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Studies on Genetic Parameters for Morphological and Quality Traits in Rice

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ABSTRACT

Thirty rice genotypes were evaluated to estimate the genetic variability parameters for 14 morphological and grain quality traits. Analysis of variance revealed the existence of significant differences among the genotypes for all the characters studied. High GCV and high PCV were observed for grain yield per plant and volume expansion ratio indicating the presencof wider variability for these traits. Low to moderate heritability and genetic advance as per cent of mean were manifested by productive tillers per plant, test weight and L/B ratio. High heritability coupled with high genetic advance as per cent of mean was observed for grain yield per plant, water uptake, volume expansion ratio and amylose content revealing the preponderance of additive gene action and direct selection may be effective for improving these traits. High heritability coupled with moderate genetic advance as per cent of mean was observed for plant height, days to 50% flowering, panicle length, spikelet fertility percentage, kernel length and protein content indicating the role of both additive and non-additive gene effects in governing the inheritance of these traits.

Key words: *Rice, genetic parameters and quality.*

Being the staple food crop, improving the crop yield and grain quality is an important consideration in rice breeding programmes. The most important criteria in any crop improvement programmme is the selection of genotypes with desirable quality and yield attributing traits. The success of plant breeding programme depends on the extent of genetic variability present in a crop. Knowledge on the nature and magnitude of genetic variation is essential for genetic improvement of quantitative traits like yield. The knowledge on heritability is also essential for selection of component traits for yield improvement as it indicates the extent of transmissibility of a character into future generations. Heritability estimates along with genetic advance is more helpful in predicting the genetic gain under selection than heritability estimates alone. Genetic advance is the improvement in mean genotypic value of progeny obtained from the selected plants over the parental population. In this context, the present investigation was undertaken to elucidate information on variability, heritability and genetic advance in rice genotypes.

MATERIAL AND METHODS

The experimental material comprised of 30 rice genotypes obtained from Agricultural Research Station, Bapatla, Andhra Pradesh. The experiment was laid out in Randomized Complete Block Design with three replications at Agricultural College farm, Bapatla during *kharif*, 2020. Observations were recorded on five randomly chosen plants for six morphological traits *viz.,* plant height (cm), productive tillers per plant, panicle length (cm), spikelet fertility

percentage, test weight (g) and grain yield per plant; three physical quality traits such as kernel length (mm), kernel breadth (mm) and kernel L/B ratio. Whereas, observations were recorded on plot basis for days to 50 per cent flowering and four cooking and nutritional quality traits such as water uptake (ml), volume expansion ratio, amylose content (%) and protein content (%). The data was subjected to statistical analysis and various genetic parameters such as PCV and GCV were worked out according to Burton and Devane (1953); heritability and genetic advance as per cent of mean were worked out as per Johnson *et al*. (1955).

RESULTS AND DISCUSSION

The results of mean performance of 30 genotypes for 14 morphological and grain quality traits revealed that the grain yield per plant ranged from 21.99g (BPT 3150) to 58.63g (BPT 3092) (Fig. 1). Among the genotypes under study, two entries possessed long slender grain type and 14 genotypes recorded medium slender grain type. The genotypes *viz.,* BPT 3086, BPT 3118, BPT 3121, BPT 3150, BPT 3168, BPT 3178, BPT 3208 and BPT 3244 exhibited high water uptake and volume expansion ratio coupled with intermediate amylose content which is desirable. Among the entries tested, five genotypes recorded high amylose content and six genotypes manifested low amylose content (Fig. 2).

The analysis of variance for different traits is furnished in Table 1. The results of ANOVA revealed significant variation among the genotypes for all morphological and quality traits suggesting that there were inherent genetic differences among the genotypes for all the characters under study. The estimates of phenotypic coefficient of variation (PCV) were higher than those of genotypic coefficient of variation (GCV) for some of the traits (Table 2) indicating that these characters might have influenced by the environment. Whereas, for some traits PCV estimates were slightly higher than those of GCV indicating least environmental influence and consequently greater role of genetic factors on the expression of the traits. Similar results were reported earlier by Eswararao *et al.* (2017) in rice.

The perusal of results revealed that panicle length manifested low GCV (6.19) while volume expansion ratio recorded high GCV (23.73) while the estimates of PCV ranged from 7.13 (days to 50% flowering) to 24.41 (grain yield per plant). Among all the characters under study, grain yield per plant and volume expansion ratio showed high estimates of GCV (22.32% & 23.73%, respectively) and PCV (24.41% & 23.82%, respectively) suggesting the existence of high variabilty for these traits. This was in conformity with the findings of Nath and Kole (2021) for grain yield per plant. The estimates of GCV and PCV were moderate for test weight (11.15;16.45), water uptake (17.71;17.74) and amylose content(12.13;12.39) which were in accordance with the previous studies reported by Hasan *et al.* (2020) for test weight & amylose content and Bandi *et al.* (2018) for water uptake. However, low GCV and low PCV were recorded for plant height, days to 50 per cent flowering, panicle length, spikelet fertility percentage, kernel length and protein content. Similar results were reported by Devi *et al.* (2020) for plant height, panicle length & kernel length, Parvathi *et al.* (2011) for days to 50 per cent flowering, Lingaiah *et al.* (2018) for spikelet fertility percentage and Hasan *et al.* (2020) for protein content.

The estimates of heritability for all traits ranged from 22.36% (productive tillers per plant) to 99.67% (water uptake). While, the maximum estimates for genetic advance as per cent of mean were manifested by volume expansion ratio (48.72) followed by grain yield per plant (42.04) and water uptake (36.42).

Table 1. Analysis of variance for morphological and quality traits in rice

Source of variation	d. f.	Plant height (cm)	Days to 50 per cent flowering	Productive tillers per plant	Panicle length (cm)	Spikelet fertility (%)	Test weight (g)	Grain yield per plant (g)	Kernel length (mm)	Kernel breadth (mm)	L/ B ratio	Water uptake (ml)	Volume expansion ratio	Amylose content (%)	Protein content (%)
		Mean sum of squares													
Replications	2	0.7	0.43	2.47	0.53	20.34	2.75	19.27	0.13	0.1	0.22	2.31	0.03	0.81	0.01
Genotypes	29	279.401**	173.341**	1.577*	8.666**	106.137**	15.444**	150.858**	0.776**	0.454**	0.889**	4189.06**	4.019**	22.593**	0.933**
Error	58	28.61	6.33	0.85	1.14	10.81	4.35	9.26	0.12	0.1	0.26	4.69	0.01	0.32	0.01

** Significant at 1 per cent level of probability; * Significant at 5 per cent level of probability

Table 2. Variability, heritability and genetic advance as per cent of mean for morphological and quality traits in rice

S. No.	Character	Range		Mean	Coefficient of		Heritability (%)	Genetic advance as per cent of mean
		Maximum	Minimum		GCV (%)	PCV (%)		
1	Plant height (cm)	134.81	94.75	112.73	8.11	9.40	74.50	14.42
2	Days to 50 per cent flowering	118.33	98.00	109.53	6.76	7.13	89.79	13.20
3	Productive tillers per plant	9.20	5.87	6.88	7.18	15.18	22.36	6.99
4	Panicle length (cm)	29.01	21.49	25.60	6.19	7.47	68.68	10.56
5	Spikelet fertility (%)	94.96	68.10	86.22	6.54	7.57	74.61	11.63
6	Test weight (g)	23.19	12.74	17.25	11.15	16.45	45.95	15.57
7	Grain yield per plant (g)	58.63	21.99	30.78	22.32	24.41	83.60	42.04
8	Kernel length (mm)	7.49	5.19	5.87	7.95	9.96	63.64	13.06
9	Kernel breadth (mm)	2.77	1.44	1.96	17.70	23.69	55.80	27.24
10	L/ B ratio	4.23	2.02	3.14	14.54	21.85	44.29	19.93
11	Water uptake (ml)	301.67	145.33	210.91	17.71	17.74	99.67	36.42
12	Volume expansion ratio	7.61	3.38	4.87	23.73	23.82	99.31	48.72
13	Amylose content (%)	27.89	17.29	22.46	12.13	12.39	95.88	24.47
14	Protein content (%)	8.43	6.03	7.26	7.63	7.77	96.64	15.46

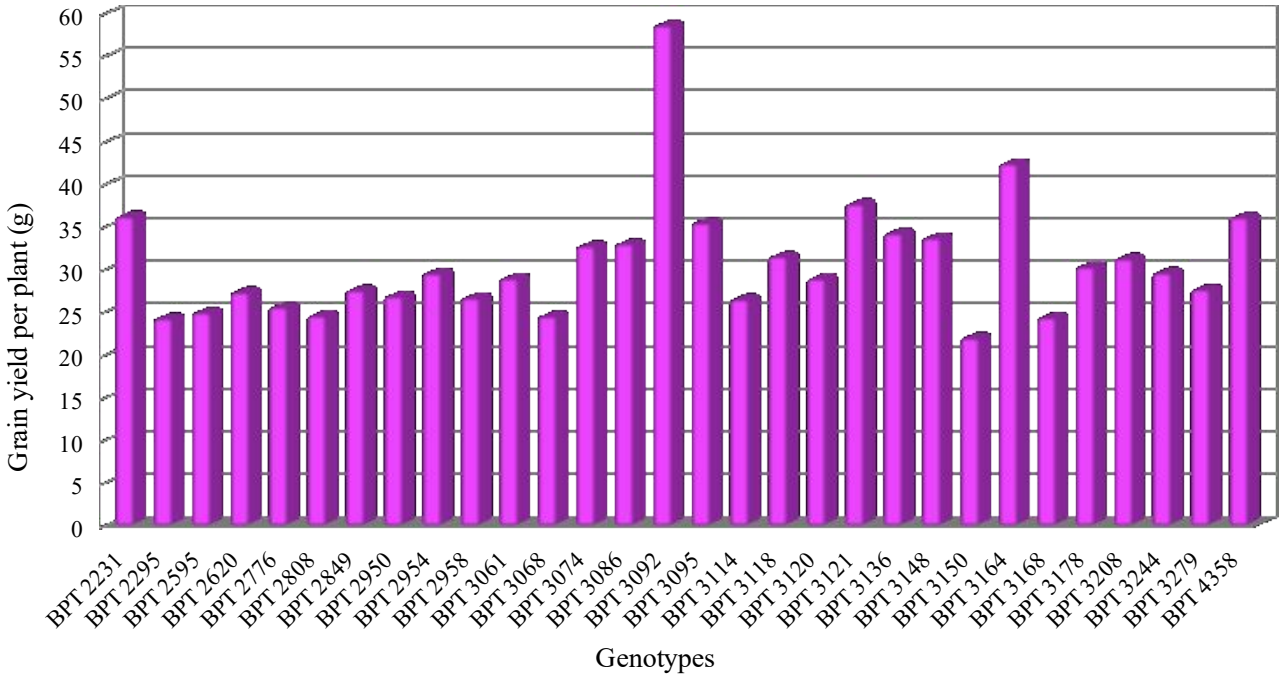

Fig 1. Mean performance of genotypes for grain yield per plant (g) in rice

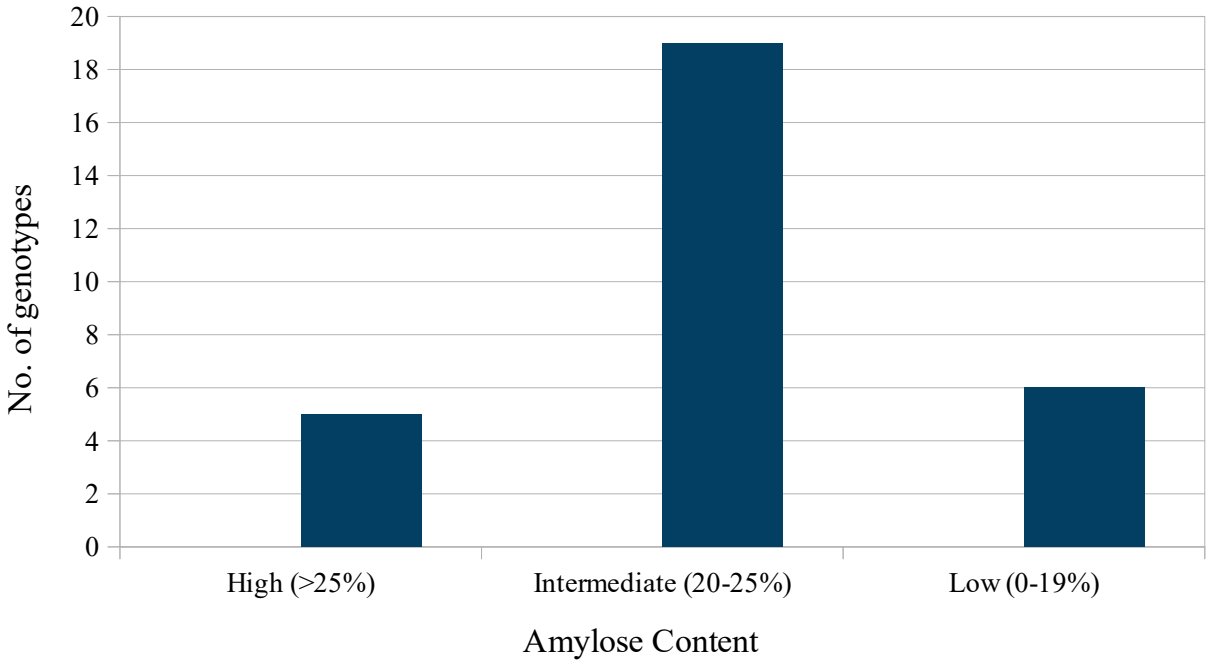

Fig 2. Performance of genotypes under study for amylose content

High heritability coupled with high genetic advance as per cent of mean were observed for grain yield per plant, water uptake, volume expansion ratio and amylose content indicating that the heritability was due to additive gene action which may be exploited through simple selection procedures for improving these traits. Similar results were reported by Bandi *et al.* (2018) for grain yield per plant, water uptake & amylose content and Devi *et al.* (2020) for volume expansion ratio. Whereas, high heritability coupled with moderate genetic advance as per cent of mean was recorded for plant height, days to 50 per cent flowering, panicle length, spikelet fertility percentage, kernel length and protein content which suggest that the inheritance of such traits might be under the control of both additive and non-additive gene effects. Therefore, selection of genotypes on the basis of phenotypic performances of the above traits may not be effective. Sudeepthi *et al.* (2020) for plant height, days to 50 per cent flowering, panicle length & spikelet fertility percentage, Mohanty *et al.* (2012) for kernel length and Kumar *et al.* (2006) for protein content also reported similar findings. The trait, kernel breadth recorded moderate heritability (55.80) coupled with high genetic advance as per cent of mean (27.24) whereas test weight and L/B ratio exhibited moderate heritability along with moderate genetic advance as percent of mean indicating the governance of these traits by both additive and non-additive gene effects. These results were in conformity with Kuchanur *et al.* (2009) for test weight and Suman *et al.* (2020) for L/B ratio. Productive tiilers per plant recorded low estimates for all the genetic parameters studied indicating the influence of non additive gene action and and selection for such trait would be ineffective which is in accordance with the previous findings by Dhavaleshvar *et al.* (2019).

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