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Short communication

Variability in grain quality attributes of high yielding rice varieties (*Oryza sativa* L.) of diverse origin

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Abstract

Genetic variability of 10 quality parameters in a set of 56 high yielding diverse rice genotypes was evaluated. Phenotypic and genotypic coefficients of variation revealed the existence of large variability in alkali-spreading value and moderate variability in L/B ratio of grain, milling percentage, amylose content, water uptake, and volume expansion. All quality attributes exhibited high broad sense heritability. High heritability, high expected genetic gain, and moderate genotypic coefficient of variation were noted for alkali spreading value, L/B ratio of grain, milling percentage, amylose content, volume expansion ratio, and water uptake, implying the potential of these parameters to be used in breeding programmes.

Keywords: Genetic variability, Heritability, Genetic advance, Genetic gain.

Rice (*Oryza sativa* L.) yield levels in India and elsewhere have reached a plateau. Being the staple food of the population in South India, improving its productivity and quality traits is of crucial importance. To accomplish this, crop improvement programmes should aim at broadening the genetic base of the breeding stock (Vanaja and Babu, 2004). Success in crop improvement generally depends on the magnitude of genetic variability and the extent to which the desirable characters are heritable. However, variability studies on grain quality characters of high yielding rice varieties of different eco-geographical origin are limited. Hence, to evaluate the extent of genetic variability in high yielding diverse genotypes for 10 important quality parameters, the present study was undertaken.

The materials consisted of 56 high yielding genotypes representing various eco-geographical regions such as Bangladesh, China, India, Indonesia, Malaysia, Pakistan, Philippines, and Sri Lanka, conserved at the Agricultural Research Station, Kerala Agricultural University, Mannuthy (see Vanaja and Babu, 2003). Field trials were laid out in a randomized block design with three replications. Plots consisted of eight rows of 36 hills with inter and intra row spacing of 20 cm and 15 cm respectively and the recommended cultural operations were carried out (KAU, 2002). Observations on physico-chemical characters like grain length, grain breadth, L/B ratio of grain, hulling percentage, milling percentage, water uptake, volume expansion ratio, and kernel elongation ratio were recorded (Shouichi et al., 1976), as well as amylose content (Sadasivam and Manikkam, 1992) and alkali spreading value (Little et al., 1958). The data were analyzed using ANOVA and the genetic parameters such as phenotypic and genotypic coefficient of variation (PCV and GCV), heritability in broad-sense (H^2), and genetic advance as percent of mean (genetic gain) were worked out as suggested by Johanson et al. (1955).

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Analysis of variance showed highly significant differences suggesting substantial to moderate genetic variability in all parameters evaluated (Table 1). Out of the 56 genotypes studied, 41 were in the range having more than 25% amylose (high), 13 in the range of 20 to 25% (intermediate), while two genotypes had less than 20% amylose (low). Since non-sticky red rice is generally preferred in Kerala, varieties with high yield and intermediate amylase content have special significance in local breeding efforts. Alkali-spreading value of 31 cultivars were in the intermediate range (4 to 6). Variations in L/B ratio of grain, milling percentage, water uptake, and volume expansion were also moderate.

A comparison of the data in Table 2 indicates that phenotypic and genotypic coefficients of variation (PCV and GCV) for various quality traits were largely similar. Highest PCV and GCV were noted for alkali-spreading value. Characters like water uptake, L/B ratio of grain, and volume expansion also showed relatively high GCV and PCV, which is consistent with the previous reports (e.g., Hussian et al., 1987). All quality characters exhibited high degree of broad-sense heritability, which revealed that these characters are less influenced by environment and there could be greater correspondence between phenotypic and breeding values. Likewise, high expected genetic advance for alkali spreading value, water uptake per unit weight of uncooked rice, L/B ratio of grain, amylose content, milling percentage, and volume expansion ratio signify that considerable improvement could be achieved in these traits by selection from segregating populations. The high heritability and high expected genetic gain coupled with moderate GCV exhibited by these characters imply that

Table 1. Analysis of variance for quality characters in high yielding rice varieties from Bangladesh, China, India, Indonesia, Malaysia, Pakistan, Philippines, and Sri Lanka, grown at Mannuthy, Kerala.

Source of variation	Df	Mean sum of squares									
		Grain length	Grain breadth	L/B ratio of grain	Hulling (%)	Milling (%)	Amylose content	Alkali spreading value	Water uptake	Volume expansion ratio	Kernel elongation ratio
Replications	2	0.004	0.003	0.002	12.04	1.02	2.54	2.899	0	0.029	0
Genotypes	55	1.346**	0.301**	0.689**	24.21**	174.03**	39.01**	7.9**	0.028**	0.268**	0.033**
Error	110	0.014	0.008	0.008	0.22	0.65	1.82	0.58	0	0.011	0.001

Df= degrees of freedom; ** Significant at 1% level.

Table 2. Range, mean, and estimates of genetic parameters for quality characters of 56 high yielding rice varieties from Bangladesh, China, India, Indonesia, Malaysia, Pakistan, Philippines, and Sri Lanka, grown at Mannuthy, Kerala.

Characters	Range		Mean ± SEm	PCV (%)	GCV (%)	H^2 (%)	Genetic advance	Genetic gain (%)
	Min.	Max.						
Grain length (mm)	7.35	10.11	9.09± 0.1	7.45	7.33	96.9	1.35	14.9
Grain breadth (mm)	2.56	3.76	3.04 ± 0.07	10.69	10.28	92.1	0.62	20.3
L/B ratio	1.95	3.85	3.03 ± 0.07	15.98	15.69	96.4	0.96	31.7
Hulling (%)	67.3	79.6	74.98 ± 0.38	3.82	3.77	97.4	5.75	7.67
Milling (%)	51.1	76.9	65.43 ± 0.7	11.68	11.62	98.9	15.6	23.8
Amylose (%)	19.46	36.8	27.13 ± 1.1	13.9	12.98	87.2	6.77	25
Alkali spreading value	1.0	7.0	3.88 ± 0.6	44.76	40.25	80.9	2.89	74.5
Water uptake	0.379	0.955	0.565 ± 0	17.1	17.1	100	0.2	35.2
Volume expansion ratio	1.873	3.17	2.44 ± 0.09	12.74	12.0	88.7	0.57	23.3
Kernel elongation ratio	1.11	1.603	1.27 ± 0.03	8.45	8.03	90.2	0.2	15.8

PCV= phenotypic coefficient of variation; GCV= genotypic coefficient of variation; H^2 =Broad sense heritability.

these are under additive gene effects and could be relied upon for further selection based on phenotypic performance.

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