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# Genetic Variability Analysis for Quantitative Traits in Rice (*Oryza sativa* L.)

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### Authors' contributions

This work was carried out in collaboration between both authors. Author BM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author BNK managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

### Article Information

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## ABSTRACT

The present study was conducted at Agricultural and Horticultural Research station, Kathalagere, Karnataka. The experiment consisted of sixty four rice genotypes that were evaluated to study genetic variability, heritability and genetic advance for grain yield along with four yield-associated traits. The experiment was conducted using 8x8 simple lattice square design during the 2015 *kharif* main cropping season. The analysis of variance revealed statistically significant differences ( $p < 0.05$ ) indicating the existence of genetic variability among the sixty four genotypes for all the traits studied. Higher PCV and GCV values were exhibited by panicles per square meter which suggest the possibility of improving this trait through selection. The highest heritability was recorded for days to 50% flowering and plant height (cm) followed by yield kg/ha and panicles per meter square. High to medium heritability coupled with high GCV and high genetic advance as percentage of means were exhibited for plant height, panicles per square meter. High genetic advances as per cent of means were recorded by yield kg per hectare, panicles per square metre, Plant height (cm) and days to fifty per cent flowering.

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**Keywords:** Rice; variability; genotypes; heritability; genetic advance.

## 1. INTRODUCTION

The genus *Oryza* includes a total of 25 recognised species out of which 23 are wild species and two, *Oryza sativa* and *Oryza glaberrima* are cultivated [1]. It can survive as a perennial crop and can produce a ratoon crop for up to 30 years but cultivated as an annual crop and grown in tropical and temperate countries over a wide range of soil and climatic condition. Rice and agriculture are still fundamental to the economic development of most of the Asian countries. In much of Asia, rice plays a central role in politics, society and culture, directly or indirectly employs more people than any other sector. A healthy rice industry, especially in Asia's poorer countries, is crucial to the livelihoods of rice producers and consumers alike. Farmers need to achieve good yields without harming the environment so that they can make a good living while providing the rice-eating people with a high-quality, affordable staple. Underpinning this, a strong rice research sector can help to reduce costs, improve productivity and ensure environmental sustainability. Indeed, rice research has been a key to productivity and livelihood.

Yield enhancement is the major breeding objective in rice breeding programmes and knowledge on the nature and magnitude of the genetic variation governing the inheritance of quantitative characters like yield and its components is essential for effective genetic improvement. A critical analysis of the genetic variability parameters, namely, Genotypic Coefficient of Variability (GCV), Phenotypic Coefficient of Variability (PCV), heritability and genetic advance for different traits of economic importance is a major pre-requisite [2].

Crop plant diseases caused by various pathogens such as viruses, bacteria, oomycetes and fungi pose major challenges to global crop production and food security. Global climate change is predicted to increase the negative impact of biotic stresses further. Higher temperatures and erratic weather pattern are likely to change the geographical pathogen distribution [3].

The present investigation was undertaken to elucidate information on variability, heritability, genetic advance in promising rice genotypes. Good knowledge of genetic resources might also

help in identifying desirable genotypes for future hybridisation program.

## 2. MATERIALS AND METHODS

The experiment was carried out during *kharif*, 2015 at Agricultural and Horticultural Research Station, Kathalagere. The material comprised of sixty four advanced breeding lines of rice sown in a 8x8 simple lattice design with two replications with spacing of 20 x 15 cm. Data were recorded on five randomly selected plants in each entry in each replications for the traits Days to 50% flowering, Plant height (cm), Number of panicles per square metre, except Yield which recorded in kg/plot converted into kg/ha. The data subjected to INDOSTAT software to estimate Genetic Coefficient of Variation (%), Phenotypic Coefficient of Variation (%), Heritability (%) (Broad sense), Genetic Advance and Genetic Advance as percent of mean. The estimates for variability treated as per the categorisation proposed by Siva Subramanian and Madhavamenon [4], heritability and genetic advance as percent of mean estimates according to criteria proposed by Johnson et al. [5].

## 3. RESULTS AND DISCUSSION

In the present study analysis of variance revealed the existence of significant differences among genotypes for all traits studied. The mean, variability estimates *i.e.*, Genetic coefficient of variation (%), phenotypic coefficient of variation (%), Heritability (%) (Broad sense), Genetic Advance as per cent of the mean are presented in Table 1. All traits under studied have a higher phenotypic coefficient of variation than the genotypic coefficient of variation. The magnitude of phenotypic coefficient of variation and genotypic coefficient of variation was moderate to high for the traits panicles per square metre and yield [6]. High PCV was observed for panicles per square meter (33.95) [6]. The high GCV obtained for a number of panicles per square metre (33.90) indicating the improvement is possible through selection. Genotypic coefficient of variation measures the extent of genetic variability per cent for a trait but does not assess the amount of genetic variation which is heritable. Heritability estimates were high for all the characters. The heritability estimates along with genetic advance can be useful to predict the effect of selection in

**Table 1. Estimates of PCV, GCV and genetic advance for four yield and yield component traits in sixty four advanced breeding lines of Rice**

Traits Parameters	Days to fifty percent flowering	Plant height (cm)	Panicles per m <sup>2</sup>	Yield (kg/ha)
Mean	89.25	90.18	364.64	6454.82
Genotypic variability	871.83	921.95	15279.15	4730149.00
Phenotypic variability	875.01	928.36	15328.48	4740608.00
GCV	33.08	33.66	33.90	33.69
PCV	33.14	33.78	33.95	33.73
Heritability	0.99	0.99	0.997	0.998
Genetic advance	60.71	62.33	254.22	4475.00
Genetic advance as per cent mean	68.02	69.11	69.71	69.33

selection programmes. The traits like days to fifty per cent flowering (68.07), yield kg/ha (69.33) [7] and plant height (69.11) exhibited high magnitude of genetic advance as per cent of the mean. The traits plant height, days to fifty per cent flowering, panicles per square metre and yield have high heritability along with genetic advance as per cent of mean indicate that these characters attributable to additive gene effects which are fixable revealing that improvement in these characters would be possible through direct selection.

Domestication and modern breeding have reduced genetic diversity of crop plants [8] by replacing landraces and traditional farmer cultivars with modern, high yielding varieties. Although this has allowed filtering out genes that cause detrimental traits, the reduction in genetic variation now limits the options of plant breeders to develop new varieties with the existing germplasm. New varieties are constantly needed to meet consumer demands and for protection of crops against highly unpredictable biotic and abiotic stresses that are encountered in agricultural systems. Breeding of improved varieties requires the identification of novel functional genes or alleles and these calls for making effective use of our global crop genetic resources available in seed bank collections. These seed collections represent a wide range of genetic diversity that is critical for maintaining and enhancing the yield potential and other quality traits because they can provide new sources of resistance and tolerance to various stresses. Many of the genes for highly relevant traits in modern crop cultivars have been transferred from their wild relatives and landraces, for example the Rht and sd-1 genes that confer dwarf stature in rice and wheat, respectively [9,10]. In the case of rice, the six wild species *O. rufipogon*, *O. longistaminata*, *O.*

*nivara*, *O. breviligulata*, *O. glumaepatula*, and *O. meridionalis* together with the two cultivated species *O. sativa* and *O. glaberrima* have been identified as the primary gene pool for rice cultivars because genes can be easily transferred between these species [11]. The wild species have been used as a source of many relevant genes for rice breeding, and *O. rufipogon* has been suggested as source of broad-spectrum rice blast resistance genes [12].

#### 4. CONCLUSION

A total of 64 rice genotypes including one local check were evaluated for four yield attributing traits. Results of the present investigation on variability, heritability and genetic advance indicated that the study needs an interrelationship between yield and other traits. Two varieties were identified that performed better and showed higher variability. This could be used for station trial and multi-season testing. A further study is needed to use the high yielding and resistant varieties in the crop improvement programme.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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