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Association Analysis for Yield Traits in Rainfed Rice (*Oryza sativa* L.)

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A B S T R A C T

Correlation and path analysis was carried out at Agricultural Research Station, Tamil Nadu Agricultural University, Paramakudi to study the association between eight yield related traits during Rabi 2019-20 in 37 rice genotypes under rainfed rice ecosystem. Days to 50% flowering, number of panicles per square metre, number of filled grains per panicle and straw yield expressed positive and significant correlation with grain yield. The trait, plant height had positive and significant association with panicle length and number of filled grains per panicle suggesting that selection based on plant height is highly fruitful in developing high yielding genotypes in rainfed situation, as it will bring simultaneous improvement of these traits. The traits number of panicles per square metre, straw yield and harvest index expressed high direct effect and plant height and number of filled grains per panicle had moderate direct effect on grain yield. The traits days to 50% flowering, number of panicles per square metre and straw yield should be given more importance for enhancing grain yield under rainfed rice ecosystem.

Introduction

Rice (*Oryza sativa* L.) is considered as a pre-eminent crop and cultivated in the region of eastern and southern parts of India. In India rice is cultivated in an area of 44.50 million hectares with a production of 116.00 million metric tons during 2018-19 (USDA 2019). Grain yield in rice is a quantitatively inherited trait and involves function of several components. Selection of superior genotypes based on yield is difficult due to the integrated structure of plant in which the component characters are interdependent and are governed by a large number of genes.

An idea on the extent of association between traits conferring higher yield will be much helpful to decide upon the traits to be given importance in selection process. A positive association between traits warrants the simultaneous improvement of both the traits while restricting selection to any one of the associated traits. On the other hand, a

negative relationship between two traits necessitates equal weightage to be given on both the traits during selection. At genetic level, a positive correlation occurs due to coupling phase of linkage and negative correlation arises due to repulsion phase of linkage of genes controlling two different traits (Nadarajan and Gunasekaran, 2008)

Path analysis has been used to organize the relationship between predictor variables and response variables. The advantage of path analysis is that it permits the partitioning of the correlation coefficient into its components-one component being the path coefficient (or standardized partial regression coefficient) that measures the direct effect of a predictor variable upon its response variables, the second component being the indirect effect(s) of a predictor variable on the response variable through other predictor variables (Deway and Lu, 1959). Path coefficient analysis assists plant breeders in identifying traits on which selection pressure should be given for improving yield. With these points in view, the present study was framed to study the relationship between yield related traits under upland rice ecosystem.

Materials and Methods

The experimental material comprised with thirty seven advanced rice cultures which were evaluated in a randomized block design with three replications at Agricultural Research Station, Tamil Nadu Agricultural University, Paramakudi during Rabi 2019-20. The experimental site is located at 9" 21' N latitude, 78" 22' E longitudes and an altitude of 242 m above mean sea level with average annual rainfall of 840 mm.

This site has clay loam soil texture with pH of 8.0.Each genotype was raised in 5x2 m plot keeping 15 x 10 cm spacing. The recommended agronomic practices followed to raise good crop stand. The data were recorded on ten randomly selected plants from each replication for various quantitative traits studied were *viz*, days to 50% flowering, plant height (cm), number of productive tillers per plant, number of panicles per square meter plot area, panicle length (cm), number of filled grains per panicle, grain yield per plot (kg), straw yield per plot (kg) and harvest index (%).

The genotypic correlation coefficients between yield and yield components as well as among the yield components were worked out. From the analysis of variance and covariance tables, the corresponding genotypic variances and covariances were calculated by using the mean square values and mean sum of products as suggested by Al-Jibouri *et al.*, (1958).

The relative influence of eight components on yield by themselves (direct effects) and through other traits (indirect effects) was evaluated by the method of path coefficient analysis as suggested by Dewey and Lu (1959). The simple correlation coefficients already estimated at genotypic level were utilized for this purpose. By keeping yield as dependent variable and other eight traits as independent variables, simultaneous equations which express the basic relationship between path coefficients were solved to estimate the direct and indirect effects. The direct and indirect effects were classified based on the scale given by Lenka and Misra (1973).

Results and Discussion

Selection based on the detailed knowledge of magnitude and direction of association between yield and its attributes is very important in identifying the key characters, which can be exploited for crop improvement through suitable breeding programme.

Genotypic correlations between yield and yield components *viz*., days to 50% flowering, plant height, number of productive tillers per plant, number of panicles per square meter, panicle length, number of filled grains per panicle, straw yield per plot and harvest index (%) were computed for rice genotypes. The results are presented in Table 1.

In the present investigation, grain yield exhibited positive and significant association with days to 50% flowering, number of panicles per square meter, number of filled grains per panicle and straw yield per plot while negative and significant correlation with number of productive tillers per plant (Table 1). This was in conformity with the findings of Babu *et al.,* (2012), Vanisree *et al.,* (2013), Islam *et al.,* (2015) and Shinde *et al.,* (2015), Muthuramu and Sakthivel (2016) and Lalitha *et al.,* (2019).

Knowledge on inter relationship between yield traits may facilitate breeder to decide upon the intensity and direction of selection pressure to be given on related traits for the simultaneous improvement of these traits. In the present study, plant height had positive and significant association with panicle length and number of filled grains per panicle. Similarly positive and significant relationship was observed between days to 50% flowering and number of panicles per square meter.

The trait, number of productive tillers per plant showed positive and significant association with number of filled grains per panicle. Likewise positive and significant relationship was observed between number of panicles per square meter and straw yield per plot. The trait, panicle length per plant showed positive and significant association with number of filled grains per panicle.

Similar results were reported by Babu *et al.*, (2012), Islam *et al.*, (2015) and Lalitha *et al.*, (2019). Both plant height and number of productive tillers per plant had negative and significant number of panicles per square meter and harvest index. Days to 50% flowering showed negative and significant association with plant height. This was in conformity with the findings of Babu *et al.*, (2012) and Muthuramu and Sakthivel (2016).

In the light of above discussion, it may be suggested that, days to 50% flowering, number of panicles per square meter, number of filled grains per panicle and straw yield per plot were to be given importance while selection as they expressed positive and significant correlation with grain yield.

The trait, plant height had positively correlated with panicle length and number of filled grains per panicle suggesting that selection based on plant height is highly fruitful in developing high yielding genotypes under rainfed condition, as it will bring simultaneous improvement of these traits.

Plant height is one of the important characters to be considered in the selection for improvement of drought tolerant rice genotypes (Hossain *et al.*, 2018). Hence result obtained from this study is similar to those mentioned above.

Rapid improvement in yield is expected to result if selection is practiced for component characters. Rate of improvement is expected to be rapid if differential emphasis is laid on the component characters during selection. The basis of differential emphasis could be the degree of influence of component characters on the character of interest.

Path analysis gives an idea about how a trait influences grain yield directly and indirectly *via* other traits. This is very important in giving due weightage to major yield contributing traits while selection.

Table.1 Genotypic correlation coefficients for yield related traits and grain yield

Characters	Days to 50% flowering	Plant Height	Productive tillers per plant	Panicles per square meter	Panicle length	Filled grains per panicle	Straw yield per plot	Harvest index	Grain yield per plot
Days to 50% flowering	1.000	-0.379**	0.023	0.680**	-0.095	0.134	0.198	0.255	**0.573****
Plant Height		1.000	0.081	-0.318*	0.748**	0.309*	0.163	-0.368*	**-0.024**
Productive tillers per plant			1.000	-0.638**	0.023	0.767**	-0.110	-0.882**	**-0.739****
Panicles per square meter				1.000	-0.213	-0.156	0.693**	-0.216	**0.760****
Panicle length					1.000	0.511**	0.127	-0.024	**0.156**
Filled grains per panicle						1.000	0.023	0.233	**0.286***
Straw yield per plot							1.000	-0.607	**0.674****
Harvest index								1.000	**0.023**
Grain yield per plot									**1.000**

*Significance at 5% level; ** Significance at 1 % level

Table.2 Direct and indirect effects of yield related traits on grain yield

Characters	Days to 50% flowering	Plant Height	Productive tillers per plant	Panicles per square meter	Panicle length	Filled grains per panicle	Straw yield per plot	Harvest index	Grain yield per plot
Days to 50% flowering	**-0.024**	0.009	-0.001	-0.017	0.002	-0.003	-0.005	-0.006	**0.573****
Plant Height	-0.097	**0.256**	0.021	-0.082	0.0192	0.079	0.042	-0.094	**-0.024**
Productive tillers per plant	-0.001	-0.003	**-0.004**	0.002	-0.001	-0.003	0.004	0.003	**-0.739****
Panicles per square meter	0.423	-0.198	-0.397	**0.622**	-0.132	-0.097	0.431	-0.134	**0.760****
Panicle length	0.007	-0.051	-0.002	0.015	**-0.068**	-0.035	-0.009	0.002	**0.156**
Filled grains per panicle	0.028	0.065	0.162	-0.033	0.108	**0.211**	0.005	0.049	**0.286***
Straw yield per plot	0.104	0.086	-0.058	0.365	0.067	0.012	**0.527**	-0.319	**0.674****
Harvest index	**0.133**	**-0.192**	**-0.461**	**-0.113**	**-0.013**	**0.122**	**-0.317**	**0.523**	**0.023**

** Significance at 1 % level ** Significance at 1 % level Residual effect = 0.36 Diagonal values (in bold) denote the direct effects

In the present investigation, the traits number of panicles per square meter, straw yield and harvest index expressed high direct effect and plant height and number of filled grains per panicle had moderate direct effect on grain yield (Table 2).

This was in conformity with the findings of Babu *et al.*, (2012), Vanisree *et al.*, (2013), Islam *et al.*, (2015), Shinde *et al.*, (2015) and Muthuramu and Sakthivel (2016).

The trait number of panicles per square meter expressed moderate to high indirect effects on grain yield *via.*, days to 50% flowering and straw yield. Likewise, the trait straw yield showed high indirect effect through number of panicles per square meter.

Genotypic residual effect (0.36) indicates that traits under study contribute 64% to the variability in grain yield. It indicates that few other traits which have not been studied here, need to be included to account fully for the variation in grain yield.

As a conclusion, the traits days to 50% flowering, number of panicles per square meter and straw yield should be given more importance for enhancing grain yield under rainfed rice cultivation system.

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