10^{-6} g/in)	Bundle strength (g/ tex)	Uni-formity ratio	Fibre elon-gation (%)
Days to 50	**P**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
per cent flowering	**G**	**-0.27**	0.07	-0.07	-0.08	-0.12	-0.01	-0.03	0.00	-0.02	-0.07	0.01	-0.08	-0.04	-0.06
Plant height (cm)	**P**	-0.01	**0.04**	-0.01	-0.01	-0.01	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	G	-0.03	**0.11**	-0.02	-0.03	-0.04	0.02	-0.03	0.01	-0.01	0.00	0.00	0.00	0.00	0.01
Monopodia /plant	**P**	0.01	-0.01	**0.04**	0.01	0.00	0.01	0.00	-0.01	-0.01	0.00	0.00	0.01	0.01	-0.01
	G	0.00	0.00	**-0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sympodia / plant	**P**	0.02	-0.02	0.02	**0.07**	0.03	0.01	0.01	-0.01	0.00	0.00	0.02	0.01	0.00	-0.01
	G	-0.31	0.31	-0.37	**-1.11**	-0.74	-0.06	-0.14	0.20	0.08	-0.06	-0.52	-0.18	-0.02	0.15
Bolls/ plant	**P**	0.29	-0.22	0.03	0.37	**0.75**	-0.26	0.00	-0.03	-0.04	-0.07	0.17	-0.07	-0.09	0.09
	G	1.02	-0.76	0.11	1.59	**2.37**	-0.93	-0.02	-0.07	-0.11	-0.19	0.68	-0.17	-0.33	0.59
Boll weight (g)	**P**	0.02	0.09	0.10	0.04	-0.20	**0.58**	0.04	-0.07	-0.04	0.20	-0.07	0.26	0.14	0.02
	G	0.06	0.21	0.20	0.06	-0.43	**1.11**	0.11	-0.15	-0.08	0.44	-0.15	0.59	0.36	0.08
Ginning outturn (%)	**P**	0.06	-0.11	-0.06	0.06	0.00	0.04	**0.64**	-0.20	0.34	0.08	0.03	0.06	0.13	0.05
	G	-0.06	0.10	0.07	-0.05	0.00	-0.04	**-0.44**	0.12	-0.19	-0.07	-0.03	-0.07	-0.13	0.01
Seed index (g)	**P**	0.01	0.04	-0.12	-0.09	-0.03	-0.07	-0.19	**0.61**	0.39	0.09	-0.07	0.02	-0.19	0.04
	G	-0.01	-0.02	0.06	0.06	0.01	0.04	0.09	**-0.31**	-0.23	-0.05	0.04	-0.01	0.12	-0.03
Lint index (g)	**P**	-0.04	0.05	0.18	0.04	0.04	0.04	-0.37	-0.45	**-0.70**	-0.15	0.03	-0.07	0.09	-0.06
	G	0.03	-0.05	-0.14	-0.04	-0.02	-0.03	0.21	0.34	**0.47**	0.12	-0.02	0.06	-0.08	0.02
2.5 per cent span	**P**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**-0.01**	0.00	0.00	0.00	0.00
length (mm)	**G**	0.20	-0.02	-0.03	0.04	-0.06	0.32	0.14	0.13	0.21	**0.81**	-0.17	0.69	-0.29	0.16
Micronaire	**P**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**-0.01**	0.00	0.00	0.00
(10^{-6} g/in)	**G**	-0.01	-0.01	0.00	0.11	0.07	-0.03	0.02	-0.03	-0.01	-0.05	**0.24**	-0.06	0.02	0.02
Bundle strength	**P**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00
(g/tex)	**G**	-0.09	0.00	-0.05	-0.05	0.02	-0.17	-0.05	-0.01	-0.04	-0.27	0.08	**-0.31**	0.02	-0.06
Uniformity ratio	**P**	-0.01	0.00	-0.01	0.00	0.01	-0.01	-0.01	0.02	0.01	0.01	0.00	0.00	**-0.05**	-0.01
	G	0.10	0.03	0.11	0.01	-0.10	0.24	0.22	-0.28	-0.12	-0.26	0.07	-0.03	**0.72**	0.23
Fibre elongation	**P**	0.01	0.01	-0.03	-0.01	0.01	0.00	0.01	0.01	0.01	0.02	0.01	0.02	0.03	**0.11**
(%)	**G**	-0.19	-0.11	0.31	0.11	-0.21	-0.06	0.02	-0.08	-0.04	-0.17	-0.08	-0.17	-0.27	**-0.85**
Correlation	**P**	**0.37****	**-0.11**	**0.16**	**0.48****	**0.61****	**0.35****	**0.11**	**-0.13**	**-0.05**	**0.16**	**0.10**	**0.24****	**0.07**	**0.22****
with seed cotton	**G**	**0.45****	**-0.13**	**0.17**	**0.63****	**0.75****	**0.40 ****	**0.08**	**-0.12**	**-0.08**	**0.19 ***	**0.15**	**0.26 ****	**0.09**	**0.28****
yield/ plant															

*=Significant at 5 per cent level

**=Significant at 1 per cent level, Bold and diagonal values indicate direct effects, Residual effect= 0.5087(P) and SQRT (1-1.2760) (G)

process.

Thus the correlation and path analysis indicated that bolls/ plant and boll weight had significant positive and positive direct effects on seed cotton yield /plant indicating the existence of true relationship among these characters and their exploitation in selection programmes.

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