CAUSE AND EFFECT ESTIMATES FOR YIELD CONTRIBUTING AND MORPHOLOGICAL TRAITS IN UPLAND COTTON *(GOSSYPIUM HIRSUTUM* L.*)*

Samia A. Rahman, Muhammad Shahid Iqbal, Muhammad Riaz, Abid Mahmood, Muhammad Rafiq Shahid, Ghazanfar Abbas and Jehanzeb Farooq*

ABSTRACT

A study was carried out at Cotton Research Institute, AARI, Faisalabad Pakistan during the year 2013 to determine the cause and effect of some morphological traits viz. number of leaves per plant, number of sympodial branches per plant, number of bolls per plant and plant height on seed yield per plant in upland cotton. Seventy two cotton genotypes at F_5 generation were sown in a RCBD with three replications. The results indicated that number of leaves (0.2334), sympodial branches (0.4859) and number of bolls per plant (0.3722) had exerted positive and significant to highly significant correlation at genotypic level with seed cotton yield per plant. The data also revealed that number of leaves showed positive and highly significant correlation with sympodial branches (0.3427) plant height (0.6924**) and bolls per plant (0.4238**). Number of leaves, bolls per plant and sympodial branches showed positive direct effect on seed-cotton yield per plant. Direct effect of sympodial branches on cotton yield was very high and positive. However, number of leaves showed positive indirect effect via sympodial branches, bolls per plant and plant height. Similarly sympodial branches had shown positive indirect effect on seed yield per plant via number of leaves and bolls per plant. Direct effect of number of leaves on seed-cotton yield per plant was low while indirect effect via number of bolls per plant was positive. The number of bolls per plant also showed positive indirect effect via number of leaves, sympodial branches and plant height but effect of plant height on cotton yield was negative via number of bolls and sympodial branches. The results conclude that sympodial branches per plant influenced the cotton yield per plant to greater extent. Hence selection based on this trait may lead to development of genotypes having high seed cotton yield potential.**

KEYWORDS: ***Gossypium hirsutum;*** **genotypes; agronomic characters; path coefficient analysis; Pakistan.**

INTRODUCTION

Cotton being one of the most important cash crops plays a major role in the economy of Pakistan for earning foreign exchange as well as engaging millions of workers in picking, textile industry, garments manufacturing, edible

***Cotton Research Institute, AARI, Faisalabad, Pakistan.**

oil production and dairy industry (1). Hence, our economy and market channels are oriented in such way that wide vicissitudes in cotton production pose significant threat to national economy. Consequently, continuous sufficient production of cotton has not only become imperative but must find out the ways to obtain maximum yield per unit area because our farmers are not in position to allocate more land for cotton production at the expense of other crops.

During present era of development of high yielding cotton varieties, compactness is widely accepted as an ideal plant type. The compactness has the advantage of shorter sympodial branches with reduced internodal length giving morphological features of compressed habit and clustered boll habit. On account of low vertical and horizontal growth it occupies minimum space. It offers great scope for reducing not only row width but also spacing between plants in a row (12). The reduced plant height makes the plant protection operations easier and effective. These compacts also provide the scope for increasing plant population per unit area by virtue of their shorter stature.

Path coefficients have been used for developing selection criteria useful to evolve high yielding seed-cotton varieties. Likewise path analysis provides an efficient mean of finding the direct and indirect causes of correlation. (4, 6, 8, 9, 11, 12, 13).

Correlation coefficient determines the simple relationship between traits, so it does not necessarily yield fruitful results and cannot be used as selection criteria. Hence, path coefficient is widely used as selection criteria especially for complex traits (3, 9).

Path analysis and correlation coefficients both provide detailed information about the relationship among plant traits and both have been previously used in cotton breeding programmes. Path analysis, an extension of multiple regression analysis, allows better understanding of complex models for regression analysis. As many other biometrical techniques, path analysis also has its own assumptions and conventions (5, 8).

The aim of present study was to determine cause and effect of different morphological traits and their relationship for high seed-cotton yield for making selection criteria leading to evolution of stable cotton varieties.

MATERIALS AND METHODS

Seventy two F_5 progenies of cotton plant were raised at Cotton Research Institute, AARI, Faisalabad, Pakistan during the year 2012-13. These genotypes were sown in RCBD with three replications. Twenty plants were grown for each genotype per replication by planting 2-3 seeds per dibble. After germination, thinning was done to maintain population of one plant per dibble. Normal agronomic practices were applied as per recommendations to all genotypes equally. Data from ten plants were collected for morphological parameters per genotype per replication and yield was measured after completing seed-cotton pickings. Morphological traits studied were; number of leaves per plant, number of bolls per plant, plant height, number of sympodial branches and seed-cotton yield per plant. The data were subjected to statistical analysis to determine correlation and path coefficients using software QB45-Path.

RESULTS AND DISCUSSION

Coefficient of correlation

The correlation data indicated that number of leaves (0.2334*), sympodial branches (0.4859**) and number of bolls per plant (0.3722**) had positive and significant to highly significant correlation with cotton yield at genotypic level (Table 1). Number of leaves had positive and highly significant correlation with sympodial branches (0.3427**), plant height (0.6924**) and bolls per plant (0.4238**). Sympodial branches had also positive and highly

Table 1. Genotypic (r_g) correlation coefficients among all possible combinations of five quantitative characters of upland cotton.

Variables	No. of leaves/ plant	Sympodial branches/ plant	Bolls/ plant	Plant height	Seed cotton yield/plant
No. of leaves/plant	1				
Sympodial branches/plant	0 .3427 **	1			
Bolls/plant	0.4238 **	0.2597 *	1		
Plant height	0.6924 **	0.3273 **	0.2771 *	1	
Yield/plant	0.2334 *	0.4859 **	0.3722 **	0.1507	1

significant correlation with plant height (0.3273**) and yield (0.4859**) and significant correlation with bolls per plant (0.2597*) while bolls per plant had significant correlation with plant height (0.2771*) and highly significant with seed-cotton yield per plant (0.3722**). This indicated that selection for

number of leaves, sympodial branches and bolls per plant can be effective for developing high yielding cotton genotypes. However, plant height was non-significantly correlated with seed-cotton yield (0.1507). Similar associations of plant height were also observed by Farooq *et al.* (7).

At phenotypic level, number of leaves had positive and highly significant correlation with sympodial branches per plant (0.3419**), seed-cotton yield (0.2334*), plant height (0.6923**) and bolls per plant (0.4203**) (Table 2). Similarly sympodial branches had positive and highly significant correlation with plant height (0.3263**), yield (0.4835**) and significant with bolls per plant (0.2608*). Bolls per plant were significantly correlated with plant height (0.2745*) and highly significantly correlated with yield (0.3671**) while plant height had positive and non-significant correlation with seed-cotton yield (0.1506).

Table 2. Phenotypic (r_p) correlation coefficients among all possible combinations of five quantitative characters of upland cotton.

Variables	No. of leaves/ plan	Sympodial branches/ plant	Bolls/ plant	Plant height	Seed cotton yield/ plant
No. of leaves/plant	1				
Sympodial branches/plant	0.3419 **	1			
Bolls/plant	0.4203 **	0.2608 *	1		
Plant height	0.6923 **	0.3263 **	0.2745 *	1	
Yield/plant	0.2334 *	0.4835 **	0.3671 **	0.1506	1

Path coefficient analysis

The path coefficient analysis showed that plant height did not show direct effect with cotton yield (Table 3). Number of leaves, number of bolls and sympodial branches per plant showed direct effect with cotton yield. Direct effect of sympodial branches on cotton yield was very high and positive (0.4338) followed by direct effect of number of bolls per plant (0.2709) and number of leaves per plant (0.0306). However, number of leaves showed positive indirect effect via sympodial branches (0.1486), bolls per plant (0.1148) and negative via plant height (-0.0605). Similarly, sympodial branches showed positive indirect effect via number of leaves (0.0105), bolls per plant (0.0703) and indirect negative effect via plant height (-0.0286). Hence, the sympodial branches can be regarded as a reliable source of getting high yield in cotton due to its highest direct effect on seed-cotton yield per plant. The bolls per plant showed positive indirect effect via number of leaves (0.013) and sympodial branches (0.1126) while negative via plant

Tale 3. Direct (diagonal and bold) and Indirect (off-diagonal) effects of various plant traits in upland cotton.

Variables	No. of leaves/ plan	Sympodial branches/ plant	Bolls/ plant	Plant height	Correlation with Seed cotton yield/ plant
No. of leaves/plant	**(0.0306)**	0.1486	0.1148	-0.0605	0.2334
Sympodial branches/plant	0.0105	**(0.4338)**	0.0703	-0.0286	0.4859
Bolls/plant	0.0130	0.1126	**(0.2709)**	-0.0242	0.3722
Plant height	0.0212	0.1420	0.0751	**(-0.0874)**	0.1507

height (-0.0242). Direct effect of plant height on cotton yield was negative (-0.0874) while its indirect effect was positive via number of leaves (0.0212), sympodial branches (0.142) and bolls per plant (0.0751). Thus plant height cannot be used as selection criteria for seed-cotton yield improvement in upland cotton.

The present study has generated useful information for cotton breeders looking for cotton plants having greater yield potential. Among plant characters studied, direct contribution of number of bolls and sympodial branches was relatively higher. Similar behaviour of characters had been previously observed by Azhar *et al.* (2). Some other workers also reported similar findings about direct and indirect effect of different components of cotton yield (7, 10). It can be concluded that number of sympodial branches had influenced cotton yield per plant to greater extent as it relatively contributed more towards seed-cotton yield per plant than number of leaves and bolls per plant. Hence, selection based on more sympodia per plant may lead to development of genotypes with increased seed-cotton yield potential.

REFERENCES

1. Ali. B., M. S. Iqbal, M. K. N. Shah, G. Shabbir and N. M. Cheema. 2011. Genetic analysis for various traits in *Gossypium hirsutum* L. Pak. J. Agric. Res. 24 (1-4): 8-13.
2. Azhar, F.M., A.I. Khan and I. Mahmoud. 1999. Path coefficient analysis of some advanced progenies of *G. hirsutum* L. Int.J. Agri. Biol. 1(3): 85-87.
3. Cakmakci, S., A. Unay and E. Acikgoz. 1998. An investigation on determination of characters regarding seed and straw yield using different methods in common vetch. Turk. J. Agric. Forest. 22: 161-166.
4. Dewey, D.R. and K.H. Lu. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J. 51: 515-518.

5. Diz, D.A., D.S. Wofford and S.C. Schank. 1994. Correlation and path coefficient analyses of seed-yield components in pearl millet x elephant grass hybrids. Theor. Appl. Genet. 89: 112-115.
6. Emigh, T. H. 1984. Path analysis, correlation and the analysis of variance. *In:* Statistical Models and Genetic Statistics. Experimental Design. Hinkelmann, K. (ed.). Marcel Dekker, New York.
7. Farooq J., M. Anwar, M. Riaz, A. Mahmood, A. Farooq, M.S. Iqbal and M.S Iqbal. 2013. Association and path analysis of earliness in yield and fibre related traits under cotton leaf curl virus (CLCuV) intensive condition in cotton. Plant Knowledge Journal. 2(1):43-50.
8. Gravois, K.A., S.B. Milligan and F.A. Martin. 1991. Additive genetic effects for sugarcane components and implications for hybridization. Trop. Agric. 68:376-380.
9. Hassan, S.M.F, M.S. Iqbal, G. Rabbani, Naeem-ud-Din, G. Shabbir, M. Riaz and I.R. Noorka. 2013. Correlation and path analysis for yield and yield components in sunflower (*Helianthus annus* L.). Afr. J. Biotech. 12(16): 1968-1971.
10. Hazeem, M. A. B. 2005. Path coefficient analysis in upland cotton. Mesop. Agri. 33-3
11. Kale, U.V., H.V. Kalpande, S.N. Annapurve and V.K. Gite. 2007. Yield components analysis in American cotton (*Gossypium hirsutum* L.). Madras Agric. J. 94 (7-12):156-161.
12. Kanavi, M. S. P. 2003. Genetic Study on Cotton Plant Types. M. Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka, India.
13. Kempthorne, O. 1957. An Introduction to Genetic Statistics. Wiley, New York.
14. Wright, S. 1921. Correlation and Causation. J. Agric. Res. 20:557-585.