225 kg N/ha level. It indicated that the effect of Azospirillum inoculation could be more indicative at optimum dose of N rather than at higher doses.

It may be concluded that the supplemental application of 7 kg of *Azospirillum* (35 pockets) along with 225 kg N/ha, produced cane yield equal to that of 300 kg N/ha. Influence of *Azospirillum* was more evident at optimum N levels.

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PATH ANALYSIS IN COLOURED LINTED COTTON VARIETIES

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ABSTRACT

Estimation of correlation coefficients in 15 parental genotypes revealed positive influence of boll weight, plant height, number of bolls per plant and days to maturity on seed cotton yield. In hybrids, number of bolls per plant and lint index were the most important characters which influenced the yield directly or indirectly. All the characters except days to first boll bursting and seed index had significant and positive correlation with seed cotton yield at the genotypic and phenotypic levels in parents. In hybrids, plant height, number of sympodia per plant, number of bolls per plant and boll weight had positive association with seed cotton yield at both the levels. In parents, colour of the lint had a positive correlation with fibre fineness and ginning outturn at the genotypic level while it was negatively correlated with bundle strength both at genotypic and phenotypic level. The colour of lint had negative relationship with 2.5 per cent span length and bundle strength in the hybrids, the respective genotypic and phenotypic correlation coefficients being negative. The association analysis showed the necessity for employing special techniques to break the linkage between lint colour and fibre quality in the breeding programme to evolve colour cotton varieties.

A knowledge on genetic correlation between different characters is very essential for a plant breeder to plan the crop improvement programmes. It assumes importance in the context of constructing a selection index as it gives the strength of relationship between the characters studied. Path coefficient analysis (Wright, 1921) provides an effective means of finding direct and indirect causes of association. The main yield components as revealed from earlier investigations are boll number, boll weight and number of sympodial branches (Singh *et al.*, 1979). Earlier reports also indicated that colour was negatively associated with lint length, and lint colour had pronounced effects on lint length, fibre maturity and fibre fineness (Silow, 1944). Since yield components of coloured linted cotton varieties have not been investigated earlier, a study was undertaken and the results are reported.

MATERIALS AND METHODS

The material consisted of 10 coloured linted varieties (Arkansas Green, Texas Green, Brymer Brown, Higgin Botham, Nankeen Brown, Russian Brown, Lousiana Brown, Algerian Brown, Hirsutum Tashkent and Parbhani American (Female lines) and 5 white-linted standard varieties, (MCU-5, MCU-7, MCU-9, KC-1 and LRA-5166 (testers) and the resulting 50 F_1's were raised in an experiment. The parents were also raised in an experiment adjacent to the hybrid plot. Each group was grown in a randomised block design with three replications at the Department of Cotton, Tamil Nadu Agricultural University, Coimbatore during summer season in 1993. Each hybrid/parent was raised in single row plot of 6m length with a spacing of 75 cm between rows and 30 cm between plants in a row. Observations were recorded on five competitive plants selected at

Table 1. Genotypic (G) and phenotypic (P) correlation co-efficients between different characters in the parents

Characters		Days to maturity (crop duration)	Plant height (cm)	No. of sympodia/ plant	No. of bolls/plant	Boll weight (g)	Seed cotton yield (g/plant)	Ginning Outturn (%)	Lint index (g/100 seeds)	Seed index (g/100 seeds)
Days to first boll	G	0.3686	-0.1263	-0.2196	0.0688	-0.2736	-0.0720	-0.1583	-0.3336	-0.3921
bursting	P	0.3672	-0.1273	-0.2050	0.0703	-0.2722	-0.0701	-0.1580	-0.3328	-0.3902
Days to maturity	G	0.6876**	0.7067**	0.6778**	0.7128**	0.8185**	0.4900*	0.4640	0.2334	
(crop duration)	P		0.6848**	0.6836**	0.6674**	0.7113**	0.8159**	0.4894*	0.4622	0.2317
Plant height (cm)	G			0.9868**	0.8982**	0.8223**	0.9127**	0.6433**	0.6798**	0.4543
	P			0.9468**	0.8846**	0.8187**	0.9079**	0.6413**	0.6758**	0.4504
No.of sympodia/plant	G				0.8572**	0.8900**	0.9413**	0.7080**	0.7726**	0.5419*
	P				0.8215**	0.8609**	0.9107**	0.6830**	0.7448**	0.5212*
No. of bolls/plant	G					0.7440**	0.8942**	0.6424**	0.6414**	0.4141
	P					0.7315**	0.8891**	0.6324**	0.6288**	0.4037
Boll weight (g)	G						0.9460**	0.6753**	0.6867**	0.4290
	P						0.9435**	0.6745**	0.6834**	0.4249
Seed cotton yield	G							0.7099**	0.7030**	0.4230
(g/plant)	P							0.7079*	0.6980**	0.4172
Ginning outturn (%)	G								0.8397**	0.3678
	P								0.8379**	0.3665
Lint index	G									0.8115**
(g/100 seeds)	P									0.8125**

G = Genotypic correlation coefficient; P = Phenotypic correlation coefficient

* Significant at 5% level ** Significant at 1% level

random for 14 characters: days to first boll bursting, days to maturity, plant height, number of sympodia per plant, number of bolls per plant, boll weight, seed cotton yield, ginning outturn, lint index, seed index, colour of the lint, fibre fineness, 2.5 per cent span length and bundle strength. The genotypic and phenotypic correlations (Goulden, 1959). and path coefficient analysis (Dewey and Lu, 1959). were computed.

Table 2. Genotypic (G) and phenotypic (P) correlation co-efficient between different characters in the hybrids

Characters		Days to maturity (crop duration)	Plant height (cm)	No. of sympodia/ plant	No. of bolls/plant	Boll weight (g)	Seed cotton yield (g/plant)	Ginning outturn (%)	Lint index (g/100 seeds)	Seed index (g/100 seeds)
Days to first boll	G	0.9925**	0.0560	0.2374	0.1499	0.1680	0.2019	0.4564**	0.0851	-0.1826
bursting	P	0.9694**	0.0479	0.2123	0.1458	0.1616	0.1963	0.4413**	0.0727	-0.1403
Days to maturity	G		0.0037	0.2331	0.1285	0.1964	0.1966	0.4418**	0.0696	-0.1890
(crop duration)	P		0.0040	0.1947	0.1159	0.1926	0.1849	0.4272**	0.0533	-0.1531
Plant height (cm)	G			0.5314**	0.4819**	-0.1275	0.3208*	0.5372**	0.4459**	0.1541
	P			0.4803**	0.4585**	-0.1135	0.3110*	0.4957**	0.3278*	0.1005
No.of sympodia/plant	G				0.7032**	0.1543	0.6391**	0.3214*	0.2330	0.0722
	P				0.6250**	0.1261	0.5703**	0.2979*	0.1803	0.0542
No. of bolls/plant	G					0.1692	0.9059**	0.2807*	0.0586	-0.0865
	P					0.1620	0.9052**	0.2608	0.0485	-0.0640
Boll weight (g)	G						0.5607**	-0.0114	-0.0579	-0.0339
	P						0.5505**	-0.0182	-0.0622	-0.0405
Seed cotton yield	G							0.2092	-0.0068	-0.1099
(g/plant)	P							0.1944	-0.0121	-0.0925
Ginning outturn (%)	G								0.4056**	-0.1641
	P								0.3619**	-0.1097
Lint index	G									0.8324**
(g/100 seeds)	P									0.8845**

G = Genotypic correlation coefficient; P = Phenotypic correlation coefficient

* Significant at 5% level ** Significant at 1% level

Table 3. Genotypic and phenotypic correlation coefficients between lint colour and different characters in the parents (lines) and hybrids

Characters		2.5% span length (mm)	Fibre fineness (micronaire)	Bundle strength (g/tex)	Ginning outturn (%)	Seed cotton yield (g/plant)
			Parents			
Colour of the lint (grade)	G	-0.3152	0.5884*	-0.8618**	0.7807**	-0.0927
	P	-0.2227	0.4916	-0.6054*	0.7453**	-0.0694
			Hybrids			
Colour of the lint (grade)	G	-0.4164**	0.0596	-0.4426**	-0.1060	0.1108
	P	-0.2807*	0.0621	-0.3026*	-0.1039	0.1047

G = Genotypic correlation coefficients; P = Phenotypic correlation coefficients

* Significant at 5 % level ** Significant at 1 % level

RESULTS AND DISCUSSION

The phenotypic and genotypic correlations for all the characters in parents are given in Table 1. The genotypic and phenotypic correlation coefficients were estimated involving seed cotton yield as the dependent character and six yield components and three quality parameters mentioned in the methods *viz.*, ginning outturn, lint index and seed index, as independent variables.

The data on parental genotypes revealed that days to maturity, plant height, number of sympodia per plant, number of bolls per plant, boll weight, ginning outturn and lint index had highly significant and positive correlation with seed cotton yield at the genotypic and phenotypic levels (Table 1). Yield is an interplay of several associated characters. Because, all the important characters such as number of sympodia per plant, number of bolls per plant and boll weight in the present study, have been found to be positively correlated with seed cotton yield, selection for these component characters is likely to bring about an overall improvement in the seed cotton yield. Reports on correlation between number of sympodia per plant with seed cotton yield, number of bolls per plant and boll weight with seed cotton yield have been made earlier.

The data on hybrids presented in Table 2 show that plant height, number of sympodia per plant, number of bolls per plant and boll weight were highly and positively correlated with the seed cotton yiled. However, there was no correlation between seed cotton yield on one hand and days to maturity, ginning outturn and lint index which had a high association with seed cotton yield in the parents on the other. The absence of parallelism in respect of character association, between parents and hybrids may be attributed to the recombination of genes during hybridisation. The colour of the lint

Table 4. Direct and indirect effects of different characters on seed cotton yield in parents

Characters	Days to first boll bursting	Days to maturity (crop duration)	Plant height (cm)	No. of sympodia/ plant	No. of bolls/ plant	Boll weight (g)	Seed cotton yield (g/plant)	Ginning outturn (%)	Lint index (g/100 seeds)	Seed index (g/100 seeds)
Days to first boll bursting	-0.0775	0.0991	-0.0398	0.0676	0.0206	-0.1313	-0.0004	-0.0328	0.0226	0.0720
Days to maturity (crop duration)	-0.0286	0.2689	0.2166	-0.2175	0.2033	0.3422	0.0013	0.0457	-0.0134	0.8185
Plant height (cm)	0.0098	0.1849	0.3150	-0.3037	0.2695	0.3948	0.0017	0.0669	-0.0262	0.9127
No. of sympodia/plant	0.0170	0.1900	0.3108	-0.3078	0.2571	0.4273	0.0019	0.0761	-0.0312	0.9413
No. of bolls/plant	-0.0053	0.1822	0.2829	-0.2638	0.3000	0.3572	0.0017	0.0632	-0.0238	0.8942
Boll weight (g)	0.0212	0.1917	0.2590	-0.2739	0.2232	0.4801	0.0018	0.0676	-0.0247	0.9460
Ginning outturn (%)	0.0123	0.1318	0.2026	-0.2179	0.1927	0.3242	0.0027	0.0827	-0.0212	0.7099
Lint index (g/100 seeds)	0.0259	0.1248	0.2141	-0.2378	0.1924	0.3297	0.0022	0.0985	-0.0467	0.7030
Seed index (g/100 seeds)	0.0304	0.0628	0.1431	-0.1668	0.1242	0.2060	0.0010	0.0799	-0.0576	0.4230

Residual effect = 0.0858

Underlined values indicate direct effect

Table 5. Direct and indirect effects of different characters on seed cotton yield in hybrids

Characters	Days to first boll bursting	Days to maturity (crop duration)	Plant height (cm)	No. of sympodia/ plant	No. of bolls/ plant	Boll weight (g)	Ginning cutturn (%)	Lint index (g/100 seeds)	Seed index (g/100 seeds)	Correlation with seed cotton yield (g/plant)
Days to first boll bursting	-0.0114	0.0232	-0.0014	-0.0021	0.1296	0.0702	- 0.1221	0.0378	0.0781	0.2019
Days to maturity	-0.0113	0.0234	-0.0001	-0.0021	0.1111	0.0821	-0.1182	0.0309	0.0808	0.1966
Plant height (cm)	-0.0006	0.0001	-0.0257	-0.0047	0.4166	- 0.0533	-0.1438	0.1981	-0.0659	0.3208
No. of sympodia/plant	-0.0027	0.0055	-0.0137	-0.0088	0.6080	0.0645	-0.0860	0.1035	-0.0311	0.6391
No. of bolls/plant	-0.0017	0.0030	-0.0124	-0.0062	0.8646	0.0707	-0.0751	0.0260	0.0370	0.9059
Boll weight (g)	-0.0019	0.0046	0.0033	-0.0014	0.1463	0.4180	0.0031	-0.0257	0.0145	0.5607
Ginning outturn (%)	-0.0052	0.0103	-0.0138	-0.0028	0.2427	- 0.0048	-0.2677	0.1802	0.0702	0.2092
Lint index (g/100 seeds)	-0.0010	0.0016	-0.0115	-0.0021	0.0507	-0.0242	- 0.1086	0.4443	-0.3561	0.0068
Seed index (g/100 seeds)	0.0021	-0.0044	-0.0040	-0.0006	-0.0748	-0.0142	0.0439	0.3699	-0.4276	-0.1099

Residual effect = 0.0771

Diagonal values indicate direct effect

was also negatively correlated with bundle strength in the parents. In the hybrids, a negative correlation between colour and bundle strength and colour and 2.5 per cent span length (Table 3) were noticed. The reports on negative relationship between colour and fibre quality as observed in the present study and strengthened by earlier reports (Kottur, 1923) are also not in support of developing high yielding and quality cotton varieties with high lint colour intensity. Nevertheless, special breeding techniques may likely to break this linkage.

The direct and indirect effects of different characters on seed cotton yield in parents are presented in Table 4. Among the characters studied, boll weight, plant height, number of bolls per plant and days to maturity exhibited a high and positive direct effects, while number of sympodia per plant which had a high positive correlation with yield, exerted only a negative direct effect. Besides, all the characters except days to first boll bursting influenced indirectly the seed cotton yield in the negative direction, through the number of sympodia per plant. Thus the key characters for use as an index in the selection programme in the present study, are boll weight, plant height and number of bolls per plant.

In the hybrids, the maximum positive direct effect on seed cotton yield was exerted by number of bolls per plant. The other characters having direct influence on the yield are lint index and boll weight and days to maturity to a lesser extent (Table 5). Considering the direct and indirect effects, the number of bolls per plant and lint index were the most important characters that modify the expression of yield either directly or indirectly. Therefore, due weightage should be given for these characters during selection of suitable hybrids for pedigree breeding work. The importance of number of bolls in the hybrids was stressed by Tyagi *et al.*,(1988).

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