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# PATH COEFFICIENT ANALYSIS IN RICE

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Twelve varieties/mutants of rice were studied for genetic correlations and path coefficients for grain yield and a few agronomic characters. Grain yield showed positive correlations with number of productive tillers per plant and grain-straw ratio. Plant height indicated negative correlations with number of productive tillers per plant, grain-straw ratio and grain yield while it was positively correlated with the distance from flag leaf collar to panicle neck node. The analysis further revealed that plant height, number of productive tillers per plant and grain-straw ratio had great effect on grain yield directly as well as indirectly through other characters.

*Key words:* Rice, Genotypic correlation, Coefficient of determination.

## INTRODUCTION

Yield is a complex character, affected by its component characters directly and other various characters indirectly. In order to accummulate optimum combinations of yield-contributing characters in a single genotype, it•is essential to know the implications of the interrelationships of various characters. Path coefficient analysis is a proven method of determining the contributions of component variables to a character. This technique has been used quite widely by animal breeders, geneticists and plant breeders [1-6].

The present study was undertaken to furnish information on the nature of association between grain yield and other economic characters in rice. Its another objective was to demonstrate the application of "Path coefficients" in the analysis of correlations.

## MATERIALS AND METHODS

Twelve rice varieties including true breeding mutants were grown at NIAB, Faisalabad in 1984. Single seedlings per hill were transplanted in a randomized complete block design with three replications. Each plot consisted of 12 rows 4.57 meter long and spaced at 22 cm. A sample of 7 plants were taken at random from each plot for recording observations on plant height, number of productive tillers per plant, distance from flag leaf collar to panicle neck node, grain-straw ratio and grain yield/plant.

The plot mean values were subjected to statistical analysis. Phenotypic, genotypic and environmental correlations were worked out by the method described by Singh and Chaudhary [7]. The path coefficient analysis was performed according to Dewey and Lu [8].

## RESULTS AND DISCUSSION

Estimates of phenotypic, genotypic and environmental correlations between all possible combinations of five variables are presented in Table 1. Grain yield showed

Table 1. Estimates of phenotypic, genotypic and environmental correlations among five characters of rice.

| Character | Tillers per plant | Distance from flag leaf collar to panicle neck node | Grain-straw ratio | Yield per plant |
|---|---|---|---|---|
| Plant height | | | | |
| P | −.761** | .727** | −.522 | −.407 |
| G | −.870** | .743** | −.579* | −.645* |
| E | .017 | .447 | .174 | .531 |
| Tillers per plant | | | | |
| P | | −.535 | .333 | .570 |
| G | | −.646* | .441 | .650* |
| E | | .154 | −.189 | .477 |
| Distance from flag leaf collar to panicle neck node | | | | |
| P | | | −.333 | −.342 |
| G | | | −.361 | −.549 |
| E | | | −.090 | .245 |
| Grain-straw ratio | | | | |
| P | | | | .730** |
| G | | | | .900** |
| E | | | | .495 |

*,** Significant at 5 % and 1 % levels respectively; P = Phenotypic correlation; G = Genotypic correlation; E = Environmental correlation.

significant positive correlations with number of productive tillers per plant and grain-straw ratio, and significant negative correlation with plant height, while its correlation with the distance from flag leaf collar to panicle neck node was not significant. Muhammad *et al.* [9], Akram *et al.* [10], Liao and Liu [11], Agrawal *et al.* [12] and Khaleque *et al.* [13,14], while studying the interrelationships among different characters in rice, reported that reduced plant stature, more number of productive tillers and higher grain-straw ratio resulted in significant increase in grain yield. On the other hand, plant height was negatively correlated with number of productive tillers and grain-straw ratio. It appears that reduction in plant height results in an increase in productive tillers and grain-straw ratio, and in turn results in higher grain yield. Similar results have been observed by Govindaswami *et al.* [15], Balakrishna *et al.* [16], Chandra Mohan and Narayanasamy [17] for number of productive tillers per plant and Cheema *et al.* [18] for grain-straw ratio in rice.

The distance from flag leaf collar to the panicle neck node was positively correlated with plant height. Rutger *et al.* [19] also found in $D_7$, a short statured mutant obtained from a variety Calrose, that with the reduction of plant height, the distance between flag leaf collar and panicle neck node was greatly reduced.

To look more closely into interrelationships among characters, path coefficient analysis was applied to the data. Grain yield was taken as dependent variable, and plant height, number of productive tillers per plant, distance from flag leaf collar to panicle neck node, and grain-straw ratio as independent variables. The estimates of direct and indirect effects and correlation coefficients are presented in Table 2.

Table 2. Path coefficient analysis of grain yield vs. plant height, tillers per plant, distance from flag leaf collar to panicle neck node, and grain-straw ratio.

| Path of association | Direct effect path coefficient (P) | Indrect effect path coefficient (P x r) | Genotypic correlation with grain yield (r) | Coefficient of determination ($r^2$) |
|---|---|---|---|---|
| *Grain yield vs plant height* | | | | |
| Direct effect | .591 | | | |
| Indirect effect via tillers/plant | | – .513 | | |
| Indirect effect via distance from flag leaf collar to panicle neck node. | | – .215 | | |
| Indirect effect via grain-straw ratio | | – .507 | | |
| Total | | | – .645* | .416 |
| *Grain yield vs tillers/plant* | | | | |
| Direct effect | .590 | | | |
| Indirect effect via plant height | | – .514 | | |
| Indirect effect via distance from flag leaf collar to panicle neck node | | .187 | | |
| Indirect effect via grain-straw ratio | | .387 | | |
| Total | | | .650* | .422 |
| *Grain yield vs distance from flag leaf collar to panicle neck node* | | | | |
| Direct effect | – .290 | | | |
| Indirect effect via plant height | | .439 | | |
| Indirect effect via tillers/plant | | – .381 | | |
| Indirect effect via grain-straw ratio | | – .317 | | |
| Total | | | – .549 | .301 |

(Continued . . . . .)

(Table 2, continue)

| | | | | |
|---|---|---|---|---|
| *Grain yield vs grain-straw ratio* | | | | |
| Direct effect | .877 | | | |
| Indirect effect via plant height | | –.342 | | |
| Indirect effect via tillers/plant | | .260 | | |
| Indirect effect via distance from flag leaf collar to panicle neck node | | .105 | | |
| Total | | | .900** | .810 |

*,** Significant at 5% and 1% levels respectively.

*Grain yield vs plant height.* The correlation between plant height and grain yield was negative (r-0.645) showing 42 % contribution of plant height towards the total variation in grain yield. The direct effect of plant height on grain yield (0.591) was positive and appreciable. However, the indirect effects via number of productive tillers (-0.513) and grain-straw ratio (-0.507) were negative. It seems that the increase in grain yield due to height reduction depends mainly on increases in productive tillers and grain-straw ratio.

*Grain yield vs number of productive tillers per plant.* The direct effect of number of productive tillers per plant was strong (0.590). The indirect effect via plant height (-0.514) was negative and high. As a result, their correlation coefficient fell down to 0.650 and coefficient of determination to 42 % only.

*Grain yield vs distance from flag leaf collar to panicle neck node.* Both the direct and indirect effects were not significant. The correlation coefficient was also insignificant suggesting that distance from flag leaf collar to panicle neck node had no bearing on grain yield.

*Grain yield vs grain-straw ratio.* The correlation between grain yield and grain-straw ratio was positive and highly significant (r=0.900) and the coefficient of determination ($r^2$) was 81 %. This was made up largely by its direct effect on grain yield (0.877).

A perusal of correlation components reveals that plant height and number of productive tillers per plant exerted great influence both directly and indirectly upon grain yield. Of particular concern to the plant breeder is the fact that in each correlation plant height and number of productive tillers per plant exerted opposite effects. The correlation between number of productive tillers per plant and grain yield was greatly reduced owing to the indirect negative influence of plant height. If maximum grain yield is to be obtained, a compromise must be reached in the selection programme for these two characters.

This analysis gives a somewhat different picture than does the simple correlation analysis. The apparent conflict between the two analyses is that the two methods are measuring different things. The correlation simply measures mutual association without regard to causation, whereas path coefficient analysis specifies the causes and measures their relative importance [20]. This later technique is obviously the most useful for the plant breeder to develop a selection criterion [21] in order to accummulate optimum combinations of yield-contributing characters in a single genotype.

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