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# Correlation Analysis of Seed Cotton Yield with Fiber Characteristics in *Gossypium hirsutum* L.

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## ABSTRACT

A 5×5 diallel cross experiment was performed to study the correlation and broad sense heritability in *Gossypium hirsutum* L. Results showed that seed cotton yield was positively and significantly associated with fiber fineness ($r_p$ = 0.59, $r_g$ =0.65) and fiber strength ($r_p$ =0.28, $r_g$ =0.54). Association between fiber length and seed cotton yield ($r_p$ =-0.45, $r_g$ =-0.82) was negative at both levels but significant only at phenotypic level. Similarly relationship between fiber fineness and fiber length was found to be negative at phenotypic and genotypic levels ($r_p$ =-0.61, $r_g$ =-0.84) but significant only at phenotypic level. The estimates of broad sense heritability of the characters studied range 28% to 51%.

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

## INTRODUCTION

Pakistan fetches a substantial amount of foreign exchange annually by exporting raw fiber and the finished products. Although synthetic fibers are commonly used in the textile industry, uses of natural fibers are preferred in making garments. In addition to white fiber, a number of other lint colours such as brown, green, grayish, tan etc. exist in nature, and the colour variation had been reported to be true (Kohel, 1985).

The advancement made in fiber technology and availability of chemicals for dyeing, the use of white cotton for making garments has become popular, and resultantly the use of naturally coloured cotton had abandoned. The luxurious use of chemicals for dyeing fiber in the local textile industry has threatened the health of mankind by making the living environment non-friendly. The chemicals being used for dyeing pollutes water. The vegetables produced by irrigating contaminated water in sub-urban areas are eaten by the consumers, and causing many diseases.

The garments which are manufactured using naturally coloured fibers have the potential to compete successfully in the international market, as the natural colours do not fade due to repeated washings but becomes darker and more intense (Dickerson, 1995). The changing circumstances around the world expects the cotton breeders to explore the potential of breeding cotton varieties having natural colours ,other than white, to be used in the textile industry. The present work is a step towards this approach. The previous work showed that seed cotton yield had significant negative correlation with fiber fineness, fiber strength and fiber length (Cheng & Zhao, 1991; Khan *et al*., 1991; Gomma, 1995).

The present research work involving $F_2$ generation was carried out at the University campus to study the nature and magnitude of phenotypic and genotypic correlations among fiber fineness, fiber strength, and fiber length and seed cotton yield in the plant material developed by crossing varieties of varying colours.

## MATERIALS AND METHODS

In the present investigation, five parents namely, CIM-726 (white cotton), Dark brown, Light brown, Dark green, Light green were crossed in all possible combinations to develop 20 $F_1$ hybrids. The seed of parents and 20 $F_1$ hybrids were field planted in single row plot having 30 plants in a row. The seeds were space planted at 75 cm between the rows and 30 cm within the row. The experimental layout was randomized complete block design with three replications. 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 from 28 consecutive plants leaving one plant at both sides of rows to avoid the border effects. The total produce of seed cotton of all the plants in 25 families was weighed in grams, and mean values of each family in each replication were obtained. As the samples of lint of each plant were tested for fiber fineness (µg / inch), fiber strength (g / tex), and fiber length (mm). The mean values of the four characters were subjected to analysis of variance technique (Steel & Torrie, 1980) in order to determine whether the genotypic differences were significant. The coefficients of phenotypic ($r_p$) and genotypic ($r_g$) correlation were computed among the four traits following Kwon and Torrie (1964). Genotypic and error mean squares obtained from the analysis of variance were used to calculate estimates of broad sense heritability ($h^2_{B.S.}$) by using the method given by Singh and Chaudhry (1985).

## RESULTS

The mean squares obtained from analysis of variance showed that differences for fiber fineness, fiber length and seed cotton yield were highly significant among the genotypes ($P \leq 0.01$, Table I) whilst the variance ratio for fiber strength was reduced to significant level ($P \leq 0.05$).

Phenotypic and genotypic correlation coefficients indicated that seed cotton yield was positively and significantly correlated with fiber fineness and fiber strength in the present plant material. The magnitude of coefficients being rp =0.59, rg =0.65 and rp =0.28, rg =0.54, respectively (Table II). Association between fiber length and seed cotton yield ($r_p$ =-0.45, $r_g$ =-0.82) appeared to be negative at both levels. Similarly relationship between fiber fineness and fiber length was found to be negative at phenotypic and genotypic levels ($r_p$ =-0.61, $r_g$ =-0.84). The associations amongst the remaining character pairs were either negative or positive but statistically non-significant.

Genotypic variances ($\delta^2 g$) and environmental variances ($\delta^2 e$) were calculated using genotypic and error mean squares obtained from analysis of variance of the four plant characters (Table I) as suggested by Singh and Chaudhry (1985), and were used to calculate estimates of broad sense heritability of the characters (Table III).

The estimates of broad sense heritability differed from each other and varied from low to moderate. For fiber length it was the highest (51%) followed by fiber fineness (41%), seed cotton yield (33%) and fiber strength (28%).

## DISCUSSION

In the present plant material of *Gossypium hirsutum* L. which was developed by crossing varieties of varying shades, seed cotton yield was found to be positively and significantly associated with fiber fineness ($r_p$ =0.59, $r_g$ =0.65) and fiber strength ($r_p$ =0.28, $r_g$ =0.54, Table II), suggest that any improvement in these characters may increase yield of seed cotton. Although in previous studies involving white cotton, seed cotton yield had been reported to be negatively associated with fiber fineness and fiber strength. The association between yield of seed cotton and fiber length was revealed to be negative and highly significant at phenotypic level ($r_p$ =-0.45) while at genetic level the correlation ($r_g$ =-0.82) was negative and non-significant. It means that improvement in fiber length may decrease seed cotton yield at phenotypic level. A highly significant but phenotypically negative ($r_p$=-0.60) relationship was found between fiber fineness and fiber length while at genotypic level the association ($r_g$=-0.84) between fiber fineness and fiber length was also negative but statistically it was non-significant. Such results had already been reported by Boucherova (1979), Khan *et al*. (1991), Lancon *et al*. (1993), Carvalho *et al*. (1994), Cheng and Zhao (1991), Gomma (1995) and Ahmad and Azhar (2000).

The estimates of broad sense heritabilities for the characters studied were of lower to moderate. The estimates were 28% fiber strength, 33% for seed cotton yield, 41% for fiber fineness and 51% for fiber length. Similar results were reported by Al-Rawi *et al*. (1986), Zhou (1986), Lancon (1987), Hussain *et al*. (1998) and Deshmukh *et al*. (1999).

**Table II. Phenotypic and genotypic correlation coefficients for all possible pairing of four characters of cotton plant**

| Traits | | Fibre strength | Fibre length | Seed cotton Yield |
|---|---|---|---|---|
| Fibre fineness | $r_p r_g$ | 0.172 N.S. 0.497 N.S. | -0.606** | 0.589** |
| | | | -0.840 N.S. | 0.647* |
| Fibre strength | $r_p r_g$ | | -0.009 N.S. | 0.280* |
| | | | -0.180 N.S. | 0.545* |
| Fibre length | $r_p r_g$ | | | -0.449** |
| | | | | -0.822 N.S. |

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

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**Table I. Mean squares obtained from analysis of variance of four plant characters of *Gossypium hirsutum* L.**

| Source of variation | Degree of freedom | Fibre fineness | Fibre strength | Fibre length | Seed cotton Yield |
|---|---|---|---|---|---|
| Replications | 2 | 0.024 N.S. | 0.313 N.S. | 1.269 N.S. | 794.237 N.S. |
| Genotypes | 24 | 0.146** | 2.441* | 3.289** | 2055.190** |
| Error | 48 | 0.047 | 1.139 | 0.788 | 837.030 |

N.S., *, ** shows non-significant, significant and highly significant differences.

**Table III. Components of variance and heritability estimates of four characters of *Gossypium hirsutum* L.**

| Components of variation | Fibrefineness | Fibre strength | Fibre length | Seed cotton yield |
|---|---|---|---|---|
| $\delta^2 g$ (Genotypic variance) | 0.033 | 0.434 | 0.830 | 406.053 |
| $\delta^2 e$ (Environmental variance) | 0.047 | 1.139 | 0.788 | 837.030 |
| $\delta^2 p$ (Phenotypic variance) | 0.080 | 1.573 | 1.622 | 1243.083 |
| Heritability($h^2_{B.S.}$) ($v_g/v_p$) | 0.41 | 0.28 | 0.51 | 0.33 |

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