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Genetic variability, correlation and path coefficient studies in rice (*Oryza sativa L.*) genotypes

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ABSTRACT

A total of 16 genotypes of rice were evaluated at SASRD, Medziphema during kharif season of 2018 in randomized block design with three replications. The analysis of variance revealed significant differences among genotypes for all the characters studied, indicating high degree of variability in the material. High GCV and PCV were recorded for filled grains/panicle followed by yield/plant, harvest index and effective tillers per plant indicating presence of variation for these traits in the present population. High heritability coupled with high GA as per cent of mean was recorded for filled grains per panicle followed by yield per plant, harvest index, plant height, effective tillers per plant and test weight. At genotypic level, characters like plant height, effective tillers per plant, filled grains/ panicle and harvest index showed positive correlation with yield/ plant indicating relative utility of this trait for selection. Path analysis revealed that number of filled grains per panicle, harvest index and number of effective tillers per plant should be given more importance while selection for improvement of yield.

Keywords: Genetic variability, rice, genotypes, correlation, path coefficient

INTRODUCTION

Rice (*Oryza sativa* L.) is a major staple food crop in the world. It feeds more than 60 percent population of India and is the principal food grain crop of the North Eastern states. The rice yield is measured through grain numbers per panicle, tiller numbers per plant, spikelet numbers per panicle and thousand grains weight. For increasing yield it is important to detect the genes responsible for grain number as well as the panicle numbers (Gauda *et al.* 2019). Assessment of genetic variability is usually made through the estimates of genetic parameters of variation such as range, genotypic and phenotypic coefficient of variation of the characters under consideration. Heritability is an index of the transmission of characters from parents to their offspring. It is generally expressed in percentage. The estimation of heritability helps the plant breeder in selection of elite genotypes. Genetic advance is the measure of genetic gain under selection. In general, diverse landraces traditionally are considered important for future food security due to their ability to sustain in changing climate (Huang *et al.*, 2018). Therefore, the present study was undertaken to assess the nature and magnitude of genetic variability present in different indigenous collections of rice. An attempt has also been made to study the correlation and path coefficient which are helpful in selecting the desirable traits.

MATERIALS AND METHODS

The present experiment was carried out at experimental farm of SASRD, Nagaland University, Medziphema campus following randomized block design with three replications and 16 genotypes. The experimental material comprises of sixteen genotypes (PYAPING LANCHA MIIPYA, JII PYAPING EMMO, KEMENYA KETHENGU KEMERIE-U NHALIEZHA, TIIPE MIIPYA, KOGYA MIIPYA, PYATII MIIPYA, TSAMHO TSIA NHALIELHA, INGLONGKIRI, HATCHA, PULU PYAPING EMMO, MISANG EMMO, AREY EMMO, AMPU EMMO, ELLANG EMMO and AMPU HATI EMMO) of rice. Rice seeds were sown on 22 June, 2018. Two- three seeds per hole were dibbled at 20 cm inter-row and 10 cm inter-plant distance. A population of 30 hills per plot was maintained. Hand weeding was done thrice at 25, 40, and 60 days after sowing. The fertilizer application was done at the rate of 120:60:60 kgha^{-1} of N_2, P_2O_5 and K_2O, respectively. Half dose of nitrogen and full dose of phosphorus and potash were applied as basal dose and the remaining half dose of nitrogen was top dressed at the time of booting. All the recommended agronomic practices were followed for raising a

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good crop. The data were recorded on five randomly sampled plants in each plot for 6 characters viz., plant height, filled grains/panicle, effective tillers/plant, harvest index, test weight and yield per plant. The mean values were subjected to statistical analysis to work out analysis of variance for all the characters as suggested Panse and Sukhatme (1957). The phenotypic, genotypic and environmental coefficients of variation were calculated according to Burton and De Vane (1953).Heritability and genetic advance were calculated according to Allard (1960) and genetic gain was estimated using the method of Johanson *et al.* (1955). Phenotypic and genotypic correlation coefficients were worked out to study the interrelationship between various pairs of characters as suggested by Al-Jibouri *et al.* (1958). The path coefficient analysis was carried out by the formula apply by the Dewey and Lu (1959).

RESULTS AND DISCUSSION

The analysis of variation revealed significant differences among the genotypes for all characters (Table 1) studied indicating high degree of variability present in the material. Phenotypic coefficient of variation was found to be higher than those of genotypic coefficient of variance for all the characters under study (Table2) indicating the role of environmental variance in the total variance. The highest GCV and PCV were recorded for filled grains per panicle followed by yield/plant, harvest index, effective tillers/plant, and plant height indicating the presence of ample variation for these characters under study. Lingaiah *et al.* (2014) and Konate *et al.* (2016) also reported same results.

Table1: Analysis of variance for yield and component characters in rice

Sources of variance	Df	Mean square					
		Plant height	Effective tillers/plant	Filled grains/panicle	Harvest index	Test weight	Yield/plant
Replications	2	4.64	0.16	5.92	0.20	0.003	0.33
Genotypes	15	357.93**	0.90**	574.60**	6.67**	18.254**	1.25**
Error	30	10.89	0.14	13.59	0.96	0.80	0.18

*** Significant at 1%*

Assessment of genetic variability present in the genetic material is important to estimate the magnitude of improvement that can be achieved in breeding material for various characters. Coefficient of variation measures the amount of variability present in the characters but alone is not sufficient to determine the expected progress that could be made in quantitative traits. It has been suggested that estimates of GCV and heritability together provide a better portrait of amount of genetic gain expected under phenotypic selection (Burton and Devane, 1953). Heritability is a useful quantitative parameter, which considers the role of heredity and environment determining the expression of trait (Allard, 1960). Heritability usually considered being low if it is less than 30%, moderate between (30-60%) and high if it is more than 60% (Johnson *et al*, 1955). The range of genetic advance as per cent of mean was classified as low if it is less than 10%, moderate between (10-20%) and high if more than 20% (Johnson *et al*, 1955). In the present study, high estimates of heritability coupled with high estimates of genetic advance were observed for all the characters under study viz. plant height at maturity, effective tillers/plant, filled grains/plant, harvest index, test weight and yield/plant (Table2). Thus, selection for these traits is likely to accumulate more additive genes leading to further improvement of their performance and may also be used as selection criteria in rice breeding programme. Kumar *et al.* (2012) reported similar observation for all the characters under study. Similar result was reported by Gokulakrishnan *et al.* (2014) for filled grains per panicle, plant height at maturity and grain yield.

Table 2: Estimates of mean, variance, coefficient of variance, heritability, genetic advance and genetic advance as % of mean

Characters	Mean ± S.E	Range	Variance			Coefficient of variation			Herita-bility	Gen. Adv. as % of mean
			σ^2_g	σ^2_p	σ^2_e	GCV	PCV	ECV		
Plant height	56.41 ±1.90	31.83-77.76	115.67	126.57	10.89	19.06	19.94	5.85	91.39	37.38
Effective tillers/plant	2.37 ± 0.21	1.66-3.16	0.25	0.39	0.14	21.19	26.42	15.78	64.32	34.48
Filled grains/ panicle	19.49 ± 2.12	4.21-48.69	187.00	200.59	13.59	70.13	72.63	18.9	93.22	139.18
Harvest index	4.59 ± 0.56	2.8-7.47	1.90	2.86	0.96	30.01	36.78	21.27	66.55	50.05
Test weight	23.5 1± 0.02	18.32-28.12	6.084	6.085	0.0014	10.49	10.49	0.15	99.97	21.59
Yield/plant	1.53 ± 0.24	0.57-2.68	0.35	0.53	0.18	39.06	47.79	27.52	66.82	64.86

The study of the nature and magnitude of association between yield and its component characters are of particular interest and an essential pre-requisite in a sound breeding programme. Correlation coefficient analysis measures the mutual relationship between various characters and is used to determine the component character on which selection can be done for improvement in yield. For the utilization of various quantitative characters in breeding programme, interrelationship between the characters is important. Therefore, in the present study, correlations between 6 characters were studied at genotypic level (Table3). The yield per plant showed positive and significant correlation with effective tillers/plant, filled grains per panicle and harvest index. Similar results were reported by Bagheri *et al.* (2011) for effective tillers and filled grains per panicle, Karim *et al.* (2014) for harvest index.

Table3: Estimates of genotypic (r_g) correlation coefficient between different characters of rice

Characters	Plant height	Effective tillers	Filled grains/panicle	Harvest index	Test weight	Yield/plant
Plant height	1	-0.466*	0.453*	0.039	0.096	0.181
Effective tillers		1	0.194	0.600**	-0.389	0.453*
Filled grains/panicle			1	0.645**	-0.295	0.843**
Harvest index				1	-0.504*	0.849**
Test weight					1	-0.445*
Yield/plant						1

**significance at 5%, **significance at 1%*

Path coefficient analysis was carried out to separate the direct and indirect effect of yield contributing characters on yield at genotypic level (Table 4). The path analysis showed that filled grains per panicle contributed maximum positive direct effect on yield followed by harvest index and effective tillers. Filled grains per panicle, harvest index and effective tillers per plant exhibited positive direct effect and also showed significant positive correlation with yield indicating a true relationship between the characters. This suggests that while selection emphasis should be given on filled grains per panicle, harvest index and effective tillers per plant in increasing seed yield.

Table4: Direct and indirect effect of different characters on yield of rice at genotypic level

Characters	Plant height	Effective tillers/plant	Filled grains/panicle	Harvest index	Test weight	Genotypic correlation with Yield/plant
Plant height	-0.0891	-0.0064	0.2618	0.0177	-0.0030	0.1810
Effective tillers/ plant	0.0415	0.0137	0.1121	0.2736	0.0122	0.4531
Filled grains/panicle	-0.0403	0.0027	0.5781	0.2939	0.0092	0.8436
Harvest index	-0.0035	0.0082	0.3727	0.4559	0.0158	0.8491
Test weight	-0.0086	-0.0053	-0.1707	-0.2297	-0.0313	-0.4456

Residual effect: 0.3482

The residual effect estimated was 0.3482 indicating that the characters under study are not sufficient to account for variability and there might be a few more characters other than those studied in the present investigation and thus inclusion of some more characters is required. Inclusion of some characters like leaf area index, spikelet fertility, chlorophyll content could be considered important in order to derive a much clear picture of casual relationship.

The present study suggested that while selection emphasis should be given on filled grains/panicle, harvest index and effective tillers per plant for improvement in seed yield.

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