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Estimates of Heritabilities and Correlations Among Seed Cotton Yield and its Components in *Gossypium hirsutum* L.

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ABSTRACT

Twenty five F_2 families originated from different cross combinations were studied in order to collect information on the nature and degree of correlation among seed cotton yield and its components in *Gossypium hirsutum* L. Analysis of the F_2 data showed that plant height and number of bolls were positively and significantly associated with yield of seed cotton at phenotypic (r_p= 0.590, r_p= 0.968) and genotypic (r_g = 1.00, r_g=1.00) levels, respectively. Plant height and number of bolls were also positively and significantly correlated (r_p = 0.58, r_g = 0.98) with each other at both the levels. Estimates of broad sense heritabilities were low to moderate; these were 22% and 23% for boll weight and lint percentage respectively. For seed cotton yield, plant height and number of bolls, the estimates being 33%, 35% and 38%, respectively. These results suggest that rigorous plant selection is required to identify desirable plants from F_2 generation.

Key Words: Heritability; Phenotypic correlation; Genotypic correlation; Yield components; *Gossypium hirsutum* L.

INTRODUCTION

The ultimate objective of a cotton breeder is to develop high yielding varieties, through selection and breeding, utilizing available genetic resources. The final product of cotton plant i.e., seed cotton yield is the outcome of interplay between genetic and non-genetic components and due to complex nature of the interaction selection, of plants from breeding population, showing harmonious combination of desirable characters becomes difficult. Thus, for the development of promising genotypes, the cotton breeder is obliged to study the breeding material regarding the nature and degree of correlations among seed cotton yield, its plant height, number of bolls, boll weight and ginning outturn under particular environmental conditions.

In addition, availability of information on the extent to which variation in individual plant character is transmitted to the next generation is also important to speed-up the process of screening the breeding population in order to looking for a plant having greater yield potential. The previous work done on this aspect of cotton plant showed that seed cotton yield had positive and significant correlation with plant height and number of bolls (Sultan *et al*., 1999; Satange *et al*., 2000), whilst Arshad *et al*. (1993) reported that plant height and number of bolls were positively and significantly correlated with each other.

The present investigations were carried out at the University campus in order to study the degree of phenotypic and genotypic correlations among seed cotton yield and its components, and also heritability of the variation existed in F_2 population originated from different combinations.

MATERIALS AND METHODS

The plant materials used in the present investigation derived from 20 F_1 families developed by crossing five *Gossypium hirsutum* L. varieties/accessions according to diallel system of mating. The parents were CIM-726 (white cotton), Dark brown, Light brown, Dark green and Light green. The F_2 population of 20 families and 5 parents were planted in the field following randomized complete block design with three replications in the field during 2002/03. Each of the 25 entries had 30 plants spaced 30 cm within and 75 cm between the rows. The seeds were dibbled to ensure uniform plant population. All the recommended agronomic practices and plant protection measures were adopted to obtain healthy plants.

At maturity the data were taken on 28 consecutive plants leaving one plant on either side of each row in each replication. The data on individual plants were collected on plant height, number of bolls, boll weight, lint percentage and seed cotton yield. The F_2 data were subjected to analysis of variance technique (Steel & Torrie, 1980) to see whether the genotypic differences for the characters under study were present. Data of two characters were also analyzed using analysis of co-variance technique (Steel & Torrie, 1980), and the mean products were used to determine genotypic (r_g) and phenotypic correlation coefficients (r_p) using the formulae given by Kwon and Torrie (1964). Estimates of broad sense heritability ($h^2_{B.S.}$) were calculated using genotypic and error mean squares obtained from the analysis of variance of the characters. The mean squares were used to calculate genotypic variance (δ^2g**)** and environmental variance (δ^2e) following Singh and Chaudhry (1985).

RESULTS

The mean squares obtained from analysis of variance showed highly significant ($P \leq 0.01$) differences for plant height, number of bolls and seed cotton yield, whilst the variances for boll weight and lint percentage were reduced to significant level ($P \leq 0.05$, Table I).

The phenotypic (r_p) and genotypic correlation coefficients (r_g) indicate that plant height had positive and complete association with number of bolls ($r_p = 0.581$, $r_g = 0.982$) and seed cotton yield ($r_p = 0.590$, $r_g = 1.00$), the coefficients being significant at genotypic and phenotypic levels (Table II). Number of bolls showed positive and significant correlation with seed cotton yield at both the levels ($r_p = 0.968$, $r_g = 1.00$) and again the relationship appeared to be strong. However, plant height was found to be negatively and non-significantly correlated with boll weight and lint percentage. Association among number of bolls, boll weight and lint percentage were negative and similarly boll weight and lint percentage were found to have negative association with seed cotton yield (Table II).

The estimates of broad sense heritabilities of the characters varied from low to moderate (Table III). For number of bolls it is 38%, followed by plant height (35%), seed cotton yield (33%), lint percentage (23%), and for boll weight the estimate was the lowest (22%).

DISCUSSION

The results of the analysis of the F_2 data for phenotypic and genotypic correlations showed that yield of seed cotton, under the limits of present studies, was positively and significantly associated with plant height and number of bolls (Table II). The relationship was strong at phenotypic and complete at genotypic level ($r_p = 0.590$, $r_g = 1.00$ and $r_p = 0.968$, $r_g = 1.00$). This information suggest that an increase in plant height had increased number of bolls, which in turn increased seed cotton yield in the present plant material. Similar results were reported by Azhar *et al*. (2000), Hussain *et al*. (2000) and Baloch *et al*. (2001). However, plant height was negatively correlated with boll weight and lint percentage (Table II). Similarly, associations among number of bolls, boll weight and lint percentage were found to be negative. In previous studies, Khan *et al*. (1977), Khan *et al*. (1979), Tariq *et al*. (1992), Alam (1995) and Shah (1995) also reported the existence of negative associations among plant height, number of bolls, boll weight and lint percentage earlier in their research findings.

Although the estimates of broad sense heritability for all the characters were moderate, these suggest that for identifying the plants having greater number of bolls from F_2 population, cotton breeder is required to make rigorous selection, as suggested by Bhatade and Bhale (1984), Khan

Table I. Mean squares from analysis of variance of different traits in *Gossypium hirsutum* L.

Source of variation	Degree of freedom	Plant height	Number of bolls	Boll weight	Lint percentage	Seed cotton yield
Replications	2	$18.253^{N.S.}$	$35.289^{N.S.}$	$0.143^{N.S.}$	$5.852^{N.S.}$	$794.237^{N.S.}$
Families	24	102.748**	223.152**	0.161*	5.528*	2055.190**
Error	48	39.281	77.905	0.087	2.943	837.030

Table II. Phenotypic and Genotypic correlation coefficients among seed cotton yield and other characters in *Gossypium hirsutum* L.

Traits		Number of bolls	Boll weight	Lint percentage	Seed cotton yield
Plant height	r_p	0.581**	$-0.067^{N.S.}$	$-0.133^{N.S.}$	0.590**
	r_g	0.982*	$-0.172^{N.S.}$	$-0.235^{N.S.}$	1.00*
Number of bolls	r_p		$-0.214^{N.S.}$	$-0.085^{N.S.}$	0.968**
	r_g		$-0.201^{N.S.}$	$-0.155^{N.S.}$	1.00*
Boll weight	r_p			$-0.108^{N.S.}$	$0.021^{N.S.}$
	r_g			$-0.309^{N.S.}$	$-0.055^{N.S.}$
Lint percentage	r_p				$-0.112^{N.S.}$
	r_g				$-0.254^{N.S.}$

N.S., *, ** shows non-significant, significant and highly significant differences respectively.
r_p is the phenotypic correlation coefficient
r_g is the genotypic correlation coefficient

Table III. Estimates of Broad sense Heritabilities of five characters of *Gossypium hirsutum* L.

Components of variation	Plant height	Number of bolls	Boll weight	Lint %age	Seed cotton yield
$\delta^2 g$ (Genotypic variance)	21.156	48.416	0.025	0.862	406.053
$\delta^2 e$ (Environmental variance)	39.281	77.905	0.087	2.943	837.030
$\delta^2 p$ (Phenotypic variance)	60.437	126.321	0.112	3.805	1243.083
Heritability($h^2_{B.S.}$) (v_g / v_p)	0.35	0.38	0.22	0.23	0.33

and Tariq (1984), Lancon (1993), Hussain *et al*. (1998) and Hu *et al*. (2001). However, Falconer and Mackey (1996) suggested that estimates of heritability are subject to environmental conditions, and therefore may be used with great care and caution in plant improvement programme.

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