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Exploiting the Genetic Variability of Quality Traits in Advanced Breeding Lines of Rice (*Oryza sativa* L.)

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ABSTRACT: In this study genetic variability parameters were studied in 70 rice genotypes (fifty three advanced breeding lines along with seventeen parents which includes check varieties) for thirteen quality traits during *summer* 2022-23 at Agricultural research Station, Nellore. Variance studies indicated incredibly substantial differences for all quality traits across all advanced breeding lines, indicating the presence of a sizable degree of variance. (The estimates of PCV and GCV were high for the alkali spreading value and gel consistency. The estimates of heritability and genetic advance as per cent of mean were high for the characters *viz.*, Kernel length, Kernel length breadth ratio and Kernel length after cooking, Alkali spreading value and Gel consistency indicating the influence of additive gene action in the inheritance of these traits hence simple selection would be rewarding. The ubiquity of additive gene activity, when revealed, opened the door for additional enhancement by selection.

Keywords: Rice, genetic variability, additive gene activity and quality traits.

INTRODUCTION

Rice (*Oryza sativa* L.) (occupies the enviable prime place among the food crops cultivated around the world with diploid chromosomes (2n = 24) and is classified under the genus *Oryza* and the family Poaceae). (Asian rice (*Oryza sativa*) and African rice (*Oryza glaberrima*) are the two major distinct cultivated rice types and is one of the world's most staple food crop for over half of the world's population (Khush, 2005). Due to, the fact that rice is often eaten as a whole grain, grain quality qualities are extremely important in breeding. The important quality attributes of rice are its cooking (Gelatinization temperature, kernel elongation, and water uptake) and eating qualities (Flavor and texture), its phytochemicals, and its micronutrients. Amylose concentration (AC), gelatinization temperature (GT), and gel consistency (GC) are the three main factors directly associated with the quality of the rice for cooking and eating.

(Variability in genotypes for variables that affect yield and its quality should be the main factor taken into account when creating a selection). Any successful hybridization program for varietal development significantly depends on the choice of parents with high variability, enabling the choice of ideal trait combinations to boost grain quality and yield. In most cases, genetic improvement along with heritability estimates improves the predictive power of heritability estimates in determining the benefits of selection (Paul *et al.*, 2006).

MATERIAL AND METHODS

(The current investigation was carried out at Wetland farm of S.V. Agricultural College, Tirupati during *rabi*, 2022-23 and the laboratory work was performed at Quality laboratory, Agricultural research Station, Nellore during *summer*, 2023 as the quality analysis in rice has to be done three months after harvest. The experimental material consists of total 53 advanced breeding lines of rice along with their 17 parents including checks *viz.*, BPT5204, NLR34449, NLR40024, MTU1153. During *rabi* 2022-23, A Randomized Block Design with three replications and a 20 × 15 cm inter- and intra-row spacing was used to set up the experiment. The observations made during the inquiry were based on five randomly chosen plants from each line in both replications that were chosen at the peak of plant growth for the evaluation of yield and quality parameters.

The significance of the data was examined using the analysis of variance technique as described by Panse and Sukhatme (1964). According to Burton (1952), PCV and GCV (phenotypic and genotypic coefficients of variation) were calculated. According to the formula Allard (1960) presented, the heritability in a broad sense was estimated. Using the formula proposed by Johnson *et al.* (1955), genetic advance is expressed as a percentage of the mean. The WINDOSTAT application was used for the statistical analysis.

RESULTS AND DISCUSSION

53 advanced breeding lines of rice, their parents, and 5 checks were the subjects of the current inquiry. Using randomized block design (RBD) and three replications, experimental material was planted. To obtain an accurate picture of genotype variability, the genetic characteristics of variability were investigated. The numerous analyses, took into consideration thirteen excellent characters. Five plants were randomly selected from each replication to be observed).

Analysis of variance. Advanced breeding lines of rice were compared using an analysis of variance to establish the degree of observed character variation. The (results are shown in Table 1. The variance analysis for each character revealed incredibly large differences among the 55 advanced breeding lines, indicating a significant amount of genetic variation in the source material). An F-test showed that the mean sum of squares values were significant (at 1% level of significance) for all yield and quality characters examined).

Genotypic and phenotypic coefficient of variance. (GCV and PCV values for quality attributes ranged from low to high. The genotypic variance was lower than the phenotypic variation for all features, indicating that the environment had a masked effect on the expression of genetic variability) (Table 2). Highest GCV and PCV value observed for trait gel consistency (GCV-47.99 % and PCV-48.35%) followed by alkali spreading value (GCV-34.93 % and PCV-38.41%). This suggests that the advanced breeding lines under consideration have a diverse genetic foundation and that there may be scope for genetic improvement through the use of direct selection for these qualities. These results are in conformity with the findings of Bandi *et al*. (2018); Jan and Kashyap (2020); Priyanka *et al*. (2020); Dinesh *et al*. (2023).

Table 1: Analysis of variance (ANOVA) for yield and yield attributes and quality traits in 70 rice genotypes.

Sr. No.	Character	Mean sum of squares		
		Replications (df:2)	Genotypes (df:69)	Error (df:138)
1.	Hulling Percentage	24.479	33.053**	9.385
2.	Milling percentage	21.894	37.244**	14.266
3.	Head rice recovery %	31.124	58.662**	10.384
4.	Kernel Length (mm)	0.009	1.036**	0.004
5.	Kernel Breadth (mm)	0.004	0.109**	0.003
6.	Kernel Length Breadth Ratio	0.004	0.286**	0.007
7.	Kernel Length After Cooking (mm)	0.043	3.235**	0.054
8.	Kernel Breadth After Cooking (mm)	0.001	0.238**	0.004
9.	Linear Elongation Ratio	0.001	0.051**	0.002
10.	Breadth wise expansion ratio	0.002	0.055**	0.003
11.	Alkali Spreading value	0.743	3.762**	0.245
12.	Gel Consistency (mm)	16.233	1150.878**	5.741
13.	Amylose content (mg/100mg)	0.091	3.372**	0.131

*Significant at 5% level; ** Significant at 1% level

Heritability and Genetic Advance. Breeders (can successfully select for desirable traits and generate the most genetic gain with the least amount of work and resources by estimating heritability. A excellent indicator of how traits are passed on from parents to children is heritability). In present investigation, highest heritability, was obtained for' kernel length (98.90%) followed by gel consistency (98.52%), kernel length after cooking (95.14%), kernel breadth after cooking (95.13%) and so on. All the quality traits showed high heritability except hulling % and milling %. Similar findings were reported by Ekka *et al*. (2015); Priyanka *et al*. (2020).

(The degree of gain achieved in a character under a certain selection pressure is referred to as genetic advance. High estimates of genetic advance as % of mean obtained from characters were Gel consistency (98.13%) followed by alkali spreading value (65.43), kernel length after cooking (23.29%), kernel size (21.85%) and kernel length (21.47%). Similar results were obtained by Priyanka *et al*. (2020); Kumar *et al*. (2020); Dinesh *et al*. (2023).

High genetic advance mixed with high heritability estimations are the ideal conditions for selection because high heritability does not always reflect great genetic gain (Larik *et al*, 2000). High heritability and high genetic progress as a percentage of the mean were found for the characteristics in this investigation *viz.*, Kernel length, Kernel length breadth ratio and Kernel length after cooking, Alkali spreading value and Gel consistency indicating the influence of additive gene action' in the inheritance of these traits hence simple selection would be rewarding. Similar results were obtained by Jan and Kashyap (2020); Priyanka *et al*. (2020); Dinesh *et al*. (2023).

Table 2: Genetic parameters for quality traits in 70 rice genotypes.

Sr. No.	Character	Mean	Range		Variance		Coefficient		Heritability (h^2_{bs})	Genetic advance (GA)	Genetic advance as percent of mean (%)
			Min.	Max.	Genotypic	Phenotypic	Genotypic	Phenotypic			
1.	Hulling percentage	75.8	64.97	81.26	7.89	17.27	3.71	5.48	45.67	3.91	5.16
2.	Milling percentage	70.19	59.17	76.47	7.66	21.93	3.94	6.67	34.93	3.37	4.80
3.	Head rice recovery %	62.43	52.07	72.70	16.09	26.48	6.43	8.24	60.78	6.44	10.32
4.	Kernel length (mm)	5.60	4.73	6.87	0.34	0.35	10.48	10.54	98.9	1.20	21.47
5.	Kernel breadth (mm)	2.03	1.70	2.57	0.04	0.04	9.22	9.66	91.24	0.37	18.15
6.	Kernel size	2.77	2.16	3.55	0.09	0.10	11.01	11.43	92.79	0.60	21.85
7.	Kernel length after cooking	8.88	6.63	10.70	1.06	1.11	11.59	11.89	95.14	2.07	23.29
8.	Kernel breadth after cooking	3.2	2.73	4.23	0.08	0.08	8.73	8.95	95.13	0.56	17.53
9.	Linear elongation ratio	1.59	1.34	2.02	0.02	0.02	8.04	8.60	87.49	0.25	15.50
10.	Breadth wise expansion ratio	1.58	1.21	1.82	0.02	0.02	8.35	9.00	86.13	0.25	15.96
11.	Alkali spreading value	3.1	2.00	6.00	1.17	1.42	34.93	38.41	82.70	2.03	65.43
12.	Gel consistency (mm)	40.71	19.67	77.67	381.71	387.45	47.99	48.35	98.52	39.95	98.13
13.	Amylose content (%)	22.69	20.49	25.84	1.08	1.21	4.58	4.85	89.21	2.02	8.91

Note: Min.: Minimum Max.: Maximum

CONCLUSIONS

In this current study, the characters that showed high heritability coupled with high genetic advance investigation *viz.*, Kernel length, Kernel length breadth ratio and Kernel length after cooking, Alkali spreading value and Gel consistency are controlled by additive gene action can be improved through simple or progeny selection methods while the characters which showed high heritability coupled with moderate or low genetic advance can be improved by intermitting superior genotypes of segregating population developed from combination breeding.

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Conflict of Interest. None.

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