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Genetic Studies of Correlation and Path Coefficient Analysis for Seed Oil, Yield and Fibre Quality Traits in Cotton (*G. Hirsutum* L.)

[1]K. Ashokkumar and [2]R. Ravikesavan

[1]Department of Plant Science, University of Saskatchewan Saskatoon, S7N 5A8, Canada.
[2]Cotton Breeding station, Centre for Plant Breeding and Genetics,
Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, INDIA.

Abstract: Correlation studies conducted using 4 lines, 7 testers and their 28 made with parents F1's of upland cotton (*Gossypium hirsutum* L.) revealed that seed cotton yield has positive significant correlation with days to fifty percent flowering, number of sympodia per plant, number of bolls per plant, boll weight, number of seed per boll, ginning outturn, lint index, seed index, and micronaire. In parents and hybrids, seed oil had negative correlation with seed cotton yield and days to first flowering. Seed oil had positive correlation with number of sympodia per plant, boll weight, number of seeds per boll, lint index, seed index and 2.5 per cent span length. Path analysis revealed that boll weight, number of sympodia per plant, lint index and number of seeds per boll directly influenced the seed cotton yield with high direct effects. Seed oil influenced the seed cotton yield negatively. The result of this study indicate that sympodia per plant, boll weight, number of seeds per boll, lint index, seed index and 2.5 per cent span length has been affected seed oil improvement in cotton. It was concluded that these characters should be considered as significant selection criteria for seed oil improvement in cotton.

Key words: Correlation, fibre quality, *Gossypium hirsutum*. L, path coefficient analysis, seed oil, seed protein and yield,

INTRODUCTION

Cotton is an important commercial crop of the country. It plays a key role in the national economy in terms of contribution in trade, industrial activities, employment, and foreign exchange earnings in India (Gite *et al.*, 2006). Among the by products of cotton, seed oil plays an important role in human diet. Cotton seed is the rich source of one of the best edible vegetable oils. The ever increasing shortage of other edible oils necessitates the increasing usage of cotton seed for oil extraction, as it is a valuable by product that can substantially augment the domestic refined cotton seed oil which practically lacks gossypol and can be used directly as a cooking medium. After extraction of oil, the cotton seed meal is protein rich by product and assumes great importance in feed and fermentation industries. Cotton seed has, therefore had an important contribution in helping the feed world in the future. A study was made for the genetic improvement of oil in cotton seeds. Any breeding programme has to take into consideration the improvement in quality especially in crop like cotton. Seed quality generally increases with high level of seed oil but declines with increase of seed cotton yield. For a simultaneous selection of both quality and yield, knowledge of inter relationship between the components of quality and those of yield is a pre-requisite. Studies were mainly under taken up to find out the genotypic correlation and direct and indirect effects responses between seed oil and seed cotton yield and also quality traits.

MATERIALS AND METHODS

The materials consist of four lines as high yielding varieties as *viz.*, MCU 5, MCU 12, Surabhi, and SVPR 2 and seven testers as high oil content genetic accessions as *viz.*, F 776, F 1861, SOCC 11, SOCC 17, TCH 1641, TCH 1644 and TCH 1646 to develop 28 intra hirsutum hybrids, during kharif season 2004 - 2005. Both parents and their hybrids were evaluated randomized block design with three replications during kharif 2005-

Corresponding Author: K. Ashokkumar, Department of Plant Science, University of Saskatchewan Saskatoon, S7N 5A8, Canada.
E-mail: agriashokkumar@yahoo.co.in and biotech.ashok@gmail.com

2006 crop season at Cotton Breeding Station, Tamil Nadu Agricultural University, Coimbatore, and Tamil Nadu in India. Each genotype was grown in a 3 plot of 4.5 meter length adopting a spacing of 75 cm between rows and 30 cm between the plants in the row, so as to have 15 plants per row. Data were recorded on 5 randomly selected plants per replication for all the 19 characters *viz.*, Days to first flowering (DFF), days to 50% flowering (D50%F), plant height (PH), number of sympodia per plant (NSPP), number of bolls per plant (NBPP), boll weight per plant (BWPP), number of seeds per bol l(NSPB), seed cotton yield per plant (SCPP), ginning outturn (GO), lint index (LI), seed index (SI), 2.5% span length (2.5%SL), bundle strength (BS), micronaire (MIC), seed oil (SO) and seed protein (SP) content. Correlation and Path Co-efficient analysis were carried out as Dewey and Lu (1959).

RESULTS AND DISCUSSION

The seed cotton yield was significant and positively correlated with days to fifty percent flowering, number of sympodia per plant, number of bolls per plant, boll weight per plant, number of seed per boll, ginning outturn, lint index, seed index, and micronaire. Since most of yield contributing characters have been found to be positively correlated with seed cotton yield in the present study, rational improvement of seed cotton yield stands a good chance through selection for these component characters (Table. 1). These findings are in conformity with earlier work done by Kowsalya and Raveendran (1996), Murthy *et al*. (1995) and Kaushik *et al*. (2003) who have noticed that sympodia per plant, bolls per plant, boll weight, seed index, lint index and micronaire value had positive correlation with seed cotton yield both at genotypic & phenotypic correlation. Plant height, number of sympodia per plant, number of seed per boll, ginning outturn, 2.5 per cent span length, bundle strength, and seed oil had significant positive correlation with days to fifty per cent flowering. Number of bolls per plant had positive intercorrelations with boll weight, number of seeds per boll, ginning outturn, lint index, seed index, and 2.5 percent span length, micronaire and bundle strength. Boll weight was significantly correlated with number of seed per boll, ginning outturn, lint index, seed index, 2.5 per cent span length and bundle strength in the positive direction. The negative correlation of bundle strength with seed cotton yield was in conformity with reports of Valarmathi (1996), Rao *et al*. (2001) and Preetha (2003).

Number of seeds per boll was positively intercorrelated with all traits except seed index, uniformity ratio, and micronaire. Ginning outturn was positively intercorrelated with days to fifty per cent flower, plant height, number of sympodia, number of bolls, boll weight, number of seeds per boll, lint index, uniformity ratio, bundle strength, elongation percentage and seed oil. Significant positive correlations were also observed between seed oil and protein contents, though most reports suggested the negative correlation between seed oil and seed protein, (Kohel and Cherry, 1983; Gururajan *et al.*, 1992) probably due to competitive synthesis of these two components. However Taneja *et al.* (1993), encountered positive correlation between the amounts of oil and protein as observed in the present study.

Lint index was positively correlated with plant height, number of sympodia per plant, number of bolls per plant, number of seed per boll, ginning outturn, seed index, 2.5 per cent span length, micronaire, bundle strength and seed oil, where as lint index was negatively correlated with days to first flowering, days to fifty per cent flowering and seed protein. Similar results were reported by Rajarathinam *et al.* (1993) for seed index and 2.5 percent span length, Sambamurthy *et al*. (1994) for ginning outturn.

Number of sympodia per plant was significant positively intercorrelated with number of boll per plant, boll weight, ginning outturn, 2.5 per cent span length and bundle strength. Earlier workers like Gururajan (2000) and Muthu *et al.* (2004) noticed number of bolls per plant and bundle strength had positive association with number of sympodia per plant. Fibre length had positively correlation with bundle strength but negative correlation with uniformity ratio, micronaire and elongation percentage. Similar results were reported by Rajarathinam *et al.* (1993) and Swati Bharad *et al.* (1999). The negative correlation of micronaire with bundle strength was in conformity with report of Singh *et al*. (1990).

The seed oil content was positively inter correlated with days to fifty per cent flowering, plant height, number of seeds per boll, ginning outturn, lint index, seed index, 2.5 per cent span length, micronaire and bundle strength, where as correlation between seed oil and seed cotton yield is negative (Rashmi *et al*., 2004). However, in the present study such a negative correlation was evident. Positive inter correlations between seed cotton yield and seed oil content is a welcome feature for combined improvement of yield and seed oil content.

Path coefficient analysis revealed that boll weight, number of sympodia per plant, lint index, and number of seeds per boll, uniformity ratio and micronaire exerted high and positive direct effect on seed cotton yield (Table 2). Valarmathi (1996) and Manimaran (1999) reported that boll weight and number of sympodia per plant directly influenced the seed cotton yield while, Murthy *et al*., (1995) and Kowsalya and Raveendran

(1996) observed positive direct effect of boll weight on seed cotton yield. Plant height, number of monopodia, ginning outturn, bundle strength, seed oil and seed protein content are negatively associated with seed cotton yield as observed earlier by Manimaran, 1999.

Indirect effects of days to first flowering influenced the seed cotton yield positively through fifty per cent flowering, seed index, micronaire and seed protein. Days to fifty per cent flowering influenced seed cotton yield indirectly through days to first flowering, plant height, number of sympodia, number of seeds per boll, ginning outturn, bundle strength, and seed oil. The indirect effects of number of sympodia per plant was positive through days to fifty per cent flower, plant height, number of bolls per plant, boll weight, ginning outturn, seed index, 2.5 per cent span length and bundle strength. Number of bolls per plant exerted positive effects on seed cotton yield through fifty per cent flowering, number of sympodia per plant, number of monopodia per plant, boll weight, number of seeds per boll, ginning outturn, lint index, seed index and bundle strength. Seed oil influenced the seed cotton yield through significant positive association with days to fifty per cent flowering.

Indirect effects of seed cotton yield was influenced positively by fifty per cent flowering, plant height, number of sympodia per plant, number of bolls per plant, boll weight, number of seeds per boll, ginning outturn, lint index, seed index, 2.5 per cent span length, bundle strength and seed protein. The direct effects of seed cotton yield was influenced in negative direction by days to first flower, number of monopodia, uniformity ratio, micronaire, and elongation percentage and seed oil.

Table 1: Genotypic correlation coefficients between different characters in the parents and hybrids

Traits	D50%F	PH	NSPP	NBPP	BWPP	NSPB	GO	LI	SI	2.5%SL	MIC	BS	SO	SP	SCYPP
DFF	2.9575**	-0.8831**	-1.2009**	-0.0884	-1.2302**	-0.9147**	-1.2367**	-0.2939	0.1937	-0.0377	0.1184	-0.6544**	-1.5429**	0.2214	-0.1032
D50%F		0.7777**	1.1097**	0.2897	0.1986	1.5957**	0.6548**	-0.5066	-0.4362**	0.4151**	-1.0018**	0.7941**	1.4244**	-0.6870**	0.6521**
PH			0.4822**	-0.2042	0.5892**	0.3785*	0.2842	0.1890	0.2595	0.3390*	-0.4694**	0.1984	0.0794	0.0929	0.1635
NSPP				0.3335**	0.5821**	0.0895	0.3341*	0.1226	0.2859	0.5244**	0.2916	0.5886**	0.2016	0.1946	0.4803**
NBPP					0.4552**	0.0041	0.3228*	0.3779*	-0.1584	0.1093	-0.1775	0.1212	-0.0387	-0.1315	-0.0243
BWPP						0.5972**	0.7112**	0.8125**	0.1812	0.1529	0.0694	0.2590	-0.0656	-0.0459	0.8566**
NSPB							0.2630	0.0206	0.5508**	0.5332**	-0.1080	0.5272**	0.0912	-0.3165*	0.8779**
GO								0.5155**	-0.1195	0.1600	-0.4413**	0.2535	0.0587	0.1335	0.3539*
LI									0.8100**	0.2993	0.1094	0.2568	0.1194	-0.0506	0.5553**
SI										0.7037**	-0.0671	0.4464**	0.1134	0.1773	0.4463**
2.5% SL											-0.4085**	0.5854**	0.1417	0.3005*	0.2955
MIC												-0.3813*	0.2520	-0.0470	-0.0625
BS													0.0421	0.4102**	0.4158**
SO														0.0178	-0.0676
SP															0.0533

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

Table 2: Direct and indirect effects of different characters in parents (Based on genotypic correlation)

Traits	DFF	D50%F	PH	NSPP	NBPP	BWPP	NSPB	GO	LI	SI	2.5%SL	MIC	BS	SO	SP	SCYPP
DFF	0.1384	0.4093	-0.1222	-0.1662	-0.0117	-0.1702	-0.1266	-0.1711	-0.0407	0.0268	-0.0052	0.0164	-0.0906	-0.2135	0.0306	-0.1032
D50%F	0.5010	0.1694	0.1317	0.1880	0.0491	0.0336	0.2703	0.1109	-0.0875	-0.0739	0.0703	-0.1697	0.1345	0.2413	-0.1164	0.6521
PH	0.0105	-0.0092	-0.0119	-0.0057	0.0024	-0.007	-0.0045	-0.0034	-0.0022	-0.0031	-0.004	0.0056	-0.0024	-0.0009	-0.0011	0.1635
NSPP	-0.4949	0.4573	0.1987	0.4121	0.1374	0.2399	0.0369	0.1377	0.0505	0.1178	0.2161	-0.1201	0.2425	0.0831	0.0802	0.4803
NBPP	-0.0542	0.1861	-0.1311	0.2141	0.6421	0.2923	0.0026	0.2073	0.2427	0.1164	0.0982	0.0445	0.1663	-0.0421	-0.0295	0.8566
BWPP	-0.0370	0.0064	0.0177	0.0175	0.0137	0.0301	0.0179	.0214	0.0244	0.0166	0.0160	-0.0032	0.0158	0.0027	-0.0095	0.8779
NSPB	-0.3475	0.6061	0.1438	0.034	0.0016	0.2268	0.3799	0.0999	0.0078	-0.0454	0.0608	-0.1676	0.0963	0.0223	0.0507	0.3539
GO	0.1127	-0.0597	-0.0259	-0.0305	-0.0294	-0.0648	-0.0240	-0.0912	-0.0470	0.0099	0.0023	0.0148	-0.0179	-0.0149	0.0198	0.4563
LI	-0.1161	-0.2041	0.0747	0.0484	0.1493	0.3210	0.0082	0.2037	0.3951	0.3200	0.1183	0.0432	0.1015	0.0472	-0.0200	0.5553
SI	0.0020	-0.0046	0.0027	0.003	0.0019	0.0058	-0.0013	-0.0011	0.0086	0.0106	0.0074	-0.0007	0.0047	0.0012	0.0019	0.4463
2.5% SL	-0.0066	0.0725	0.0592	0.0916	0.0267	0.0931	0.0279	-0.004	0.0523	0.1229	0.1747	-0.0714	0.1023	0.0248	0.0525	0.2955
MIC	-0.0238	0.0682	0.0782	0.0982	0.0328	0.09525	0.0043	0.038	0.0645	0.0789	0.0532	0.2116	- 0.0807	0.0533	-0.0099	-0.0625
BS	-0.0259	0.0027	-0.0240	-0.0011	0.0523	-0.0007	0.0047	-0.0454	0.0608	-0.1676	0.0099	0.0324	-0.0850	-0.0036	-0.0349	0.4158
SO	-0.0259	-0.0305	-0.0294	-0.0305	-0.0294	0.1183	0.0432	0.0047	0.0012	0.0047	0.0012	-0.0559	-0.0093	-0.2219	-0.0040	-0.0676
SP	0.1023	0.0248	-0.0036	-0.0349	-0.0739	0.0703	0.0505	0.1178	0.2161	0.0026	0.2073	-0.0003	0.0029	0.0001	0.0071	0.0533

Residual effect = (0. 1518)

Conclusion:

Correlation and Path coefficient studies disclosed the significant positive association of seed cotton yield with days to fifty per cent flowering, number of sympodia per plant, number of bolls per plant, boll weight, number of seeds per boll, ginning outturn, lint index and seed index. Seed protein had positive strong correlation with 2.5 per cent span length and bundle strength, while seed protein was significant and negatively correlated with boll weight.

In parents and hybrids, seed oil had negative correlation with seed cotton yield and days to first flowering. Seed oil had positive correlation with number of sympodia per plant, boll weight, number of seeds per boll, lint index, seed index and 2.5 per cent span length. The result of this study indicate that sympodia per plant, boll weight, number of seeds per boll, lint index and seed index will play a role in seed oil improvement of cotton. It was concluded that these characters should be considered as significant selection criteria for seed oil improvement in cotton.

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