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Genetic Variability Studies for Grain yield and its Component Characters in Rice (*Oryza sativa* L.)

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ABSTRACT

The present investigation was undertaken to study the extent of genetic variability in 45 elite rice (*Oryza sativa* L.) genotypes for twenty one yield and quality characters during *kharif* 2015. The magnitude of difference between PCV and GCV was relatively low for all the traits, indicating less environmental influence. High GCV and PCV were recorded for grain yield plant^{-1}, water uptake, volume expansion ratio and alkali spreading value. High heritability coupled with high genetic advance as percent of mean were recorded for days to 50% flowering, productive tillers plant^{-1}, filled grains panicle^{-1}, total grains panicle^{-1}, test weight, grain yield plant^{-1}, L/B ratio, water uptake, kernel elongation ratio, volume expansion ratio, alkali spreading value and protein percent indicating the preponderance of additive gene action and these characters could be improved through selection.

Key words: *GCV, Genetic Advance, Heritability, PCV and Rice.*

Rice (*Oryza sativa* L.) is the world's second most important cereal crop after wheat and about 90 percent 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 seggregating population depends on the magnitude of the genetic variability among genotypes that 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 use in further breeding programmes. Assessment of variability for yield and its component characters becomes absolutely essential before planning 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 variability of characters. Keeping this in view, an attempt has been made to assess the extent of genetic variability and heritability of yield and yield components among the 45 rice genotypes.

MATERIAL AND METHODS

A field experiment was conducted with 45 rice genotypes during *kharif* 2015 at Agricultural Research Station, Nellore, Andhra Pradesh in a Randomized Block Design with two replications. Each genotype was planted in three rows of 4 m length with a spacing of 20 cm between the rows and 15 cm between the hills. Recommended agronomic practices were followed to raise a good crop. Observations were recorded on 21 morphological, yield component and quality characters.

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 (1957). The genotypic and phenotypic coefficients of variability were calculated as per the formulae proposed by Burton and Devane (1953). 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 morphological , yield component and quality characters (Table 1). A wide range of variation was observed among the 45 genotypes for 21 quantitative and quality characters. This suggested that there were inherent genetic differences among the genotypes for all the characters under study. The results revealed that phenotypic variances were higher than the genotypic variance for all the characters, thus indicated the influence of environment on expression of these traits.

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 magnitude of the difference between GCV and PCV was low for all the traits which indicated less environmental influence and consequently greater role of genetic factors on the expression of the traits.

In the present investigation characters studied exhibited low, moderate and high PCV and GCV values. Among the yield characters high percent of GCV and PCV were recorded for grain yield (20.85 and 20.03). Among the grain quality characters highest GCV and PCV were recorded for volume expansion ratio (49.69 and 49.59) followed by alkali spreading value (43.47 and 43.40) while the character hulling percent (2.34 and 1.66) and milling percent (3.37 and 3.01) recorded the lowest GCV and PCV values. Moderate genotypic and phenotypic coefficient of variation were recorded for the characters, days to 50% flowering (11.60 and 11.38), productive tillers plant^{-1}(15.38 and 12.95), filled grains panicle^{-1} (19.08 and 18.16), total grains panicle^{-1} (17.33 and 16.46) test weight (18.16 and 18.03), L/B ratio (17.24 and 17.15) and protein percent (11.63 and 11.56). High magnitude of phenotypic and genotypic coefficient of variations, low environmental variation indicated high genetic variability for different traits. Therefore selection on the basis of phenotype alone can be effective for the improvement of these traits. Similar results for low to moderate values of GCV and PCV were also found by Shiva Prasad *et al*. (2011), Tushara *et al*. (2013) and Kumar *et al*. (2013).

Heritability and Genetic advance

The reliability of the phenotypic value depends on the estimates of heritability for a particular character. Therefore high heritability helps in the effective selection for a particular character. High estimates for heritability was exhibited by all the characters under study.

The estimates of genetic advance as per cent of mean provide more reliable information regarding

Table 1. Analysis of variance for yield and yield contributing characters in 45 genotypes of rice (*Oryza sativa* L.) during 2015-16

Source of variation	df	Days to 50% flowering	Days to maturity	Plant height (cm)	Productive tillers/plant	Panicle length (cm)	Filled grains/ panicle	Total grains/ panicle	Spikelet fertility (%)	Test weight (g)	GrainYield/Plant (g)
		Mean Sum of Square									
Replication	1	4.44	19.66	1.76	0.14	0.01	128.64	285.15	1.53	0.07	9.45
Genotype	44	251.20**	221.27**	107.5**	4.92**	9.92**	2038.90**	2295.27**	64.15**	25.83**	120.83**
Error	44	4.69	5.62	6.32	0.84	0.98	100.21	117.15	7.78	0.19	9.23

** Significant at 5% level of probability

Source of variation	df	Hulling %	Milling %	Head rice Recovery	L/B Ratio	Water Uptake	Kernel Elongation ratio	Volume Expansion ratio	Alkali Spreading Value	Gel Consistency	Amylose content	Protein %
		Mean Sum of Square										
Replication	1	0.54	1.11	0.56	0.003	1.34	0.003	0.032	0.01	0.215	0.24	0.005
Genotype	44	221.55**	428.95**	828.83**	0.58**	5645.6**	0.075**	9.82**	3.99**	64.22**	10.19**	1.302**
Error	44	72.95	48.88	65.24	0.003	31.57	0.002	0.02	0.006	0.76	0.16	0.01

** Significant at 5% level of probability

Table 2. Mean, variability, heritability and genetic advance as per cent of mean for yield, yield components in rice (*Oryza sativa* L.).

Character	Mean	Range		Coefficient of variation (%)		Heritability (%) (broad sense)	Genetic advance as percent of mean (5%level)
		Minimum	Maximum	PCV	GCV		
Days to 50% Flowering	97.52	79.00	129.00	11.60	11.38	96.33	23.02
Days to Maturity	129.09	111.50	157.00	8.25	8.04	95.04	16.16
Plant Height (cm)	83.52	68.40	103.70	9.04	8.52	88.89	16.55
Productive Tillers/ Plant	11.04	7.40	16.60	15.38	12.95	70.90	22.46
Panicle Length (cm)	22.20	17.40	26.10	10.52	9.53	82.04	17.78
Filled Grains/ Panicle	171.41	106.50	260.00	19.08	18.16	90.63	35.62
Total Grains/ Panicle	200.45	129.00	299.00	17.33	16.46	90.28	32.23
Spikelet Fertility (%)	85.28	71.24	93.12	7.03	6.23	78.36	11.35
Test Weight (g)	19.87	13.91	29.10	18.16	18.03	98.56	36.87
Grain yield (g)	38.67	20.00	58.20	20.85	20.03	85.80	36.86
Hulling %	78.28	74.00	81.00	2.34	1.66	50.45	2.43
Milling %	69.08	63.00	74.00	3.37	3.01	79.53	5.53
Head rice recovery	57.63	51.00	66.00	5.53	5.11	85.40	9.73
L/B Ratio	3.13	2.05	4.86	17.24	17.15	98.96	35.14
Water uptake	202.26	106.00	314.00	26.34	26.20	98.88	53.66
Kernal elongation ratio	1.68	1.31	2.47	11.68	11.43	95.85	23.06
Volume expansion ratio	4.47	1.25	10.00	49.69	49.59	99.61	101.96
Alkali spreading value	3.25	2.00	7.00	43.47	43.40	99.61	89.27
Gel consistency	72.79	58.30	81.30	7.83	7.74	97.65	15.75
Amylose content	23.33	17.46	26.87	9.75	9.60	96.80	19.45
Proteine %	6.96	5.03	9.23	11.63	11.56	98.80	23.67

PCV= Phenotypic coefficient of variation; GCV= Genotypic coefficient of variation

the effectiveness of selection in improving the traits. Among the characters studied for genetic advance as per cent of mean , high, moderate and low estimates were recorded. The genetic advance as per cent of mean was higher for test weight (36.87) followed by grain yield per plant (36.86), filled grains per panicle (35.62) and total grains per panicle (32.23) and lowest was recorded for spikelet fertility among quantitative characters. Whereas, for grain quality characters, volume expansion ratio (101.96) recorded the highest value followed by alkali spreading value (89.27), water uptake (53.66) and lowest was recorded for hulling percent (2.43).

Heritability estimates along with genetic advance are more useful than heritability alone in predicting the effectiveness of selection (Johnson *et al.* 1955). In the present study the characters which showed high heritability associated with high genetic advance are volume expansion ratio, alkali spreading value, water uptake, test weight, grain yield, filled grains per panicle and total grains per panicle which are controlled by additive gene action (Panse and Sukhatne, 1957) and can be improved through simple or progeny selection methods. Similar results were also reported by Bhadru *et al.* (2012), Sobha Rani *et al.* (2013) and Tushara *et al.* (2013).

CONCLUSION

Therefore, it is concluded that the characters which showed high genotypic value coupled with high heritability and genetic advance should be considered for direct selection. In the present study, grain yield plant^{-1}, water uptake, volume expansion ratio and alkali spreading value showed high GCV, PCV, heritability and genetic advance. Thus one should consider these characters for direct selection.

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