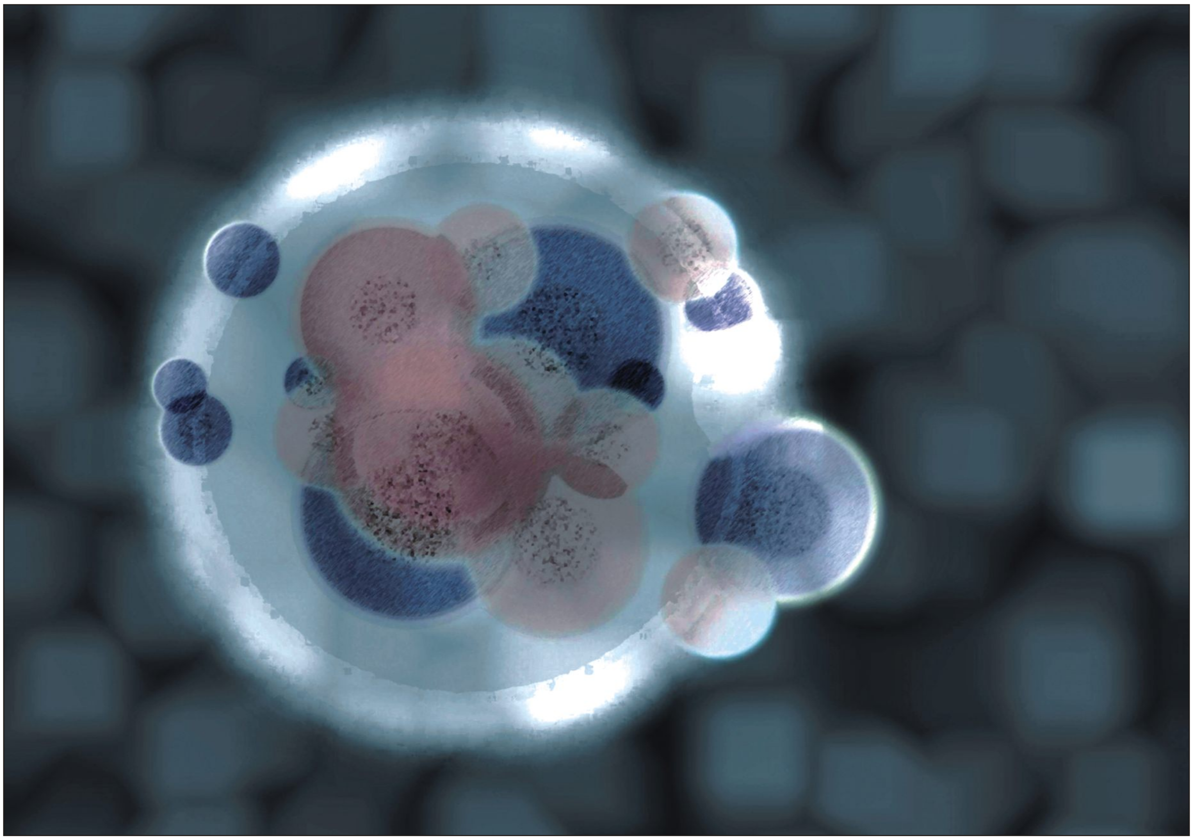

Journal of Biological Sciences

ISSN 1727-3048

OnLine Journal of Biological Sciences 1 (5): 354-355, 2001

Path Coefficient Analysis for Assessting Direct and Indirect Effects of Yield Components on Seed Cotton Yield in *Gossypium hirsutum* L.

Mohammed Jurial Baloch, Abdul Rahim Lakho, Hidayatullah Bhutto and Mohammed Yousuf Solangi
Cotton Research Institute Sakrand, Sindh, Pakistan

Abstract: Yield is the outcome of many component characters, thus assessing the extent of contribution of each factor is important in designing an effective plant breeding programmes. Phenotypic correlations between bolls per plant with yield was r = 0.998, boll weight with yield was r = -0.768 and lint% with yield was r = 0.932. These results suggested that improvement in yield could be achieved by selecting cotton plant for higher bolls and more lint%. On the contrary, selection for boll weight will decrease cotton yield. These phenotypic correlations were further partitioned in to their direct and indirect effects on seed cotton yield by path coefficient analysis. This analysis revealed that bolls per plant had significant direct and indirect effects on yield, whereas boll weight and lint% had negligible effects. Multiple correlation coefficient revealed that about 91.8% of the total variation in yield is dependent on variables, bolls per plant, boll weight and lint%.

Key words : Path coefficient analysis, phenotypic correlations, seed cotton yield, *Gossypium hirsutum* L.

Introduction

The information on the extent of association between the yield and other factors is important to bring the simultaneous improvement in correlated traits. Although, knowledge of phenotypic correlation of agronomic characters with yield in cotton (Shaver and Dilday, 1982) is indispensable in the characterization of component influences on manifesting the characters, these associations yet do not provide explicit information on the relative importance of direct and indirect effects of each componential character on seed cotton yield. As the number of variables increase, it becomes imperative to measure the contribution of each variable towards the observed correlation. Therefore, partitioning the observed correlation coefficients in to components of direct and indirect influences provide perceptions in the characterizations of more complex traits, like yield (Baloch *et al.*, 1992). In that situation, path coefficient analysis provides precise information on the direct and indirect effects in order to perceive the most influencing characters to be utilized as selection criteria in cotton breeding programmes.

Materials and Methods

The variety CRIS-121 (*Gossypium hirsutum* L.) evolved by cytogenetics section of Central Cotton Research Institute at Sakrand was grown in randomized complete block design with four replications during, 1999. The plot size was 12.5′ x 45′ and row to row and plant to plant distances were kept at 2.5′ and 9.0′′ respectively. Therefore, there were five rows per plot each 45 feet long. Ten plants at random from only three central rows, thus 40 plants in total were tagged as index plants for taking the observations. The data on four quantitative characters such as bolls per plant, average boll weight weighed in grams, lint% calculated as the ratio of lint against cotton seed from seed cotton sample and seed cotton yield per plant weighed in grams were recorded.

Phenotypic correlation coefficients (r), multiple correlation (R^2) and regressions were determined by the methods outlined by Gomez and Gomez (1984). Phenotypic correlation coefficients were further partitioned in to the components of direct and indirect effects by path coefficient analysis by Dewey and Lu (1959) used by Singh and Choudhry (1979).

Results and Discussion

Phenotypic correlation (r), multiple correlation coefficient (R^2) and path coefficient analysis were worked-out for yield and its important components. Phenotypic correlation coefficients presented in Table 1 reveal significant and positive correlations of r = 0.998 between bolls per plant and yield per plant, and r = 0.894 between lint% and yield and significant but negative correlation of r = -0.814 between boll weight and yield per plant. Based on the strong associations of other characters with yield, it is expected that improvement in number of bolls and lint% will bring simultaneous or say indirect improvement in cotton yield. Other researchers (Khan *et al.*, 1980; Baloch *et al.*, 1992) concluded from their studies that bolls per plant best be actuated for developing high yielding cotton varieties. Whereas negative association between boll weight and yield indicated that one should not expect positive correlated response in yield while selecting for higher boll weight. Baloch *et al.* (1992) and Khan *et al.* (1980) also reported similar results in their studies.

Yield is influenced by many of its components, thus cumulative effect of all the factors contributing to yield is important to determine. Multiple correlations were therefore exercised to determine the total effect of independent variables such as bolls per plant, boll weight and lint% on dependent variable (yield per plant). The mean square from multiple regressions was significant (Table 1) which suggested that independent variables under present study are important in exploring the yield. Multiple correlation coefficient, R^2 = 0.957 and coefficient of determination, r^2 = 91.8 further revealed that about 91.8% of total variability in yield is accounted due to three independent variables.

Path coefficient analysis was also carried-out so as to determine direct and indirect effects of each independent variable on dependent variable (Table 2). The direct effect of bolls per plant on yield was very high, 0.969 whereas indirect effects via boll weight and lint% were -0.104 and 0.123 respectively, however total effect (direct+indirect) on yield was 0.998 which was mainly due to direct effect of bolls per plant. Baloch *et al.* (1992) reported that out of 0.978 total phenotypic correlation, 63.1% was attributable to only direct effect of bolls per plant on seed cotton yield. Rajper *et al.*

Table 1: Phenotypic correlation coefficients (r) and multiple regression analysis for yield and its components in *Gossypium hirsutum* L.

Characters correlated	Bolls Per plant	Bolls weight	Lint%	Yield per plant
Bolls per plant		-0.814	0.894	0.998*
Boll weight			-0.722	-0.768**
Lint%				0.932**

Multiple correlation coefficient (R^2) = 0.957

Testing the significance of multiple regression coefficient

Source of variables	Degrees of freedom	Mean squares
Regression on three variables	3	96.020**
Residual (error)	36	0.361

**Significant at 1% probability levels

Table 2: Direct and indirect pathway effects of bolls per plants, boll weight and lint% on seed cotton yield in *Gossypium hirsutum* L.

Pathway of correlation	Direct effect	Percent	Indirect effect	Percent	Phenotypic correlation
Number of bolls per plant	0.969	97.1			
i.Direct effects (P_1Y)					
ii.Indirect effects					
Via boll weight (P_2Yr_{12})			-0.104	10.4	
Via lint% (P_3Yr_{13})			0.123	12.3	
iii. Total, direct and indirect effects					0.998
Bolls weight					
i.Direct effects (P_2Y)	0.128	16.7			
ii.Indirect effects					
Via bolls per plant (P_1Yr_{21})			-0.789	102.7	
Via lint% (P_3Yr_{23})			-0.106	13.8	
iii. Total, direct and indirect effects					-0.768
Lint percent					
i.Direct effects (P_3Y)	0.148	15.9			
ii.Indirect effects					
Via bolls per plant (P_1Yr_{31})			0.866	92.9	
Via lint% (P_2Yr_{32})			-0.093	10.1	
iii. Total, direct and indirect effectsq					0.932

(1987) also noted that about 118.3% of total phenotypic correlation in yield was due to direct effect of bolls per plant.

The direct effect of boll weight on yield was very low (0.128), nonetheless indirect effects via boll number and lint% were -0.789 and -0.106 respectively. The negative phenotypic correlation coefficient, r = -0.768 between boll weight and yield suggest that as we increase the boll size, it gives corresponding decrease in yield. The large indirect effect of -0.789 via boll weight further connoted that decrease in yield is actually due to fewer number of bolls formed. In fact, it clearly indicated that as the boll weight increases above certain limit, the yield decreases due to proportional decrease in total number of bolls set by the cotton plant. Negligible direct effect of boll weight on yield in present study is in conformity with that of Baloch *et al.* (1992). The direct effect of lint% on yield was only 0.148 from 0.932 total phenotypic correlation whereas indirect effects via bolls per plant was 0.866 which is much higher as compared to boll weight, that in fact was negative, -0.093. Thus, 92.9% of total phenotypic correlation was again due to in direct effect via bolls per plant. Rajper *et al*. (1987) also reported similar findings.

In brief, it was observed that number of bolls per plant take toll of major effect on seed cotton yield. The large direct and indirect effects of bolls per plant on yield were also supported with their high correlation coefficient values, r = 0.998. It is therefore concluded from present studies that significant improvement in cotton yield could be made due to varieties that set higher bolls rather than big bolls.

References

Baloch, M.T., A.R. Lakho and M.Y. Salangi, 1992. Unidirectional and alternate pathway impacts of yield components on seed cotton yield of *G. hirsutum* L. Pak. Cotton, 36: 107-114.

Dewey, D.R. and K.H. Lu, 1959. A correlation and path-coefficient analysis of components of crested wheatgrass seed production. Agron. J., 51: 515-518.

Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. 1st Edn., John Wiley and Sons Inc., New York.

Khan, M.D., N.A. Choudhry and M. Saleem, 1980. Association analysis of some characteristics in parents and hybrids of (*Gossypium hirsutum* L.). Pak. Cottons, 24: 252-261.

Rajper, M.M., A.J. Malik, N.N. Ansari and A.J. Shah, 1987. Influence of unidirectional and alternate pathways on yield of cotton (*Gossypium hirsutum* L.). Pak. Cottons, 24: 252-261.

Shaver, T.N. and R.H. Dilday, 1982. Measurement of and correlations among selected seed quality factors for 36 texas race stocks of cotton. Crop Sci., 22: 779-781.

Singh, R.K. and B.D. Choudhry, 1979. Biometrical Methods in Quantitative Genetic Analysis. Haryana Agriculture University Press, Hissar, India, pp: 70-79.