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# Correlation and Path Coefficient Analysis of Yield Components of Upland Cotton (*Gossypium hirsutum* L.) Sympodial

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**Abstract:** Phenotypic correlation and path coefficient analysis have been worked out for some important characters in fifteen genotypes (six parents, nine crosses) of American upland cotton (Gossypium hirsutum L.) Sympodial branches, bolls per plant, boll weight, G.O.T (%) and lint index were found to be positively correlated with yield per plant in all the genotypes at 1.0 percent level of probability. Further partitioning of correlation coefficients into direct and indirect path ways of influences showed that the characters having most influence on seed cotton yield were bolls per plant and boll weight, which should be taken care of while selecting for higher yields in further breeding programme.

**Key words:** Missing

## INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is an important cash crop of Pakistan. It enjoys prominent position in the economic perspective of Pakistan for its value and potential in strengthening the nation's economy. Cotton is cultivated cover 2.820 m.ha with an average yield of 713kg/ha., which contribute about 1.6 % value added in GDP of Pakistan [1]. Nevertheless, the need for further amplified efforts for continued genetic improvement of cotton is even greater today than before in the face of low production per unit area in Pakistan as compared to other advanced cotton-growing countries of the world. The cotton improvement programme is responded to the needs of the growers and industry and strived to combine high yield, early maturity and good fibre quality.

The main objective for a plant breeder is to evolve high yielding varieties. There are many factors on which the yield of cotton crop depends, such as plant height, number of fruiting branches, number of bolls per plant, boll weight, seed index, G.O.T% etc. It is desirable for plant breeder to know the extent of relationship between yield and its various components which will facilitate him in selecting plants of desirable characteristics. The knowledge of relationship among various yield components has been successfully exploited towards cotton improvement.

Correlation study is an important asset to cotton breeders. It is therefore, necessary to determine the relationship between yield and quality characters or between the various factors contributing to seed cotton and lint yield. It also happens that due to character association, improvement in respect of one character may have been obtained at the expense of other. The increase in ginning percentage may result in the reduction of staple length and vice versa.

Path coefficient analysis provides an effective means of partitioning correlation coefficients into unidirectional path ways and alternate pathways thus permitting a critical examination of specific factors that produce a given correlation which can be successfully. Employed in formulating an effective selection programme in cotton breeding. The technique of path coefficient analysis has been extensively used by Zerhum Desalegu *et al*. [2], I.K. Azeem and S.M. Azhar [3] and Afiah and Ghoneim [4], Larik *et al.* [5], Murthy [6] and Sultan *et al.* [7] in cotton crop.

The present study of correlation and path coefficient analysis involves 15 genotypes of cotton for the information of interrelationship between yield and other important yield components and to partition the observed phenotypic correlation's into their direct and indirect effects through other character which could be used as selection criteria in the breeding programme.

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## MATERIALS AND METHODS

The data were collected from an experiment conducted at the experimental farm of Nuclear Institute of Agriculture Tandojam during Kharif Season 2001, in order to find out the correlation and path coefficient analysis of cultivars of *Gossypium hirsutum* L. The seeds of nine intra-specific $F_2$ hybrids, developed through crossing six genotypes of cotton by line x tester method, along with their parents were sown in a randomized complete block design with three replications. For each $F_2$ population, plot size was 20'x15' (300 Sq. feet). Row to row space was kept 2.5 feet and plant to plant distance was 6 inches. The inter-association between the important yield components were ascertained by working out the path coefficient analysis of phenotypic correlation coefficients. This was accomplished by partitioning the direct and indirect effects of various yield components upon the final yield. Seed cotton yield was considered as the resultant variable, where as the number of sympodial branches per plant, boll weight, number of bolls per plant and G.O.T(%) were supposed to be the causal variables. The residual 'X' was taken as the influence of other variables that could not be studied and in effect it measures the failures of four components to account for seed cotton yield. The direct influences acting alone for each component and indirect effects acting in combination with the other variables with which it was correlated have been worked out. In the dependent variable the amount of variation accounted for by path coefficient analysis can be determined as $1-R^2$, where 'R' is the path coefficient of residual.

## RESULTS AND DISCUSSION

The analysis of variance (ANOVA) presented in Table 1 showed that all the genotypes differed significantly at $P<0.01$ for all the characters. This provided the evidence for the significant genetic variability present for these traits among the genotypes.

The matrix of phenotypic correlations is presented in Table 2 and the results of path coefficient analysis are given in Table 3. The path diagram based on the phenotypic correlations is presented in Figure 1, where 'P' indicates the direct effect (path coefficient), 'X' residual effect and 'r' reveals the phenotypic correlations among the characters. The following characters were studied through path coefficient analysis.

Table 1: Mean squares corresponding to various sources of variation for seed cotton yield and other quantitative traits in *Gossypium hirsutum* L.

| Source of Variance | D.F | Sympodia/Plant (No.) | Boll Weight (g) | Bolls /Plant (No.) | G.O.T(%) |
|---|---|---|---|---|---|
| Genotypes | 14 | 6.70** | 0.09** | 53.93** | 7.11** |
| Replication | 2 | 0.47 | 0.03 | 2.5 | 0.03 |
| Error | 28 | 0.44 | 0.003 | 1.30 | 0.53 |

**Significant at P<0.01 percent level of probability

Table 2: Phenotypic correlations of seed cotton yield and other quantitative and qualitative traits in *Gossypium hirsutum* L.

| Character Association | Sympodial Branches/Plant | Bolls/Plant | Boll Weight (gm) | G.O.T. (%) | Seedcotton yield/ plant (gm) |
|---|---|---|---|---|---|
| Sympodial Branches/plant | 1.000 | | | | |
| Bolls/plant | 0.432** | 1.000 | | | |
| Bolls weight (gm) | 0.658** | 0.383** | 1.000 | | |
| G.O.T. % | 0.008N.S | 0.624** | 0.105N.S | 1.000 | |
| Seed cotton Yield/plant | 0.567** | 0.959** | 0.597** | 0.538** | 1.000 |

*Significant **Highly Significant N.S. Non-significant

Table 3: Direct and indirect influence of sympodial branches, boll weight, number of bolls per plant and G.O.T (%) on seed cotton yield.

| S.No. | Pathways of Association | Direct effect P | Direct effect % | Indirect effect Pxr | Indirect effect % | Correlation Coefficient "r" |
|---|---|---|---|---|---|---|
| 1. | Number of sympodia per plant | | | | | |
| | a) Direct effect ($P_1y$) | 0.05784 | 10.18 | | | |
| | b) Indirect effect | | | 0.13703 | | |
| | Via boll weight ($P_2yr_{12}$) | | | 0.37336 | 24.12 | |
| | Via No.of bolls/plant | | | 0.00019 | | |
| | ($P_3yr_{13}$) | | | | 65.73 | |
| | Via G.O.T.(%) ($P_4yr_{14}$) | | | | 0.03 | |
| | c) Total effect | | | | | 0.568 |

Table 3: Continued

| | | | | | | |
|---|---|---|---|---|---|---|
| 2. | Boll weight | | | | | |
| | a) Direct effect ($P_2y$) | 0.20826 | 36.23 | | | |
| | b) Indirect effect | | | 0.03805 | | |
| | Via No.of sympodia/plant | | | 0.33101 | 0.07 | |
| | ($P_1r_{12}$) | | | | | |
| | Via No.of bolls/plant | | | 0.00250 | 57.59 | |
| | ($P_3yr_{23}$) | | | | | |
| | Via G.O.T (%) ($P_4yr_{24}$) | | | | 0.43 | |
| | c) Total effect | | | | | 0.575 |
| 3. | No.of bolls/plant | | | | | |
| | a) Direct effect ($P_3y$) | 0.86330 | 90.48 | | | |
| | b) Indirect effect | | | 0.02491 | | |
| | Via No.of sympodia/plant | | | | 2.61 | |
| | ($P_1yr_{13}$) | | | 0.079890.01 | | |
| | Via Boll weight ($P_2yr_{23}$) | | | 398 | 8.37 | |
| | Via G.O.T.(%) ($P_4yr_{34}$) | | | | 1.40 | |
| | c) Total effect | | | | | 0.954 |
| 4. | G.O.T.(%) | | | | | |
| | a) Direct effect ($P_4y$) | -0.02240 | 4.17 | | | |
| | b) Indirect effect ($P_4y$) | | | -0.00046 | | |
| | Via No.of sympodia/plant | | | 0.02190 | 0.08 | |
| | ($P_1yr_{14}$) | | | 0.53870 | | |
| | Via Boll weight ($P_2yr_{24}$) | | | | 4.07 | |
| | Via No.of bolls/plant | | | | 100.17 | |
| | ($P_3yr_{34}$) | | | | | |
| | c) Total effect | | | | | 0.538 |
| 5. | Residual effect Pxy | | | | | 0.188729 |

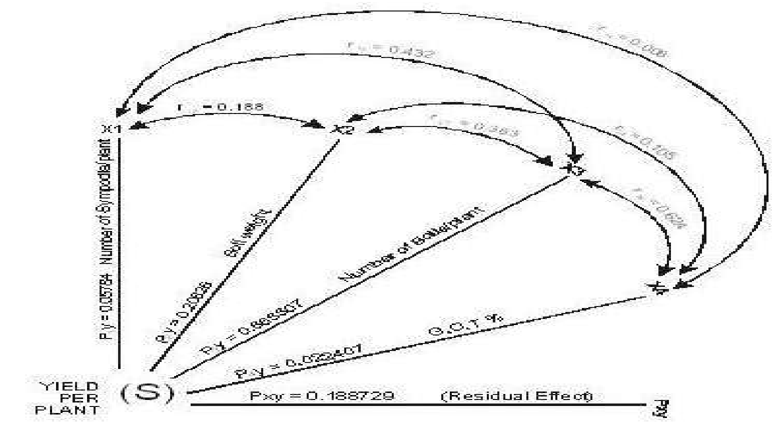


Fig. 1: Diagrammatic representation of direct and indirect influence of independent variable on variable dependent.

**Number of Sympodia Branches per Plant:** The phenotypic association between sympodial branches and yield per plant was worked out as 0.567 (Table 2). The direct effect of sympodial branches on yield of seed cotton was positive but very low (0.05784) which formed only 10.18% of the phenotypic correlation coefficient. The phenotypic correlation was further enhanced by the indirect effects of this character via boll weight, which came out to be 0.13703, via number of bolls per plant, it was 0.37336 and via G.O.T (%), it was 0.00019 which formed about 24.12, 65.73 and 0.03 percent of correlation respectively. These results indicate that the sympodial branches per plant had little effect on yield as its own but its greatest effect on yield per plant was through the number of bolls per plant which formed 65.73% of the total phenotypic correlation (Table 3 and Figure 1). These results are in agreement with those of Afiah and Ghoneim [4] and Surriya [8] they found a very low direct effect of, sympodia on seed cotton yield but recorded its high and positive effect through number of bolls per plant.

**Boll Weight:** The phenotypic correlation coefficient between boll weight and yield per plant was found to be 0.597 presented in Table 2. The direct effect of boll weight on yield was positive but not too high (0.20826) and contributed about 36.23 percent to the phenotypic correlation. The indirect effect of boll weight through number of sympodial branches per plant was 0.03805, via number of bolls per plant was 0.33101 and through G.O.T(%) was -0.0025. It was observed that although boll weight itself contributed significantly towards the final yield, nevertheless its major effect on seed cotton yield was through number of bolls per plant which contributed about 57.59 percent towards the total phenotypic correlation in positive direction (Table 3 and Figure 1).

These results are in agreement with those of Afiah and Ghoneim [4] and Soomro [9] who while working on path analysis in cotton also concluded that the trait boll weight found a very low direct effect on seed cotton yield but recorded its high and positive effect through number of bolls per plant.

**Number of Bolls per Plant:** The data presented in Table 2 reveals that phenotypic correlation between number of bolls per plant and seed cotton yield per plant was positive and very high (0.959). The direct effect of number of bolls per plant on yield of seed cotton was positive and extremely high (0.863307) which alone formed 90.48 percent of the phenotypic correlation. The indirect effect of bolls per plant via number of sympodia per plant was 0.0249177, through boll weight was 0.079897 and by the way of G.OT% was in negative direction (- 0.014). The major significant effect of number of bolls per plant on yield was therefore, its own (Table 3 and Figure 1). The results obtained also confirm the results reported by Afiah and Ghoneim [4], Soomro [3], Surriya [8], Baluch *et al.* [10], Killi [11], Larik *et al.* [5] Murthy [6], Gomaa *et al.* [12] and Sultan *et al.* [7] also found number of bolls per plant as the major contributor towards the seed cotton yield.

**G.O.T(%):** The phenotypic correlation coefficient between G.O.T(%) and yield per plant was observed to be 0.538 (Table 2). The results obtained also confirm the results reported Baluch *et al.* [10], Killi [11], Larik *et al.* [5], Gomaa *et al.* [12], Sultan *et al.* [7] and Azeem and Azhar [3] also found GOT% as the major contributor towards the seed cotton yield through number of bolls. The direct effect of G.O.T (%) on yield of seed cotton was negative and very low (- 0.02240) which formed only 4.17 percent of phenotypic correlation in negative direction, but was counter balanced by the effects of other yield components. Its indirect effect through number of sympodia per plant was also negative and very low (- 0.00046), through boll weight was positive but also low (0.0219) but via number of bolls per plant was positive and very high (0.5387). The major and overwhelming effect of G.O.T (%) on seed cotton yield was therefore, through number of bolls per plant which formed about 100.18 percent of the total phenotypic correlation (Table 3 and Figure 1).

## CONCLUSION

From the results it was observed that among four yield components studied, the trait number of bolls per plant was of much importance as it had a major and pronounced direct effect (90.48%) on the yield of seed cotton, followed by boll weight which made 36.23% of phenotypic correlation. The traits G.O.T (%) and number of sympodia, although highly significantly and positively correlated with seed cotton yield, had their negligible direct effects on the yield, but they exerted their major influence on seed cotton yield by the way of number of bolls per plant.

From the results concerning phenotypic correlations it is evident that seed cotton yield was highly significantly influenced by the yield components in order of their importance as bolls per plant, boll weight, sympodial branches per plant, G.O.T (%) and lint index which contributed from 92% to 23% towards their correlation coefficients. However, it was further clarified through the intensive investigation of path coefficient analysis that bolls/plant was the only yield component of major influence followed by boll weight which contributed substantially towards the final seed cotton yield. From the results of path analysis it is therefore, concluded that while selecting for higher yields in any breeding programme major emphasis should be placed on the boll bearing of lines/varieties in conjunction with boll weight.

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