

Original Research Article

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Studies on Association, Path Analysis and Genetic Parameters for Seed Cotton Yield and It's Contributing Characters in Desi Cotton (*Gossypium arboreum* L.)

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ABSTRACT

The research work comprising of genetic variability, heritability and genetic advance as well as correlation and path analysis study for 12 quantitative traits in three genotypes of cotton (*Gossypium arboreum* L.) was carried out during 2015 and 2016 at Research Farm of Cotton Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar, India. The genotypic differences were significant for all the traits except number of monopods/plant and number of seeds/boll. The variability studies indicated that high PCV and GCV were observed for seed cotton yield per plant, lint yield per plant and number of bolls per plant. Seed cotton yield per plant, lint yield per plant, number of bolls per plant and days to first flower 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 viz. lint yield per plant, number of bolls per plant, boll weight, seed index, number of seeds per boll, number of monopods per plant, plant height, days to boll bursting and days to first flower. Path analysis revealed that lint yield per plant exhibited maximum positive direct effect on seed cotton yield followed by number of bolls per plant, seed index, boll weight and plant height. Hence selection for these traits would be quite effective to improve the seed cotton yield.

Keywords

Gossypium arboreum.
L, Variability,
Correlation, Path
analysis, Yield.

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Introduction

Cotton is a crop of prosperity having a profound influence on men and matter. Cotton is one of the most important commercial crops and popularly known as the "White Gold". It is an industrial commodity of worldwide importance. India has been the traditional home of cotton and cotton textiles. It occupies the place of pride in Indian agriculture and economy by earning valuable foreign exchange. 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. Genetic variability is pre-requisite for plant breeders to exercise selection. The phenotypic and genotypic coefficients of variation were estimated using genotypic and phenotypic variances respectively. The coefficient of variation indicated only the extent of existing variability for various traits, but does not give any information about the heritable portion of it. Therefore, heritability accompanied by

estimates of genetic advance and genetic advance as per cent mean were also estimated. Heritability itself provides no indication about the genetic progress that would result from selection. However, at a fixed selection pressure, the amount of advance varies with magnitude of heritability. Genetic advance in a population cannot be predicted from heritability alone. Many investigations had studied heritability for seed cotton yield and other traits (Basbag and Gencer, 2004; Basal and Turgut, 2005; Khurram *et al.*, 2009; Dhamayanathi *et al.*, 2010). Further, efficiency of selection in any breeding programme mainly depends upon the knowledge of association of the characters. Phenotypic correlation indicated the extent of the relation between two characters while genotypic correlation provides an estimate of inherent association between the genes controlling them. The cause for negative effect of the trait is very essential for formulating selection indices 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 the present study was planned to assess the variability, correlation and path analysis for various yield and yield contributing characters in a set of genotypes. Such information may be fruitful in formulating efficient selection programme for synthesis and development of new cotton genotypes with improved yield and its contributing traits.

Materials and Methods

The study was conducted at the Research Farm of Cotton Section, Department of Genetics and Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar. It is situated in the semi-arid zone at an elevation of 215.2 m with a longitude of $75^{\circ} 46' E$ and latitude of

$29^{\circ} 10' N$. The experimental material for the present study comprised of 3 varieties of *desi* cotton *i.e.* HD123, HD 324 and HD 432. All the experimental material was grown in six environments (Table 1) which comprised of two years (2015 and 2016) and three different sowing times (early, normal and late). All the varieties were grown in a randomized block design (RBD) with six replications. There were eight rows of each genotype of six meter length, rows were spaced 67.5 cm apart and plant to plant distance was kept 30 cm. At the time of square initiation five competitive plants were tagged from each treatment and replication for taking the observations for days to first flower, days to boll bursting, plant height (cm), number of monopods per plant, number of bolls per plant, boll weight (g), number of seeds per boll, ginning out turn (%), seed cotton yield per plant (g), lint yield per plant (g), seed index (g) and lint index (g).

Genotypic and phenotypic coefficient of variation was calculated using the method suggested by Burton and de-vane (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). Correlation coefficients at phenotypic and genotypic level were calculated as per procedure given by Al-Jibouri *et al.*, (1958). Path analysis was carried out as suggested by Dewey and Lu (1959), respectively.

Results and Discussion

Analysis of variance revealed significant differences among all genotypes for all the traits except number of monopods/plant and number of seeds/boll. Estimates of genetic variability (Table 2.) revealed high estimate of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) for seed cotton yield per plant (27.89% and 25.63%), lint yield per plant (27.87% and

25.34%) and number of bolls per plant (20.76% and 19.21%) whereas, moderate estimates of PCV and GCV were estimated for traits like days to first flower (11.93% and 11.59%), plant height (15.04% and 10.35%), boll weight (9.21% and 8.56%), number of monopods per plant (12.19% and 10.78%) and lint index (10.25% and 9.27%). Days to boll bursting, number of seeds per boll, seed index and ginning outturn exhibited low PCV and GCV of 5.45% and 4.92%, 6.77% and 5.94%, 6.12% and 4.84%, 4.35% and 4.06%, respectively, indicated that characters were highly influenced by environmental factors (Fig. 1). The phenotypic co-efficient of variation which measures total variation was found to be greater than genotypic coefficient of variation for all the characters indicated some degree of environmental influence on the traits. Selection for improvement of such traits may sometimes be misleading. These

findings were also supported by Patnaik and Sial (2010) and Kulkarni *et al.*, (2011). The estimates of high heritability value was noticed in for characters like days to first flower (94.52%), boll weight (86.39%), number of bolls per plant (85.63%), seed cotton yield per plant (84.44%), lint yield per plant (82.67%), lint index (81.75%), days to boll bursting (81.52%), ginning out turn (81.10%), seed index (80.66%) and number of seeds per boll (76.86%). These findings were in accordance with previous reports by Joshi *et al.*, (2006). High heritability and high genetic advance over the mean was observed in case of seed cotton yield per plant, lint yield per plant, number of bolls per plant and days to first flower. It indicated that most likely the heritability is due to additive gene effect and selection will be effective for these traits. Similar findings were observed by Neelam and Potdukhe (2002).

Table.1 Description of environments

Environment		Date of Sowing	Environment Designation
Year	Sowing period		
2015	Early season	10-04-2015	E ₁
	Normal season	15-05-2015	E ₂
	Late season	5-06-2015	E ₃
2016	Early season	26-04-2016	E ₄
	Normal season	5-05-2016	E ₅
	Late season	2-06-2016	E ₆

Table.2 Genetic components of variance for various quantitative traits

Characters	Mean	Genetic components of variance				
		PCV (%)	GCV (%)	h^2_{bs} (%)	GA	GAM (%)
Days to first flower	69.90	11.930	11.598	94.523	16.245	23.229
Days to boll bursting	113.70	5.453	4.924	81.528	10.414	9.158
Plant height	167.75	15.042	10.358	47.419	24.649	14.693
No. of monopods/plant	9.88	12.197	10.784	40.726	1.008	10.233
No. of bolls/plant	28.84	20.765	19.216	85.635	10.567	36.631
Boll weight	2.43	9.210	8.561	86.399	0.400	16.393
No. of seeds/boll	24.71	6.777	5.941	76.865	2.637	10.730
GOT	40.35	4.357	4.066	87.109	3.155	7.818
Lint index	3.51	10.259	9.276	81.752	0.607	17.277
Seed index	5.16	6.125	4.849	80.660	9.408	11.907
Seed cotton yield/plant	61.04	27.895	25.633	84.441	29.621	48.523
Lint yield/ plant	24.60	27.877	25.347	82.674	11.683	47.476

GCV- Genotypic coefficient of variation, PCV- Phenotypic Coefficient of Variation, h^2_b – heritability (broad sense), GA -Genetic advance, GAM -Genetic advance expressed as percentage of mean

Table.3 Genotypic and phenotypic correlations of various quantitative traits

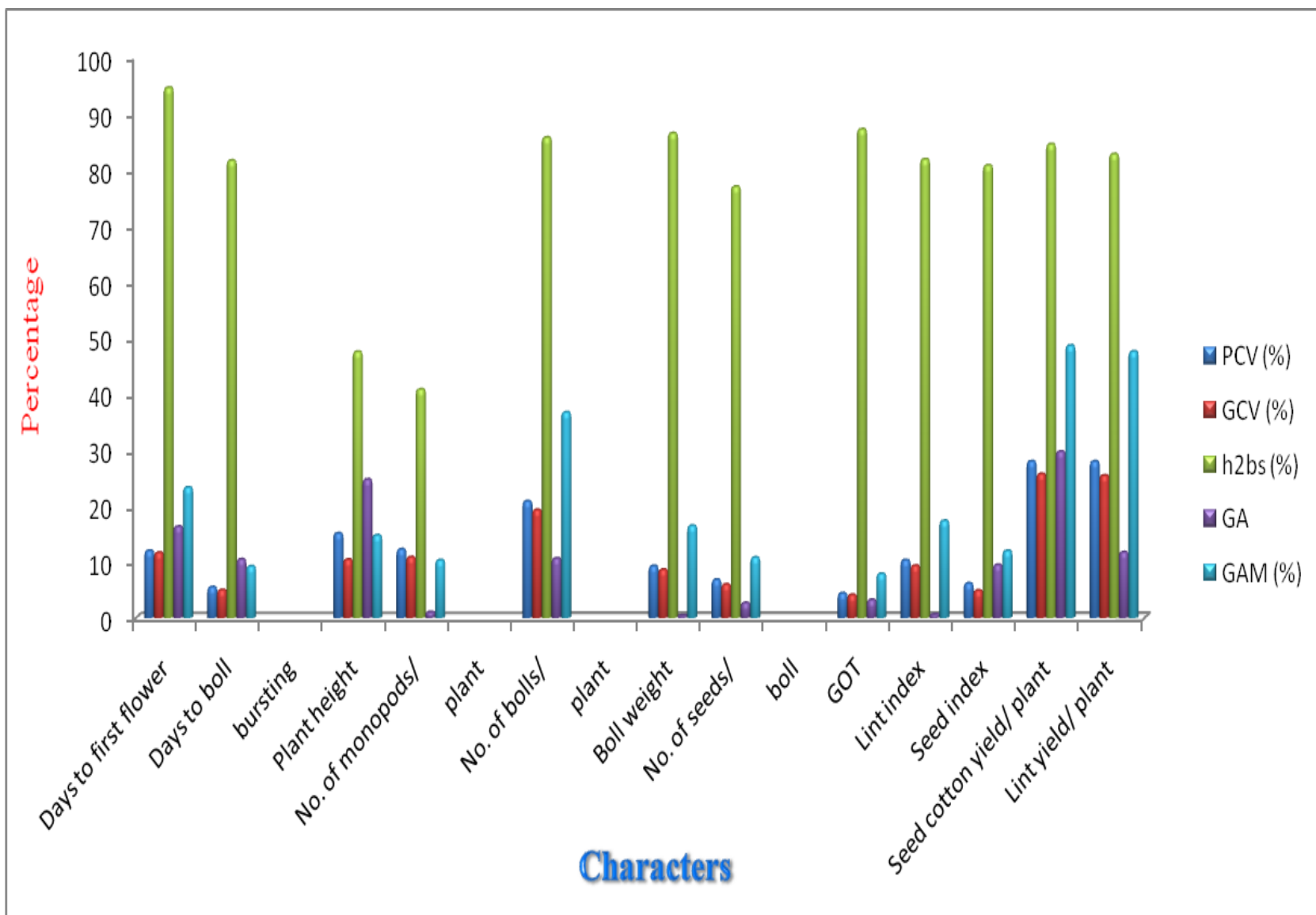
Characters		Days to first flower	Days to boll bursting	Plant height	No. of monopods/ plant	No. of bolls/ plant	Boll weight	No. of seeds/ boll	GOT	Lint index	Seed index	Seed cotton yield/ plant	Lint yield/ plant
Days to first flower	G	1.00	0.801**	0.863**	0.960**	0.623**	0.644**	0.658**	0.268**	0.635**	0.814**	0.825**	0.882**
	P	1.00	0.692**	0.578**	0.590**	0.553**	0.586**	0.560**	0.258**	0.567**	0.622**	0.742**	0.787**
Days to boll bursting	G		1.00	1.011**	0.657**	0.214*	0.516**	0.394**	0.691**	0.914**	0.752**	0.442**	0.559**
	P		1.00	0.589**	0.324**	0.216*	0.423**	0.321**	0.582**	0.733**	0.520**	0.395**	0.490**
Plant height	G			1.00	0.728**	0.389**	0.379**	0.276**	0.735**	0.892**	0.653**	0.555**	0.680**
	P			1.00	0.221*	0.252**	0.264**	0.216*	0.452**	0.546**	0.356**	0.338**	0.405**
No. of monopods/ plant	G				1.00	0.656**	0.830**	0.996**	-0.068 ^{NS}	0.422**	0.913**	0.870**	0.867**
	P				1.00	0.343**	0.492**	0.526**	-0.059 ^{NS}	0.273**	0.546**	0.470**	0.461**
No. of bolls/ plant	G					1.00	0.007 ^{NS}	0.341**	-0.299**	-0.060 ^{NS}	0.303**	0.946**	0.911**
	P					1.00	-0.014 ^{NS}	0.289**	-0.248**	-0.050 ^{NS}	0.207*	0.910**	0.875**
Boll weight	G						1.00	0.837**	0.092 ^{NS}	0.530**	0.874**	0.323**	0.346**
	P						1.00	0.692**	0.090 ^{NS}	0.457**	0.657**	0.273**	0.291**
No. of seeds/ boll	G							1.00	-0.280**	0.209*	0.823**	0.541**	0.505**
	P							1.00	-0.169 ^{NS}	0.188 ^{NS}	0.539**	0.466**	0.442**
GOT	G								1.00	0.854**	0.195*	-0.171 ^{NS}	-0.021 ^{NS}
	P								1.00	0.799**	0.129 ^{NS}	-0.124 ^{NS}	0.027 ^{NS}
Lint index	G									1.00	0.675**	0.184 ^{NS}	0.319**
	P									1.00	0.691**	0.164 ^{NS}	0.288**
Seed index	G										1.00	0.577**	0.617**
	P										1.00	0.413**	0.436**
Seed cotton yield/ plant	G											1.00	0.988**
	P											1.00	0.988**
Lint yield/ plant	G												1.00
	P												1.00

Table.4 Direct effects (diagonal) and indirect effects (off diagonal) of various quantitative traits on seed cotton yield at genotypic level

Characters	Days to first flower	Days to boll bursting	Plant height	No. of monopods/ plant	No. of bolls/ plant	Boll weight	No. of seeds/ boll	GOT	Lint index	Seed index	Lint yield/ plant	Genotypic correlation with seed cotton yield
Days to first flower	-0.073	-0.037	0.037	0.000	0.114	0.054	-0.015	0.047	-0.234	0.181	0.748	0.825**
Days to boll bursting	-0.058	-0.046	0.044	0.000	0.039	0.044	-0.009	0.122	-0.336	0.168	0.474	0.442**
Plant height	-0.063	-0.046	0.044	0.000	0.071	0.032	-0.006	0.130	-0.328	0.146	0.577	0.555**
No. of monopods/ plant	-0.070	-0.030	0.032	0.000	0.119	0.070	-0.023	-0.012	-0.155	0.204	0.735	0.870**
No. of bolls/ plant	-0.045	-0.009	0.017	0.000	0.282	0.000	-0.008	-0.053	0.022	0.068	0.673	0.946**
Boll weight	-0.047	-0.023	0.016	0.000	0.001	0.085	-0.019	0.016	-0.195	0.194	0.294	0.323**
No. of seeds/ boll	-0.048	-0.018	0.012	0.000	0.062	0.071	-0.023	-0.050	-0.077	0.183	0.428	0.541**
GOT	-0.019	-0.031	0.032	-0.000	-0.054	0.008	0.006	-0.177	-0.137	0.043	-0.018	-0.171 ^{NS}
Lint index	-0.046	-0.042	0.039	0.000	-0.011	0.045	-0.005	0.151	-0.368	0.151	0.271	0.184 ^{NS}
Seed index	-0.059	-0.034	0.028	0.000	0.055	0.074	-0.018	0.035	-0.249	0.223	0.523	0.577**
Lint yield/ plant	-0.064	-0.025	0.029	0.000	0.166	0.029	-0.011	-0.004	-0.117	0.137	0.848	0.988**

Residual effect 0.00046

Fig.1 Genetic components of variance for various quantitative traits



The genotypic and phenotypic correlation coefficient between yield and its components were presented in Table 3.

Seed cotton yield per plant had highly significant and positive correlation with characters *viz.*, lint yield per plant, number of bolls per plant, boll weight, seed index, number of seeds per boll, number of monopods per plant, plant height, days to boll bursting and days to first flower. It indicated that increase in one trait will simultaneously increase in the other. Such positive association of seed cotton yield per plant with these traits was also observed by Rajamani *et al.*, (2013), Pujer *et al.*, (2014) and Asha *et al.*, (2015). Seed cotton yield per plant was having non-significant association lint index and ginning out turn.

In the present study, genotypic correlation coefficient were higher than phenotypic correlation coefficient, which revealed that there was strong genetic association between these characters but the phenotypic value lessened by the significant interaction of environment.

The genotypic correlation coefficients of seed cotton yield with other yield contributing traits were further partitioned into direct and indirect effects and the results were presented in Table 4.

The component of residual effect of path analysis in yield was 0.00046. Lint yield per plant exhibited maximum positive direct effects on seed cotton yield followed by number of bolls per plant, seed index, boll weight and plant height. Whereas negative direct effect was observed in case of lint index followed by ginning outturn, days to first flower, days to boll bursting and number of seeds per boll. Kaushik and Kapoor (2006), Pujer *et al.*, (2014) and Asha *et al.*, (2015) also reported the same findings.

High estimate of PCV and GCV were observed for seed cotton yield per plant, lint yield per plant and number of bolls per plant. High heritability and high genetic advance over the mean was observed in case of seed cotton yield per plant, lint yield per plant, number of bolls per plant and days to first flower. Correlation and direct and indirect effect estimates vary for different traits with variation in genetic material. Hence, these findings will be effective to formulate a sound breeding program to develop new cotton cultivars with desirable traits suitable in varying environmental conditions.

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