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ESTIMATES OF HERITABILITIES AND PATTERN OF ASSOCIATION AMONG DIFFERENT CHARACTERS OF *GOSSYPIUM HIRSUTUM* L.

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Estimates of broadsense heritability of seven characters measured in 26 F_3 progenies were of varying magnitude ranging from 62% to 97%. Number of bolls, boll weight, and staple length showed positive and significant correlation with seed cotton yield. Staple length also had positive and significant association with number of bolls. Lint index and seed index were also positively correlated with each other, but lint index exhibited negative relationship with other characters. The nature of correlation of staple length, boll weight and number of bolls with seed cotton yield, and high estimates of heritability of these characters suggest that chances of improving seed cotton yield and staple length do exist by following single plant selection method.
Key words: *Gossypium hirsutum* L., heritability, pattern of association

INTRODUCTION

Although tremendous increase in national cotton production has been made by planting high yielding varieties during the recent years, yet the need to accelerate the efforts for breeding varieties to boost cotton production has become more acute than before. For the development of a cultivar through selection and breeding, availability of genetically based variation in seed cotton yield and its components is essential..

Yield of seed cotton, as in other crops, is the product of many genetic and non-genetic components: and thus selection of a plant showing harmonious combination of desirable characters is complicated. This crucial task of screening the material becomes easier if some information about the nature and degree of correlation among yield and its components is available. The previous work showed that number of bolls, boll weight, seed and lint indices had positive association with seed cotton yield (Khan et al., 1991; Tariq et al., 1992; Akbar et al., 1994; Azhar et al., 1997; Azhar et al., 1999). Ginning percentage and staple length also exhibited significantly positive correlation with yield of seed cotton (Khan et al., 1985; Hussain et al., 1998). Estimates of broadsense heritabilitiesof variation of varying magnitude in plant yield and other characters have been reported (Khan and Tariq, 1984; Sethi and Singh, 1984; Al-Rawi et al., 1986; Bahadur et al., 1994, Akbar et al., 1994). The present paper reports these estimates about seed cotton yield and its components, and the pattern of genotypic correlation among them in the plant material developed at the Campus.

MATERIALS AND METHODS

In present study, 26 F_3 families and two standard cultivars, NIAB-78 and FH-682 were used. The segregating families were developed by crossing 14 exotics namely Bar F-8, Arkogo 904, Hg 105 MHE, Pilose 3, HgHNE-134, Highm-min, HGF-197, HG-61-N, LA677-FG-N-E, Seadland, 6-1-3, G.H DO S-Nll, Hgt-216,. Hgs M-451, to five local varieties CIM-I09, CIM-240, FH-87, FH-682 and Gohar. The crosses were made in different combinations of the parents. The seeds of 28 entries were planted in randomized complete block design with three replications. The seeds of each family were dibbled in 3 rows, each 3.6 m long having 13 plants spaced 30 cm within the row and 75 cm apart between the rows. Thus there were 39 plants in each repeat.

For measurement of characters 11 middle plants in the central row were taken, one plant on either end of the row was treated as guarded. The characters measured were number of bolls, yield of seed cotton (g), average boll weight (g), ginning percentage, seed index, lint index and staple length (mm). The family means of all the characters were subjected to analysis of variance technique to see whether the genotypic differences were significant. Data of two characters were analysed by using analysis of covariance and the mean products were used to calculate genotypic correlation between the two characters according to the method given by Kwon and Torrie (1964). Estimates of broadsense heritability (h^2_{Bs}) of all the characters were calculated by using genotypic "and error mean squares obtained from the analysis of variance, by following the formula given by Singh and Chaudhry (1985).

RESULTS

The mean squares given in Table 1, showed that genotypic differences for seed cotton yield, number of bolls, boll weight, ginning percentage, staple length, seed and lint indices were significant (P ~ 0.01).

Table 1. Mean squares and mean products of seven characters of G. *hirsutum* L.

Source of variation		Degrees of freedom	Seed cotton yield	Number of bolls	Boll weight	Ginning percentage	Staple length	Seed index	Lint index
(a) Mean squares									
Replications		2	11,595	0.634	0.012	0.114	0.039	0.053	0.001
Genotypes		27	327.056"*	26.206"*	0.193"	3.699"	2.843"	1,222"	0.076"
Error		54	28.344	3.014	0.073	0.163	0.097	0.027	0.015
(b) Mean products									
Seed cotton yield	Genotypes			83,46"	2.61"	1,36"	7.21"*	-4.03"	-2.12"
	Error			5.97	0.51	-0.07	-0.26	0.12	0.11
Number of bolls	Genotypes			-	_0.23 NS	-0.20"	1,77"	-0.52"	-0'.45"
	Error				-0.22	-0.02	-0.14	0.05	0.04
Boll weight	Genotypes			-	-	0.11"*	0.03"	-0.15"	-0.04"
	Error					0.003	0.01	-0.002	-0.001
Ginning percentage	Genotypes			-	-	-	0.12"	-1,95"	-0.35"
	Error						-0.06	-0.003	-0.031
Staple length	Genotypes			-	-	-	-	-0.05"	-0.08"
	Error							-0.002	0.01
Seed index	Genotypes			-	-	-	-	-	0.26"
	Error								0.003

*, **, NS = Significant (P ~ 0.05), highly significant (P ~ 0.01) and non-significant respectively.

Table 2. Estimates of heritabilities and genotypic correlation coefficients of seven characters of G. *hirsutum* L.

Source of variation	Vg	h^2_{BS}	Number of bolls	Boll weight	Ginning percentage	Staple length	Seed index	Lint index
Seed cotton yield	99.570 (9,448)	0.913	0.931'	0.352'	0.044	0.260'	-0.219	-0.526'
Number of bolls	7.376 (1,004)	0.884		-0.006	-0.020	0.239'	-0.108	-0,413'
Boll weight	0.039 (0.024)	0.618			0.253	0.032	-0,400'	-0,457'
Ginning percentage	1,178 (0.054)	0.955				0.056	-0.945'	-0.823'
Staple length	0.915 (0.323)	0.965					-0.024	-0.169
Seed index	0.398 (0.009)	0.977						0.953'
Lint index	0.020 (0.005)	0.800						

* Denotes significant differences (P ~ 0.05).
Vg indicates genotypic variances and the values in parentheses are the error variance.

Results of analysis of covariance are given in Table 2. The mean products revealed that covariance of seed cotton yield with all the characters was highly significant (P ~ 0.01). Mean product of number of bolls with boll weight was non-significant, but with the remaining characters the values were significant (P ~ 0.01). Covariance of boll weight with ginning percentage, staple length, seed and lint indices were significant (P ~ 0.01). Mean products of ginning percentage with staple length, seed and lint indices were significant. Covariance of staple length with seed and lint indices, and of seed index with lint index were highly significant (P ~ 0.01).

Coefficient of genotypic correlations among different character combinations are given in Table 2. The coefficient revealed that number of bolls, boll weight and staple length had positive and significant correlation with yield. Number of bolls and staple length were positively and significantly correlated with each other, but number of bolls showed negative association with lint index. Boll weight exhibited negative relationship with seed and lint indices, the »; being -0.400, and -0.457, respectively. The same nature of association occurred between ginning percentage and seed and lint indices, the 'r_g' being -0.945 and -0.823 respectively. Correlation between seed index and lint index was significantly positive, whilst staple length had negative association with seed and lint indices.

Genotypic and error variance, and estimates of heritabilities of seven characters are given in Table 2. These estimates for all the characters are generally of high magnitude. The estimates for seed cotton yield, number of bolls, boll weight, ginning percentage, staple length, seed index, and lint index are 0.91, 0.88, 0.61, 0.~5, 0.96, 0.97 and 0.80 respectively.

DISCUSSION

From evolutionary point of view, whether it may be occurring under natural conditions or under experimental conditions, the availability of variation in a plant character is essential. The progress in improvement in a character is more rapid and effective if the variation subjected to selection is controlled by a significant genetic component. In this study the 26 segregating families of *Gossypium hirsutum* L. exhibited significant amount of variation in all the characters measured on individual plant basis. The F, families were derived from promising plants which originated from different crosses, and therefore, the analysis of the data by following an appropriate biometric method to study the genetic basis of the variation was not possible here, but according to the suggestion of Mather and Jinks (1982), the 'variation in seven characters had arisen due to the presence of additive genetic effects.

The estimates of braodsense heritabilities of all the characters are inflated (Table 2). Saranga et al. (1992) had speculated that higher magnitude of heritabilities may be a result of greater genetic variation in F, generation due to the expression of genes and/or a smaller environmental variation. According to Falconer and Mackay (1996) estimates of heritability are subject to considerable environmental variation, and thus these must be reported and used with great care and imagination while screening the material in order to look for desirable genotypes from F, population. Therefore, it is suggested that these estimates about the plant material studied here may be substantiated by using some biometric technique.

When potential plant material is available to a breeder, 'the selection of plants combining desirable features becomes important. Genotypic correlation analysis of the breeding material showed that number of bolls, average boll weight and staple length were strongly and positively correlated with seed cotton yield (Table 2). Although seed and lint indices are considered to be components of plant yield (Singh, 1982; Soomro et al., 1982), these were revealed to have negative association with seed cotton yield, and this got sufficient support from the previous studies (Mithaiwala et al. , 1984; Khan et al., 1985). The opinion of different workers regarding the correlation between fibre quality 'characteristics, and seed cotton yield differs in the literature e.g. Cheng and Zhao (1991) and Khan et al. (1991) reported negative association, and in contrast the studies of Khan et al. (1985), Hussain et al. (1998) and Azhar et al. (1999) showed positive relationship between staple length and plant yield as also found in the present plant material.

The presence of strong and positive association of number of bolls, boll weight and staple length with seed cotton yield, and significant relationship between staple length and number of bolls in the plant material is really encouraging to a cotton breeder, suggesting that the segregating material holds a great promise for improving seed cotton yield and its staple length by following the single plant selection method.

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