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J Meher

National Rice Research
Institute, Cuttack, Odisha, India

SK Dash

National Rice Research
Institute, Cuttack, Odisha, India

LK Bose

National Rice Research
Institute, Cuttack, Odisha, India

Sutapa Sarkar

National Rice Research
Institute, Cuttack, Odisha, India

PC Rath

National Rice Research
Institute, Cuttack, Odisha, India

HN Subudhi

National Rice Research
Institute, Cuttack, Odisha, India

Genetic variability and character association among the quality traits in rice

J Meher, SK Dash, LK Bose, Sutapa Sarkar, PC Rath and HN Subudhi

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Abstract

One hundred rice genotypes released for different ecologies such as upland, irrigated, lowland and saline were evaluated for 12 quality characters like Hulling(%), Milling(%), Head rice recovery(%), Kernel length(cm), Kernel breadth(cm), Length breadth ratio, Volume expansion ratio, Elongation ratio and Amylose content(%) etc. Analysis of variance showed high significant difference among the genotypes. Milling(%) is very good in all the genotypes and ranged from 74.5(PR113) to 81.3 (Improved Lalat). HRR (%) is highest in Bhanja (72.0) and lowest in Konark(42.5). Intermediate amylase content are in most of the genotypes except GR 103(27.1), IR 64 MAS(27.86) WGL32100(27.3), WGL32183(27.5) and Purnendu (27.9). Water uptake ranged from 77.5(WGL 32100) to 342.5(PR116) indicating very wide variation. Elongation ratio is > 2.0 in Sudhir, Sashi, Bindli. PCV is always greater than GCV indicating less influence of environment. Hulling (%) is positively significantly correlated with Milling (%) and kernel breadth and negatively significantly correlated with L/B ratio, volume expansion ratio.

Keywords: Variation, correlation, quality characters, rice

Introduction

Rice occupies a pivotal role in Indian food and livelihood security system. India is the second most populous nation and stand first in areas and second in production followed by China. It is grown in all agro-climatic zones. This wide adaptation leads to evolution thousands of varieties having diverse cooking and eating characters. Before 2000AD, there is demand for increase the production and productivity to meet the food requirement of the growing population. After that, India became self-sufficient and surplus country so far as rice is concerned. People became more concerned about quality than quantity. Previously breed varieties are mostly bold grain, which people do not like. Grain quality in rice is determined by grain appearance nutritional value, cooking and eating quality (Juliano *et al.*, 1990) [10]. Good grain quality fetches high market price. Demand for better grain quality is increasing day by day in developing and developed countries. Now quality is an important breeding objective in all rice breeding programme. Subudhi *et al.* (2012) [19] evaluated 42 released varieties of Odisha for their quality characters. It is evident that there is no systematic study of grain quality characters for released varieties of India except some sporadic reports. Now attempts have been made to evaluate the released varieties for their quality traits to find out better donors for hybridisation, popularisation and development of database. In this study, 100 genotypes of different states and for different ecologies were evaluated to find out better donors for hybridisation and popularisation among the farmers.

Materials and methods:

One hundred released rice varieties of different states were transplanted in randomised block design with two replications. 25 days old seedlings were transplanted with spacing 15x20cm. All the agronomic practices were followed with N:P:K 80:40:40 to raise good crop. The samples are cleaned and analysed in 12-14% moisture content.

Methods

Physical properties

Kernellength, kernel breadth, and Kernellength breadth ratio were measured by dial micrometer (Ramiah, 1969) [14].

Corresponding Author:

HN Subudhi

National Rice Research
Institute, Cuttack, Odisha, India

Hulling (%) and Milling (%) were done by using standard rice huller (SatakeThuza) and rice polisher (Satake TMO5A) respectively and method following Govindswamy and Ghosh, (1969) [6].

Chemical properties: Alkalispreading value and Amylase content was analysed following Little *et al.* (1958) [11] and Juliano, (1971) [9]. Similarly KLAC and elongation ratio were done following Azeez and Shafi, (1966) [2].

Results and discussions

The analysis of variance showed highly significant difference among the genotypes for all the 12 characters. (table-1). The rice millers prefer varieties with high milling (%) and Head rice recovery (HRR%). But consumers prefer good cooking and eating quality (Merca and Juliano, 1981) [12]. The hulling (%) is very important for the miller and it ranged from 74.5 (PR113) to 81.3 (Improved Lalat). High HRR (%) provide more profit to the consumers and millers and It depends on the varieties, grain type, cultural practices and drying conditions (Asish, 2006) [1]. HRR (%) is heritable and very easy to improve (Jenning *et al.*, 1979) [8] and depend on environmental factors and post-harvest handling (Fan *et al.*, 2000) [4]. It ranged from 42.5 (Konark) to 72.0 (Bhanja). Grain shape and size are classified according to IRRI (1996) [7]. Consumer preference depend on grain length and thickness. Now most consumers prefer medium slender grains. Kernel length varied from 4.8 (Sarasa) to 7.2 (Bhanja). Similarly low value of kernel breadth is preferred by consumers. Bold grains are not preferred by elite class. Kernel breadth varied from 1.75 (Krishnahamsa) to 2.76 (Golak). More water uptake require more energy to cook. So less water uptake will be preferred and it ranged from 77.5 (WGL 32100) to 342.5 (PR116). High kernel length after cooking (KLAC) looks good in appearance. It ranged from 8.45 (Golak) to 14.75 (PR 114). Intermediate amylase content (20-25%) is usually preferred by Indians in general and eastern Indians in particular. It ranged from 20.65 (Sankar) to 27.9 (Purnendu). Most of the varieties are having intermediate amylase content except GR 103(27.1), IR 64 MAS (27.86) WGL32100(27.3), WGL32183(27.5) and Purnendu (27.9).

PCV is always greater than GCV indicating less influence of environment. Therefore selection on the basis of phenotype alone can be effective for improvement of these traits. High PCV and GCV are recorded in water uptake.

Heritability is classified low (<30%), medium (30-60) and high (>60%). Heritability is lowest in hulling (49%) and highest in VER (152%). So there is less influence of environment. The breeders can make selection on the basis phenotypic expressions and high heritability indicate scope for selection of genetic improvement. Similar result was reported by Panwar *et al.* (1997) [13], Sarawagi *et al.* (2000) [17], Gannamani (2001) [5], Sao (2002) [15]. Heritability along with genetic advance would give more reliable selection index value. High genetic advance with high genetic advance as mean are controlled by additive genes and can be improved by simple progeny selection.

Correlation studies

Hulling (%) is positively significantly correlated with Milling (%) and kernel breadth is negatively significantly correlated with L/B ratio, volume expansion ratio. Similar results were reported by Sarkar *et al.* (1994) [16], Chauhan *et al.* (1995) [3],

Subudhi *et al.* (2009) [18]. Milling (%) is positively significantly correlated with kernel breadth, alkali spreading value but negatively significantly correlated with kernel length, L/B ratio, kernel length after cooking, elongation ratio and amylase content. Head rice recovery is positively significantly correlated with milling %. Kernel length is negatively correlated with Kernel breadth but positive significantly correlated with L/B ratio, alkali spreading value, water uptake and kernel length after cooking. Kernel breadth is negatively correlated with L/Bratio, amylase content, volume expansion ratio, kernel length after cooking but positively correlated with hulling% and milling %. L/B ratio is positively correlated with kernel length, hulling (%) milling (%), kernel length after cooking and amylase content and negatively correlated with kernel breadth

Path analysis

As simple correlation is not sufficient to provide accurate contribution of characters to Head rice recovery(HRR%). The correlation is partitioned in to direct and indirect effect through path coefficient analysis. The detailed contribution is presented in table-4. The highest positive direct contribution is made by milling (%) (0.474), followed by amylose content (0.122), KLAC (0.090), VER (0.057). The negative direct effect was from kernel breadth (-0.153), elongation ratio (-0.121), water uptake (-0.067), and L/B ratio (-0.047). Milling and amylase content should be given emphasis for selection criteria as these characters are positively correlated to HRR(%).

Table 1: Analysis of variance (mean square) of 12 grain quality traits in 100 genotypes.

Characters	Replication	Treatment	Error
Hull (%)	60.390	5.01**	1.69
Mill (%)	40.230	17.56**	3.55
HRR (%)	54.60	83.68**	5.45
KL (cm)	0.060	0.479**	0.040
KB (cm)	0.075	0.110**	0.007
L/B	0.093	0.319**	0.017
ASV	0.661	4.160**	0.085
WU	941.78	8399.83**	62.18
VER	0.123	0.069(ns)	0.051
KLAC	0.020	2.411**	0.117
ER	0.009	0.046**	0.003
AC(%)	10.552	4.607**	0.514

** , significant at 1%

Table 2: Range, Mean, PCV and GCV for 12 quality characters of 100 rice genotypes

Characters	Range	Mean	PCV (%)	GCV (%)	He	GA	GA as mean
Hull (%)	74.5-81.3	78.2	2.34	1.64	0.49	1.87	2.39
Mill (%)	61-72	70.5	4.61	3.75	0.66	4.4	6.3
HRR (%)	42.5-72	58.7	11.38	10.66	0.87	12.06	20.57
KL (cm)	4.8-7.2	5.77	8.8	8.1	0.84	0.88	15.6
KB (cm)	1.75-2.76	2.26	10.7	10.0	0.87	0.43	19.26
L/B	1.9-2.6	2.58	15.89	15.04	0.89	0.75	29.3
ASV	2.75-7.25	4.9	29.69	29.06	0.96	2.88	58.7
WU	77.5-342.5	164.7	39.48	39.1	0.98	132.0	80.14
VER	3.7-4.8	3.97	6.1	2.4	0.152	0.077	1.93
KLAC	8.45-14.75	10.3	10.95	10.4	0.90	2.1	20.4
ER	1.5-2.46	1.78	8.87	8.1	0.84	0.27	15.4
AC (%)	20.65-27.9	24.04	6.7	5.9	0.79	2.63	10.95

Table 3: Phenotypic correlation among the 12 quality characters in 100 genotypes

Characters	Mill(%)	KL	KB	L/B	ASV	WU	VER	KLAC	ER	AC(%)	HRR(%)
Hull (%)	0.405**	0.267	0.274**	-0.149*	0.501	-0.071	-0.169*	-0.074	-0.077	0.006	0.171
Mill (%)		-0.150*	0.319**	-0.286**	0.158*	0.033	-0.162*	-0.255**	-0.159*	-0.223*	0.404
KL (cm)			-0.270**	0.742**	0.178*	0.232**	0.003	0.607**	-0.201*	0.127	0.016
KB (cm)				0.787**	0.118	0.083	-0.145*	-0.292**	-0.086	0.146*	-0.007
L/B					0.051	0.124	0.105	0.561**	-0.043	0.178*	0.011
ASV						0.607**	-0.074	0.126	-0.019	-0.143*	0.019
WU							0.151*	0.325**	0.173*	-0.042	-0.051
VER								0.195*	0.243**	0.140*	-0.010
KLAC									0.610**	0.068	-0.089
ER										-0.053	-0.131
AC(%)											0.051

Table 4: Path analysis of different quality characters on HRR (%)

Characters	Hull	Mill	KL	KB	L/B	ASV	WU	VER	KLAC	ER	AC(%)	HRR(%)
Hull (%)	0.014	0.005	0.000	0.003	-0.002	0.001	-0.001	-0.002	-0.001	-0.001	0.000	0.171
Mill (%)	0.192	0.474	-0.071	0.151	-0.135	0.075	0.015	-0.076	-0.121	-0.075	-0.106	0.404
KL (cm)	0.000	0.001	-0.001	0.000	-0.000	-0.000	-0.000	0.000	-0.001	0.000	-0.000	0.016
KB (cm)	-0.042	-0.049	0.041	-0.153	0.121	-0.018	-0.012	0.022	0.045	0.013	0.023	-0.007
L/B	0.007	0.013	-0.035	0.037	-0.047	-0.002	-0.005	-0.005	-0.026	0.002	-0.009	0.011
ASV	0.001	0.002	0.002	0.001	0.000	0.013	0.008	-0.001	0.002	-0.000	-0.002	0.019
WU	0.004	-0.002	-0.015	-0.005	-0.008	-0.040	-0.067	-0.010	-0.021	-0.012	0.003	-0.052
VER	-0.009	-0.009	0.000	-0.008	0.006	-0.004	0.008	0.057	0.011	0.014	0.008	-0.010
KLAC	-0.006	-0.023	0.054	-0.026	0.050	0.011	0.029	0.017	0.090	0.055	0.006	-0.089
ER	0.009	0.019	0.024	0.010	0.005	0.002	-0.021	-0.029	-0.074	-0.121	0.007	-0.132
AC(%)	0.001	-0.027	0.015	-0.017	0.021	-0.017	-0.005	0.017	0.008	-0.007	0.122	0.051

Residual effect (Phenotypic)=0.887

Bold figures denotes direct effects

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