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Studies on Genetic Variability, Heritability and Genetic Advance for Grain Yield and its Components in Medium Duration Rice Genotypes

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ABSTRACT

Genetic based information of different traits plays important role in varietal improvement of rice. A field experiment was conducted using twenty six medium duration rice genotypes at the Agricultural college farm, Bapatla with respect to the yield components to study genetic variability, heritability and genetic advance (GA) for yield and yield associated traits in rice. The analysis of variance showed highly significant differences among the genotypes for all the characters studied, indicating the presence of adequate variability. Further, coefficient of variation studies indicated that the estimates of GCV were lesser than the corresponding PCV values for all the traits indicating the influence of environment on expression of these characters and therefore phenotypic selection will be misleading. High PCV and GCV were recorded for grains per panicle and grain yield per plant indicating the existence of high variability. High heritability along with high expected genetic advance as per cent of mean was observed for test weight implying that this trait was under probable control of additive gene effect and simple selection is sufficient to improve these traits.

Keywords: *Expected genetic advance, GCV, Heritability, PCV, Rice and Variability.*

Rice (*Oryza sativa* L. 2n = 2x = 24) is the principal staple cereal food and source of calories for more than half of the world's population. It offers a wealth of material for genetic studies because of its wide ecological distribution and enormous variation encountered for various qualitative and quantitative characters (Kohnaki *et al*., 2013). It is the staple food for 65% of the global population and forms the cheapest source of food energy and protein. To meet the food demands of the growing population and to achieve food security in the country, the present production levels need to be increased by 2 million tonnes every year, which is possible through heterosis breeding and other innovative breeding approaches (Padmavathi, 2012). Creation of genetic variability and selection for important traits is a crucial activity that any plant breeder should apply to achieve better yield and other desirable agronomic traits. Considering its importance in food and fodder security, available information on variability and interrelationship between yield and its attributes is meagre in rice. For improvement of rice, study on genetic variability of important traits responsible for grain yield is essential.

Knowledge on heritability and genetic advance of the character indicate the scope for the improvement of a trait through selection. However, to carry out effective selection, the information on available genetic variation among rice genotypes, the nature of component traits on which selection would be effective and the influence of environmental factors on each trait need to be known (Jaleta *et al*., 2011). Hence, heritability estimates along with genetic advance are helpful in predicting the genetic gain under selection (Johnson *et al.,* 1955). Hence, the present study aims at determining the heritable and non-heritable variation of yield and its contributing traits.

MATERIAL AND METHODS

The experimental material for the present investigation consisted of 26 elite genotypes of rice collected from different rice research stations of Andhra Pradesh state, namely, Bapatla (BPT), Ragolu (RGL), Maruteru (MTU), Nellore (NLR) and Jangamaheswarapuram (JMP). These genotypes were evaluated during *kharif*, 2016 at Agricultural College Farm, Bapatla in a randomized complete

block design with three replications. The seeds were raised on nursery bed and seedlings were transplanted in main field after 28 days. Each genotype was planted in two rows of 4 m length with a spacing of 20 cm between rows and 15 cm between the plants. Observations were recorded on 10 randomly chosen plants for eight quantitative characters, namely, days to 50% flowering, days to maturity, productive tillers per plant, plant height, panicle length, grains per panicle, test weight and grain yield per plant. Mean value of the recorded data was subjected to analysis of variance.

Analysis of variance was calculated as per Panse and Sukathme (1967). Phenotypic and genotypic coefficients of variation (PCV and GCV) were computed as per Burton and Devane (1953). Heritability in broad sense was computed as per Allard (1960). Genotypic and phenotypic correlations were calculated according to Falconer (1981). Heritability and genetic advancement were categorized into low, moderate and high as per Johnson *et al.,* (1955).

RESULTS AND DISCUSSION

In the present study the analysis of variance revealed significantly high differences among genotypes for all the traits (Table 1), which indicates presence of sufficient variability and scope for further selection and breeding superior and desirable genotypes. The mean, range of variation and the estimate of genetic parameters such as, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability in broad sense and expected genetic advance as per cent of mean are presented in Table 2.

The variation for number of days taken to 50% flowering ranged from 96.66 days to 114.01 days with a mean of 104.01 days. Days to maturity ranged from 126 days to 145 days with a mean of 133.98 days. Productive tillers per plant ranged from 10.66 to 23.00 with a mean of 15.17. Plant height ranged from 85.33cm to112.33cm with a mean of 100.32. Panicle length ranged from 19.66cm to 24.66cm with a mean of 22.19cm. Grains per panicle ranged from 106.66 to 282.33 with a mean of 153.30. Test weight ranged from 15.40g to 24.7g with a mean of 19.92g. Grain yield per plant ranged from 20.66g to 60.00g with a mean of 38.09g.

The experimental material had wide range of variability and favourable mean performance for most of the traits studied and these possible combinations could be exploited for simultaneous improvement of grain yield and other yield attributing traits. The PCV was higher in magnitude than the magnitude of GCV for all the traits, indicating the presence of influence of environment on the expression of these traits. High estimates of GCV and PCV were observed for grains per panicle (24.79, 26.44) and grain yield per plant (20.24, 30.29) respectively. It indicates the genotypes had a great deal of intrinsic variability, making them more useful for selection. Likewise, high estimates of variability were also reported by Bhadru *et al*. (2012) for grain per panicle and grain yield per plant with the findings of the present study. High PCV and moderate GCV was observed for productive tillers per plant (21.79, 16.66). Similar findings were observed in the studies of Garg *et al.* (2010), Parvathi *et al.* (2011) and Prasad *et al*. (2011) for productive tillers per plant.

Among the studied traits, Low GCV and PCV was noticed for days to 50% flowering (5.27, 4.68), days to maturity (4.13, 3.66) and plant height (9.77, 8.71) indicating a limited range of variability for these traits, limiting the possibilities for effective selection. Similar kind of findings were also reported Dhanwani *et al.* (2013), Vanisree *et al.* (2013), Devi *et al.* (2016) and Devi *et al*. (2017).

The traits, grains per panicle and test weight had high heritability and expected genetic advance as per cent of mean and these traits may be controlled by additive gene action, hence simple selection among genotypes with respect to these traits would be effective. Same results were earlier reported by Saidaiah *et al.* (2010). The trait, plant height shows high heritability with moderate expected genetic advance as per cent of mean indicating the operation of both additive and non-additive gene action in the inheritance of this trait and the desired results may not be obtained by simple selection. These findings are in agreement with Paikhomba *et al.* (2014) and Tejaswini (2016). High heritability accompanied with low expected genetic advance as per cent of mean was observed for the trait days to 50% flowering indicating the predominance of non-additive gene action in the inheritance of this trait and desired results may not be obtained by simple selection and the same

results were earlier reported by Sreeparvathy *et al*. (2010) and Osman *et al*. (2012).

The traits productive tillers per plant and grain yield per plant shows moderate heritability coupled with high expected genetic advance as per cent of mean indicates the predominance of non-additive gene action, for the inheritance of these traits desired results may not be obtained by the simple selection, these results were earlier reported by Krishna *et al.* (2008) for productive tillers per plant; and by Chandra *et al.* (2009) for grain yield per plant. Moderate heritability and moderate expected genetic advance was recorded by panicle length. While, low heritability combined with low genetic advance as per cent of mean for the trait days to maturity also indicates the non-additive gene action. Similar results for panicle length were earlier reported by Parvathi *et al*. (2011).

Analysis of variance revealed substantial differences among genotypes for all the traits with sufficient variability and scope for selecting suitable genotypes. In the current study it is clear that grains per panicle and grain yield per plant had high variability among the genotypes. The trait test weight had higher heritability and genetic advance as percent of mean and this may be controlled by additive gene action, hence simple selection among genotypes with respect to this trait would be effective.

Table 1: Analysis of variance for grain yield and yield components in medium duration rice (*Oryza sativa* L.) varieties

Source of variation	d.f	Days to 50% flowering	Days to maturity	Productive tillers per plant	Plant height (cm)	Panicle length (cm)	Grains per panicle	Test weight (g)	Grain yield per plant(g)
	Mean sum of squares								
Replications	2	14.01	14.62	9.24	19.47	2.34	167.8	0.97	7.5
Treatments	25	77.63**	78.86**	23.73**	249.05**	11.71**	4532.37**	23.26**	252.16**
Error	49	6.27	6.52	4.55	19.67	2.17	198.91	2.49	73.78

** Significance at 1% level

Table 2: Estimates of variability, heritability and genetic advance as per cent of mean for grain yield and yield components in medium duration rice (*Oryza sativa* L.) varieties

S.NO	Character	Mean	Range		Coefficient of variation		Heritability (broad sense)	Expected genetic advance as percent of mean
			Minimum	Maximum	PCV (%)	GCV (%)		
1	Days to 50% flowering	104.01	96.66	114.01	5.27	4.68	79.11	8.59
2	Days to maturity	133.98	126	145	4.13	3.66	11.2	6.69
3	Productive tillers per plant	15.17	10.66	23	21.79	16.66	58.43	26.23
4	Plant height (cm)	100.32	85.33	112.33	9.77	8.71	79.53	16.01
5	Panicle length (cm)	22.19	19.66	24.66	10.42	8.03	59.4	12.75
6	Grains per panicle	153.3	106.66	282.33	26.44	24.79	87.9	47.87
7	Test weight (g)	19.92	15.4	24.7	15.4	13.2	73.54	23.33
8	Grain yield per plant(g)	38.09	20.66	60	30.29	20.24	44.63	27.85

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