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# GENETIC VARIABILITY IN DIFFERENT BIOMETRIC TRAITS OF UPLAND COTTON GENOTYPES

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## ABSTRACTS

The experiment was conducted to determine the direct and indirect effects of the some yield attributing traits like plant height, bolls. plant$^{-1}$, boll weight, seed index, lint index and ginning outturn on seedcotton yield per hectare. The experiment was carried out in randomized complete block design with twelve genotypes during 2014-15 at Central Cotton Research Institute Sakrand. Analysis of Variance revealed that all genotypes significantly differ from each other for all the recorded traits which were further grouped by the least significant difference. Seedcotton yield per hectare showed highly significant positive genotypic and phenotypic correlation with bolls. plant$^{-1}$ (0.984, 0.982) and with boll weight (0.490, 487). Plant height also showed highly significant negative genotypic and phenotypic correlation with seed index (-0.526, -0.522). Plant height Seed index, lint index and ginning outturn showed non significant genotypic and phenotypic correlation with seedcotton yield per hectare. Bolls. plant$^{-1}$ had maximum direct effect (0.945) followed by the boll weight (0.062), seed index (0.007), lint index (0.040) and plant height and ginning outturn had negative direct effect (-0.119 and -0.014) to the seedcotton yield per hectare.

**Keywords:** Upland Cotton, GCV and PCV, Genetic Advance, Correlation Coefficient, Path Analysis

## INTRODUCTION

Cotton is an important fiber and cash crop of our country which not only provides lint to the textile industry but also plays a significant role in employment during cultivation, ginning, spinning and making garments. Being a second most important oilseed crop after soybean worldwide but in Pakistan it contribute 65-70% to the local oil production (Khan *et al.* 2007; 2010a; 2010b; Gul *et al.,* 2014).

Pakistan is the 4th largest cotton producing country after china, India and America. This crop contribute 1.6% to the country GDP and 7.8% to the value added in agriculture. It earns 45-60% foreign exchange depends upon the production and consumption (Khan *et al.,* 2009a, 2209b, Gul, *et al.,* 2014). During the year 2013-14 cotton was cultivated on the area of 2806 thousand hectares with the production with the average 773kg per hectare and total production was 12.8 million bales (Anonymous. 2013-14).

From last two decades average cotton yield of Pakistan is stagnant and quite low as compared to other cotton growing countries like Australia, America, China (Khan and Hassan, 2011). Many factors responsible for this low yield include rain fall during sowing, high temperature, CLCV and other diseases, improper production technology, low yielding cultivars etc.,

Development of the cultivar having better characters, higher yield potential, resistant to insect pest, better fit to local environment is the primary objective of the cotton breeders. Seedcotton yield influenced by both genotypic and environment factors and interaction between these factors makes the selection difficult, knowledge between the yield associating traits facilitate the breeder in selecting the better genotype.

Correlation coefficient is an important biometrical tool which determines the simple relation between the traits but it does not gives accurate results about final selection criteria (Ahmad *et al.,* 2014; Cakmakci *et al.,* 1998; Ekinci *et al.,* 2010). Iqbal *et al.,* (2003); Wang *et al.,* (2004); Khan *et al.,* (2007); Ahmed *et al.,* (2008); Taohua and Haiping *et al.,* (2006); Meena *et al.,* (2007); Ahsan *et al.,* (2014) and Chatha *et al.,* (2013) studied the adaptability and variability and positive correlation for different agronomic traits with seed cotton yield in *Gossypium hirsutum* L. Mendez-Natera *et al.,* (2012) observed the positive association of seed cotton yield with yield components in *hirsutum* cultivars. Path analysis has been used to develop selection criteria for complex biometrical traits in several crops (Kang *et al*., 1993; Diz *et al.,* 1994; Ekinci *et al.,* 2010). For simultaneous selection of both yield and fiber quality traits, knowledge about association of yield and its path is a prerequisite.

The objective of the study was to assess genetic variability, genotypic and phenotypic coefficient of variation, correlation coefficients and their direct and indirect effects. The information thus obtained may be useful to define the suitable selection criteria for yield improvement through selection.

## MATERIALS AND METHODS

This experimental material consisted of 12 upland cotton genotypes viz., CIM-496, CIM-499, CIM-506, CIM-534, MNH-786, BH-160, BH-167, CRIS-342, CRIS-134, Sadori, Hari dost and Shahbaz. The experiment was laid out in randomized complete block design with three replications at Central Cotton Research Institute Sakrand (Benazirabad), Sindh during 2014-15. The genotypes were sown in four rows with plant to plant distance 30cm and row to row 75cm. All recommended agronomic practices were followed equally for each replication. Ten randomly competitive plants were selected in each replication and observations on biometric traits were calculated for plant height (cm), bolls. plant$^{-1}$, boll weight (g), ginning out turn (%) and seedcotton yield per hectare. The mean performance of the individual genotypes was employed for statistical analysis. To test the significance of the characters the analysis of variance was carried out according to the Steel and Torrie (1984). Genotypic and phenotypic coefficient of variation (GCV and PCV) were calculated as formula given by the Burton (1952), broad sense heritability $H^2$ by the Burton and Vane (1953) and Genetic advance at 20% selection intensity was calculated after given by the Poehlman and Sleper (1995). All correlations i.e. phenotypic and Genotypic were calculated by the statistical technique as suggested by the Kowon and Torrie (1964). Path coefficients analysis was worked out as suggested by the Dewey and Lu (1959).

## RESULTS AND DISCUSSION

Analysis of variance (Table-2) revealed that the genotypes were significantly varied from each other for all the recorded traits. Ahsan *et. al.* (2014), Ashokkumar and Ravikesavan (2010), Bechere *et. al.,* (2014), Dhivya *et. al.* (2014), Farooq *et. al*. (2014) and Vineela *et al*., (2013) also observed the significant variations in upland cotton for the various traits. Maximum plant height i.e. 147.67 cm attained by the genotype MNH-786 followed by the BH-167 i.e. 146.0cm, highest bolls plant$^{-1}$ was observed in the cultivar CRIS-342 (35.42) and CRIS-131 (31.40), highest boll weight was found in BH-160 (3.60g) and BH-167 (3.34g), highest seed index observed for the cultivar CIM-499 (8.61g) followed by the Sadori (7.12g), maximum lint index was observed for the cultivars CIM-499 (6.98g) and Sadori (5.97g), ginning outturn was highest for the cultivars CIM-534 (40.26%) and CIM-496 (38.23%) and seedcotton yield per hectare was produced highest by the cultivars CRIS-342 (3134.7Kg) and CRIS-131 (2821.0Kg) (Table 1).

The estimates of genetic variability parameters were worked out and presented in Table 3. PCV higher than GCV which indicated environmental influence on all recorded biometric traits. Highest phenotypic and genotypic coefficient of variations was observed for the traits lint index, seedcotton yield per hectare and bolls. plant$^{-1}$ thereby exhibiting the sufficient variability having a scope of genetic improvement through selection (Khan *et al.,* 2009b) and Very low genotypic and phenotypic coefficient of variation was observed for the traits plant height, boll weight and ginning outturn. High heritability was found for all the traits. The heritability was more fruitful when expressed in term of genetic advance. Highly heritability coupled with high genetic advance in term of percent of mean was observed for the trait lint index, seedcotton yield per hectare, bolls plant$^{-1}$ and seed index indicating the importance of these traits in crop improvement. The present findings totally matched with the results of Khan *et al.,* (2007; 2010b) and Majeedano *et al.,* (2014).

Genotypic and phenotypic correlation coefficients were presented in Table 4. Highly significant and positive genotypic and phenotypic correlation with seedcotton yield per hectare was observed for the trait bolls. plant$^{-1}$ (0.984, 0.982) and boll weight (0.490, 0.487) (Baloch *et al.,* 2014). Plant height, seed index, lint index and ginning outturn showed non significant genotypic and phenotypic correlation with seed cotton yield per hectare. Erande *et al.,* (2014) also observed the non significant correlations of the above recorded traits with the seedcotton yield. Plant height showed highly significant but negative genotypic (-0.526) and phenotypic (-0.522) correlation with the seed index and highly significant negative genotypic (-0.432) and significant negative phenotypic (-0.419) correlation with lint index (Erande *et al.,* 2014), bolls. plant$^{-1}$ exhibited highly significant but negative genotypic correlation (-0.449) and highly significant positive phenotypic correlation (0.448) with the trait boll weight (Ahsan *et. al.,* 2015, Bangaremma *et al.,* 2014), seed index depicted significant positive genotypic (0.361) and phenotypic (0.358) correlations with the trait lint index (Erande *et al.,* 2014) and lint index showed highly significant genotypic (0.499) and phenotypic (0.491) correlations with the trait ginning outturn (Asad *et al.,* 2002; Bangaremma *et al.,* 2014). All

other correlations were non significant the results were totally in conformity with the findings of Ahsan *et al.,* (2014), Bangaremma *et al.,* 2014), Gul *et. al.,* (2014); Dhivya *et. al.* (2014).

Table 1. Average performance of the different upland cotton genotypes for the recorded biometric traits.

| Sr. | Genotypes | Plant Height | Bolls Plant$^{-1}$ | Boll Weight | Seed Index | Lint Index | GOT% | Seed cotton Yield ha$^{-1}$ |
|---|---|---|---|---|---|---|---|---|
| 1 | CIM-496 | 119.02 i | 25.70 h | 3.26 d | 8.18 d | 5.07 b | 38.23 b | 2241.7 f |
| 2 | CIM-499 | 124.31 efg | 28.13 e | 2.73 j | 8.61 a | 6.98 a | 35.60 h | 2486.7 c |
| 3 | CIM-506 | 147.05 c | 25.23 i | 3.16 e | 7.77 d | 4.98 d | 36.56 g | 2170.3 g |
| 4 | CIM-534 | 125.30 ef | 28.13 e | 2.94 g | 8.61 e | 3.93 a | 40.26 a | 2461.3 d |
| 5 | MNH-786 | 147.60 a | 29.96 c | 2.98 f | 6.18 e | 3.97 h | 37.70 c | 2494.3 c |
| 6 | BH-160 | 122.67 gh | 26.10 g | 3.60 a | 7.77 d | 5.14 d | 36.50 g | 2185.0 e |
| 7 | BH-167 | 146.03 a | 23.36 j | 3.34 b | 7.86 f | 3.58 c | 37.20 f | 1924.5 h |
| 8 | CRIS-342 | 126.02 e | 35.30 a | 2.83 i | 7.86 f | 3.58 c | 37.53 d | 3134.7 a |
| 9 | CRIS-134 | 121.01 h | 31.40 b | 3.30 c | 7.79 c | 5.57 d | 37.53 d | 2821.0 b |
| 10 | Sadori | 132.03 d | 22.23 k | 2.23 d | 7.12 b | 5.97 e | 37.36 e | 1930.3 h |
| 11 | Hari Dost | 144.02 b | 29.36 d | 3.16 e | 6.53 e | 3.93 f | 38.30 b | 2469.7 d |
| 12 | Shahbaz | 124.02 fg | 26.46 f | 2.88 h | 6.47 e | 5.03 g | 36.60 g | 2326.0 e |
| | Mean | **130.92** | **27.61** | **3.12** | **7.56** | **4.73** | **37.45** | **2387.1** |

Table 2. Analysis of Variance of different biometric traits of the upland Cotton.

| No. | Source of Variation | df | Plant Height | Bolls Plant$^{-1}$ | Boll Weight | Seed Index | Lint Index | GOT% | Seed cotton Yield ha$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Genotypes | 11 | 327.46$^{**}$ | 38.851$^{**}$ | 0.1860$^{**}$ | 1.982$^{**}$ | 3.454$^{**}$ | 5.1500$^{**}$ | 359092$^{**}$ |
| 2 | Replications | 2 | 0.581 | 0.0250 | 0.0001 | 0.002 | 0.001 | 1.0500 | 3.0000 |
| 3 | Error | 22 | 1.345 | 0.0292 | 0.0004 | 0.000 | 0.023 | 0.0072 | 95.000 |

**and * Significant at 1.0 and 5.0 per cent level of probability; MS: Values of ANOVA results depicting the highly significant differences among the genotypes.

Table 3. Estimates of genetic variability parameters for the upland cotton genotypes.

| Sr | Character | Mean ± SE | Range | (PCV) | (GCV) | Heritability $H^2$ | Genetic Advance (% Mean) |
|---|---|---|---|---|---|---|---|
| 1 | Plant Height | 147.91 ± 0.66 | 119.0-147.67 | 8.01 | 7.96 | 98.78 | 16.30 |
| 2 | Bolls. Plant$^{-1}$ | 27.61 ± 0.098 | 22.1-35.5 | 13.04 | 13.02 | 99.77 | 26.80 |
| 3 | Boll Weight | 3.12 ± 0.012 | 2.73-3.62 | 7.99 | 7.97 | 99.33 | 16.36 |
| 4 | Seed Index | 7.56 ± 0.015 | 6.47- 8.61 | 10.74 | 10.73 | 99.94 | 22.13 |
| 5 | Lint Index | 4.73 ± 0.125 | 3.58 – 6.98 | 22.83 | 22.59 | 97.98 | 46.08 |
| 6 | GOT% | 37.45 ± 0.049 | 35.5-40.3 | 3.15 | 3.14 | 99.47 | 6.45 |
| 7 | Seedcotton Yield ha$^{-1}$ | 2387.08 ± 5.6 | 1920-3150 | 14.49 | 14.48 | 99.92 | 29.84 |

The path coefficient analysis showed that direct effect of bolls. plant$^{-1}$ (0.945) to the seed cotton yield per hectare was positive and highest followed by the seed index (0.007) and lint index (0.040) which totally support the findings of the Alkuddsi *et al.,* (2013) and Bechere *et al.,* (2014) . Plant. height (-0.119) boll weight (-0.062) and ginning outturn (-0.014) showed negative direct effect to the seed cotton yield per hectare (Table 5) (Alishah *et al.,* 2008). The residual effects in this path analysis only 0.00845 this shows most of the yield contributing traits included in this study.

Therefore it can be concluded from the genetic variability parameters, genotypic and phenotypic correlation and path coefficient analysis that numbers of bolls per plant and boll weight are the most important parameters and should be kept in mind while doing selecting the genotypes for higher seed cotton yield per hectare.

Table 4. Estimates of Phenotypic and Genotypic Coefficients of Correlation among recorded biometric traits of Upland Cotton.

| Characters | | Plant Height | Bolls Plant$^{-1}$ | Boll Weight | Seed Index | Lint Index | GOT % |
|---|---|---|---|---|---|---|---|
| Plant Height | $r_g$ | 1.00 | | | | | |
| | $r_p$ | 1.00 | | | | | |
| Bolls. plant$^{-1}$ | $r_g$ | -0.016$^{NS}$ | 1.00 | | | | |
| | $r_p$ | -0.157$^{NS}$ | 1.00 | | | | |
| Boll. Weight | $r_g$ | 0.040$^{NS}$ | -0.449$^{**}$ | 1.00 | | | |
| | $r_p$ | 0.037$^{NS}$ | 0.448$^{**}$ | 1.00 | | | |
| Seed Index | $r_g$ | -0.526$^{**}$ | -0.014$^{NS}$ | -0.006$^{NS}$ | 1.00 | | |
| | $r_p$ | -0.522$^{**}$ | -0.014$^{NS}$ | -0.006$^{NS}$ | 1.00 | | |
| Lint Index | $r_g$ | -0.432$^{**}$ | 0.259$^{NS}$ | 0.051$^{NS}$ | 0.361$^{*}$ | 1.00 | |
| | $r_p$ | -0.419$^{*}$ | -0.257$^{NS}$ | 0.048$^{NS}$ | 0.358$^{*}$ | 1.00 | |
| GOT % | $r_g$ | 0.029$^{NS}$ | 0.172$^{NS}$ | -0.014$^{NS}$ | 0.079$^{NS}$ | 0.499$^{**}$ | 1.00 |
| | $r_p$ | 0.030$^{NS}$ | 0.173$^{NS}$ | -0.015$^{NS}$ | 0.079$^{NS}$ | 0.491$^{**}$ | 1.00 |
| Seedcotton Yield. ha$^{-1}$ | $r_g$ | -0.292$^{NS}$ | 0.984$^{**}$ | 0.490$^{**}$ | 0.072$^{NS}$ | -0.162$^{NS}$ | 0.156$^{NS}$ |
| | $r_p$ | -0.291$^{NS}$ | 0.982$^{**}$ | 0.487$^{**}$ | 0.072$^{NS}$ | -0.161$^{NS}$ | 0.154$^{NS}$ |

Table 5. Phenotypic and Genotypic Path Analysis showing direct and indirect effects of different biometric traits on seed cotton yield per hectare.

| Characters | Plant Height | Bolls plant$^{-1}$ | Boll Weight | Seed Index | Lint Index | GOT % | Correlation with Yield ha$^{-1}$ |
|---|---|---|---|---|---|---|---|
| Plant Height | -0.1190 | -0.1495 | -0.0025 | -0.0037 | -0.0172 | 0.0004 | -0.292$^{NS}$ |
| Bolls. plant$^{-1}$ | 0.0188 | 0.9450 | 0.0279 | -0.0001 | -0.01033 | 0.0024 | 0.984$^{**}$ |
| Boll Weight | -0.0048 | -0.4243 | -0.0620 | -0.0004 | 0.0020 | -0.0002 | 0.490$^{**}$ |
| Seed index | 0.0626 | -0.0131 | 0.0004 | 0.0071 | 0.0144 | 0.0011 | 0.072$^{NS}$ |
| Lint Index | 0.0514 | -0.2452 | -0.0032 | 0.0025 | 0.0401 | -0.0069 | -0.161$^{NS}$ |
| GOT % | -0.0034 | 0.1636 | 0.0009 | 0.0006 | -0.0190 | -0.0141 | 0.156$^{NS}$ |

Residual effects were 0.00845

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