The Andhra Agric. J 61(1): 82-85, 2014

Assessment of Genetic Variability and Genetic Parameters for Grain Yield and Its Component Characters in Rice (*Oryza sativa* L.)

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ABSTRACT

Twenty one rice genotypes were evaluated during *rabi,* 2011 for eleven quantitative and kernel traits to examine the nature and magnitude of variability, heritability (broad sense) and genetic advance. Analysis of variance revealed significant differences among twenty one genotypes for all the characters. Grain yield per plant and total number of productive tillers per plant exhibited high estimates of genotypic coefficient of variation and phenotypic coefficient of variation. Broad sense heritability was highest for kernel L/B ratio followed by number of grains per panicle, grain yield per plant and harvest index, which suggested that these traits would respond to selection owing to their high genetic variability and transmissibility. Maximum genetic advance as per cent of mean was recorded for grain yield per plant with high value of heritability.

Key words : Genetic advance, Rice, Variability, heritability, Yield.

Rice *(Oryza sativa* L.) is the world's second most important cereal crop after wheat and about 90 per cent of the people of South- East Asia consume rice as staple food. The demand of rice is increasing day by day in the state as well as in the country. Therefore, it is necessary to escalate the production of rice proportionate to growing population. The pre-requisite in yield improvement is to identify the genotypes with high variability. Genetic variability among traits is important for breeding and in selecting desirable types. Development of high yielding varieties requires the knowledge of existing genetic variability among genotypes. The large spectrum of genetic variability in segregating population depends on the amount of the genetic variability among genotypes and offer better scope for selection. The magnitude of heritable variation in the traits studied has immense value in understanding the potential of the genotypes for further breeding programme. Assessment of variability for yield and its component characters becomes absolutely essential before planning for an appropriate breeding strategy for genetic improvement. Genetic parameters such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are useful in detecting the amount of variability present in the germplasm. Heritability coupled with high genetic advance would be more useful tool in predicting the resultant effect in selection of the best genotypes for yield and its attributing traits. It helps in determining the influence of environment on the expression of the genotypic reliability of characters. Keeping this in view, an attempt has been made to assess the genetic variability and heritability of yield and yield components among the twenty one rice genotypes.

MATERIAL AND METHODS

A field experiment was conducted with twenty one rice genotypes during *rabi,* 2011 at S.V. Agricultural College, Tirupati in a completely randomized block design with three replications. Twenty one days old seedlings of each genotype were transplanted in three rows of 2.0 m length by adopting a spacing of 22.5 cm between rows and 10 cm between plants within rows at the rate of 20 plants per row. The crop was grown with the application of fertilizer N, P and K @ 120, 60 and 60 kg ha^{-1}, respectively. Standard agronomic practices were followed to raise a good crop. A composite sample of five plants from the middle row was used to record observations on these plants for plant height, total number of productive tillers per plant, panicle length, number of grains per panicle, test weight, harvest index, grain yield per

Table 1. Analysis of variance for RBD for grain yield and yield components in rice.

S. No.	Character	Mean sum of squares due to		
		Replications (df=2)	Genotypes (df=20)	Error (df=40)
1.	Days to 50% flowering	3.53	150.28**	3.65
2.	Days to maturity	0.25	59.74**	3.88
3.	Plant height (cm)	0.96	381.99**	2.15
4.	Total number of productive tillers per plant	0.45	34.57**	0.33
5.	Panicle length (cm)	1.82	7.55**	0.63
6.	Number of grains per panicle	9.08	466.67**	3.92
7.	Grain yield per plant (g)	0.16	81.82**	1.09
8.	Test weight (g)	0.01	6.87**	0.28
9.	Harvest index (%)	0.78	85.05**	2.19
10.	Milling percentage	0.05	11.90**	0.55
11.	Kernel L/B ratio	0.01	0.19**	0.01

** Significant at P = 0.01 level

plant, milling percentage and kernel L/B ratio, while the traits *viz*., days to 50 per cent flowering and days to maturity were recorded on per plot basis.

The data collected for all the characters studied were subjected to analysis of variance technique on the basis of model proposed by Panse and Sukhatme (1961). The genotypic and phenotypic coefficients of variability were calculated as per the formulae proposed by Burton and Devane (1952). Heritability in broad sense and genetic advance were estimated using the formulae given by Lush (1940) and Johnson *et al.* (1955), respectively.

RESULTS AND DISCUSSION

Analysis of variance revealed highly significant differences among the genotypes for yield and yield components (Table 1.). A wide range of variation was observed among twenty one rice genotypes for eleven quantitative and kernel characters. This suggested that there were inherent genetic differences among the genotypes for all the characters under study. The results revealed that phenotypic variance was higher than the genotypic variance for all the characters, thus indicated the influence of environment on these traits. High genetic variability for different quantitative traits in rice was reported earlier by Akinwale *et al.* (2011) and Ullah *et al.* (2011).

The estimates of phenotypic coefficient of variation (PCV) were slightly higher than those of genotypic coefficient of variation (GCV) for all the traits studied (Table 2.). The extent of the environmental influence on traits is explained by the magnitude of the difference between GCV and PCV. Large differences between GCV and PCV values reflect the presence of high environmental influence on the expression of traits. In this study, the observation of slight differences between GCV and PCV values indicated least environmental influence and consequently greater role of genetic factors on the expression of the traits. Similar observations were also noted earlier by Mustafa and Elsheikh (2007) and Kole *et al.* (2008) in rice. In contrary to the present study, which showed closer values between GCV and PCV, Akinwale *et al.* (2011) and Sadeghi (2011) recorded wide differences between GCV and PCV values of the traits. The difference between PCV and GCV estimates were relatively low for all the traits except for total number of productive tillers per plant and panicle length, indicating less environmental influence on these traits. Total number of productive tillers per plant and grain yield per plant showed higher estimates of GCV (21.12%); PCV (21.43%) and GCV (21.09%); PCV (21.51%), respectively and therefore, simple selection can be practiced for further improvement of these characters. This

Table 2. Estimates of variability and genetic parameters for grain yield and yield components in rice.

S. No.	Character	Mean	Range	Variance		Coefficient of variation (%)		Heritability in broad sense (%)	Genetic Advance (%)	Genetic Advance as per cent of Mean at 5% level
				V_g	V_p	GCV	PCV			
1.	Days to 50% flowering	98.60	87.00 – 113.67	48.87	52.53	7.09	7.35	93.00	13.89	14.08
2.	Days to maturity	126.87	118.00 – 133.67	18.62	22.50	3.40	3.73	82.70	8.08	6.37
3.	Plant height (cm)	86.57	64.80 – 119.77	126.61	128.76	12.99	13.10	98.30	22.98	26.55
4.	Total number of productive tillers per plant	15.99	8.50 – 20.98	11.41	11.74	21.12	21.43	97.20	6.86	42.90
5.	Panicle length (cm)	21.93	17.63 – 24.47	2.30	2.93	6.92	7.81	78.60	2.77	12.65
6.	Number of grains per panicle	128.95	105.73 – 147.00	154.25	158.17	9.63	9.75	97.50	25.26	19.59
7.	Grain yield per plant (g)	24.59	11.87 – 36.87	26.91	28.00	21.09	21.51	96.10	10.47	42.59
8.	Test weight (g)	20.62	17.77 – 23.00	2.19	2.48	7.18	7.63	88.60	2.87	13.93
9.	Harvest index (%)	50.01	36.33 – 60.57	27.62	29.81	10.50	10.91	92.60	10.42	20.83
10.	Milling percentage	65.87	60.93 – 68.60	3.78	4.33	2.95	3.16	87.30	3.74	5.68
11.	Kernel L/B ratio	2.91	2.22 – 3.24	0.06	0.06	8.68	8.72	99.20	0.51	17.82

V_g : Genotypic Variance
V_p : Phenotypic Variance
PCV : Phenotypic Coefficient of Variation
GCV : Genotypic Coefficient of Variation

was in conformity with the findings of Kundu *et al*. (2008) and Rema Bai *et al.* (1992) for grain yield and productive tillers. On contrary, moderate estimates of PCV and GCV values were recorded for plant height and harvest index. These results were in consonance with the findings of Sampath Kumar *et al.* (2011) and Sharma and Sharma (2007) for plant height and and Kundu *et al.* (2008) for harvest index. However, other characters showed low PCV and GCV estimates.

High heritability values were recorded for all the traits indicating the least influence of environment. High heritability suggests high component of heritable portion of variation that can be exploited by breeders in the selection of superior genotypes on the basis of phenotypic performance. These findings were in consonance with the reports made earlier in rice by Sampath Kumar *et al.* (2011), Kundu *et al*. (2008) and Deepa Sankar *et al.* (2006).

The estimates of genetic advance as percent of mean were found high for grain yield per plant (85.83%), total number of productive tillers per plant (43.50%), number of grains per harvest index (30.44), plant height (27.08%), test weight (23.99), Panicale length (21.60) and harvest index (20.46%). While, these were moderate for number of grains per panicle, kernel L/B ratio, days to 50% flowering, test weight and panicle length, while it is low for milling percentage and days to maturity.

The estimates of genetic parameters revealed that the trait days to 50% flowering exhibited high heritability coupled with moderate genetic advance, which indicated the importance of additive gene action in the inheritance of this trait. However, high heritability coupled with high genetic advance as per cent of mean was recorded for grain yield per plant, total number of productive tillers per plant, plant height and harvest index, indicating that most likely the heritability is due to additive gene effects and selection may be effective for these characters. Similarly, high heritability coupled with high genetic advance was reported by Sampath Kumar *et al.* (2011) for grain yield per plant, total number of productive tillers per plant, test weight, harvest index and plant height, Ullah *et al.* (2011) for grain yield, and Deepa Sankar *et al.* (2006) for plant height, productive tillers per plant, test weight and grain yield per plant.

The perusal of results revealed that there is adequate genetic variability in the present material studied. The characters number of grains per panicle, harvest index, plant height, total number of productive tillers per plant and test weight were less influenced by environment and had high heritability coupled with high genetic advance, implying additive gene action. Therefore, simple selection of these characters based on phenotypic values can be advocated for yield improvement in rice using the present material. The characters showing high heritability with low genetic advance indicated the presence of non-additive gene action. Hence, selection based on these characters could be postponed to later generations or these characters could be improved by intermating of superior genotypes of segregating population through recombination breeding.

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(Received on 29.06.2012 and revised on 26.12.2012)