Oryza Vol. 48. No. 4, 2011 (319-323)

Variability, correlation and path analysis for quality characters in rice

H.N. Subudhi, Sanjukta Das, D.Swain and O.N. Singh

Central Rice Research Institute, Cuttack-753006, Odisha

ABSTRACT

The physico-chemical and cooking characters were analysed in respect of 41 promising rice genotypes of eastern India to study the variability and correlation coefficient to understand the degree of association of different characters. Head rice recovery ranged from 43.5 (Kalyni-2) to 68.0(Pooja). Kernel length is highest in Geetanjali(7.54mm) and lowest in Nuadhusara(3.88mm).Kernel breadth ranged from 1.74mm(Satyakrishna) to 2.68mm(Hanseswari). Elongation ratio is highest in Nuadhusara(2.07) and lowest in Chandan(1.44).Amylose content is intermediate in all the genotypes except Heera(25.6) and Vanaprava(26.1). PCV is highest in water uptake (31.97) followed by ASV (23.91) and lowest in hulling %(2.7) followed by amylase content (4.65). The HRR% showed negative correlation with kernel length and positive correlation with alkali spreading value, water uptake, elongation ratio. L/B ratio showed significant positive correlation with kernel length after cooking and negative association with elongation ratio. Kernel length had direct effect on amylase content and L/B, KLAC had high negative direct effect on amylase content

Key words : *rice, variation, correlation, path analysis ,physico-chemical, cooking attributes*

Rice is the staple food in India and it is grown in 44.6.mha. The production of rice reached its plateau and people are now more concern for quality due to economic upliftment of the people. In the past, breeders have concentrated for higher yield. But now the consumers are more concerned for quality rice. Again, due to low quality rice, there is distress sale of paddy and farmers are getting less price. So rice variety having good quality characters should be identified /developed, so that demand will be more in national as well as international market. Rice grain quality is of great importance for all people involved in processing, production and consumption. Consumer preference depends on appearance, milling, cooking and nutritional quality. It also differs from region to regions. Self sufficiency and change in economic standard are the main factors for the consumers to change the preference to quality rice. Cultivation of quality rice will bring more profit to the farmers .Keeping this facts in view,41 CRRI developed rice varieties were evaluated for their physico-chemical and cooking characters to find better varieties for the farmers. in this connection, Shivani et al (2007) and Chakraborty *et al* (2010) studied the variability, correlation of quality characters in rice respectively.

MATERIALS AND METHODS:

This experiment was conducted in the experimental farm of CRRI during 2008 wet season.25 days old seedlings were transplanted in Randomised Block Design with three replications and the spacing was 15x20cm. The recommended dose of NPK was applied. Forty one rice genotypes of different ecology were evaluated for quality characters at 14% moisture content. The physico-chemical characters viz Hulling (%), Milling (%), Head Rice Recovery (%) were determined (Govindswamy and Ghosh, 1969). The length and breadth of the grains were determined by dial micrometer. Then amylase content and alkali spreading value (ASV) were estimated as per Juliano (1971) and Little *et al.*(1958)respectively. Water uptake and volume expansion ratio were determined as per Beachell and Stansel (1963). Cooked kernel length and kernel elongation ratio were determined following Azeez & Shafi, (1966). The quality attributes were studied in some promising varieties/ lines of rice by Binodh *et*

al.(2006).The quality characters in scented rice were also studied by Nayak and Reddy(2005).

RESULTS AND DISCUSSION

The analysis of variance gives a significant result for all the characters of the tested genotypes (Table 1). The genetic variability of different characters are presented in Table 2. The hulling % ranged from 71.0 (Vanaprava) to 81.0 (Ajay).The milling recovery is good for all the genotypes and ranged from 62.0 (Vanaprava) to 76.0 (Radhi).Head rice recovery is very important characters because more head rice recovery will give more profit to the farmers and it ranged from 43.5 (Kalyni-2) to 68.0 (Pooja).In upland varieties, the HRR % is not good i.e <50.0%. Kernel length is highest in Geetanjali (7.54mm) and lowest in Nuadhusara (3.88mm).Kernel breadth ranged from 1.74mm (Satyakrishna) to 2.68mm (Hanseswari). L/B ratio varied from 1.8 (Gayatri) to Geetanjali (3.97).Alkali spreading value ranged from 3.0 (Naveen) to 7.0 (Radhi) with mean value 4.88.Usually intermediate value (4-5) for alkali spreading value and intermediate amylase content (20-25%) are preferred by the consumers. Water uptake ranged from 97.5 (Tapaswini) to 330 (Tara).It showed wide variability and needs improvement. Less water uptake will require less energy which is very economical. Volume expansion ratio is lowest in Uday (3.25) and highest in Nuakalajeera (5.25).Kernel length after cooking is also very important for acceptability of the variety and it ranged from 8.1mm (Chandan) to 12.5mm (Geetanjali).Similarly elongation ratio is highest in Nuadhusara (2.07) and lowest in Chandan(1.44). Amylose content is intermediate in all the genotypes except Heera (25.6) and Vanaprava (26.1).

Phenotypic correlation coefficient (PCV) is more than genotypic correlation coefficient (GCV) but the difference is very less which indicate less environmental effect (Table-3). PCV is highest in water uptake (31.97) followed by ASV (23.91) and lowest in hulling %(2.7) followed by amylase content (4.65).Moderate value for PCV is observed in L/B ratio(18.92), Kernel length (13.54).Similarly GCV is highest in water uptake (30.34), alkali spreading value (23.75) and lowest in hulling %(2.4) ,amylase content (4.07).High heritability was observed in Alkali spreading value (98.0),Kernel length (96.0), kernel breadth (96.0), L/B ratio (96.0), KLAC (96.6) and Elongation ratio (92.6).but lowest in milling recovery (31.0). High genetic advance was also observed in water uptake (59.29), Alkali spreading value (48.59), L/B ratio (37.8) and low in hulling% (4.4), milling % (3.6) and amylase content (7.34). Chauhan (1998) and Krishnabeni et al (2006) reported high estimate of heritability for kernel length, kernel breadth while high heritability for L/B ratio was observed by Lalitha and Sreedhar (1999). The estimate of heritability and genetic advance in combination is more important than heritability alone (Panse, 1957). High heritability with high genetic advance was observed in L/B ratio, alkali spreading

Table-1. Varieties included in the study.

Kshira	Supriya	Lunishree	Ketekijoha
Indira	Naveen	Panidhan	Nuakalajeera
Saktiman	Samalei	Gayatri	Nuadhusara
Radhi	Chandan	Tulsi	BPT5204
Tara	Chandrama	Durga	Lalat
Tapaswini	Satyakrishna	Sarala	Ajay
Saket-4	CR1014	Savitri	Rajlaxmi
Ratna	Pooja	Varshadhan	Kalinga-3
Udaya	Padmini	Hanseswari	Vandana
Heera	Utkalprava	Geetanjali	Kalyni-2
			Vanaprava

Table 2. Analysis of variance for quality characters

	Source of variation		
Characters	Replication	Genotypes	Error
Hulling(%)	0.923	8.108**	0.986
Milling(%)	9.155	20.240**	10.513
HRR(%)	0.901	83.528**	5.051
KL(mm)	0.044	1.257**	0.017
KB(mm)	0.002	0.129**	0.002
L/B	0.008	0.537**	0.008
Water uptake	82.0	6676.82**	350.75
ASV	0.076	2.712**	0.018
KLAC	0.102	2.310**	0.039
VER	0.206	0.379**	0.076
ER	0.002	0.036**	0.001
AC(%)	0.110	2.173**	0.289

*,** significant at 5% and 1% level respectively.

Table-3. Range, mean, PCV, GCV and heritability of quality characters

Characters	Range	Mean + SE	PCV(%)	GCV(%)	Heritability in broad sense%	Genetic advance as % mean
Hull%	71--81	78.3 +0.69	2.7	2.4	78.3	4.4
Mill%	62--76	70.9+2.26	5.5	3.1	31.6	3.6
HRR%	43.5--68	60.1 +1.56	11.04	10.4	88.6	20.19
KL(mm)	3.9--7.5	5.89 +0.09	13.54	13.35	96.2	27.1
KB(mm)	1.74--2.68	2.16 +0.03	11.86	11.85	96.5	23.89
L/B ratio	1.8--3.97	2.76 +0.06	18.9	18.6	96.9	37.8
ASV	3.0--7.0	4.88 +0.09	23.9	23.75	98.7	48.59
WU	97.5--330	185.36 +13.08	31.97	30.34	90.0	59.29
KLAC	7.9--12.5	9.78 +0.14	11.07	10.88	96.6	22.04
VER	3.4--5.25	3.95 +0.19	12.06	9.84	66.6	16.54
ER	1.44--2.07	1.66 +0.025	8.23	7.93	92.6	15.75
AC%	22.1--26.1	23.8 +0.37	4.65	4.07	77.5	7.34

Hull%:hulling percentage, Mill%:milling percentage, HRR: Head rice recovery, KL: Kernel length, KB: kernel breadth, L/B Ratio: kernel length and kernel breadth ratio, ASV: Alkali spreading ratio, WU: Water uptake, KLAC: kernel length after cooking, VER: Volume expansion ratio, ER: elongation ratio, AC% :Amylase content.

value and water uptake indicating additive gene action for gene expression. Kernel length, kernel breadth, kernel length after cooking exhibit high heritability with moderate genetic advance indicating both additive and dominant gene action might be involved in controlling these traits.

Knowledge of association of different characters helps in selection for breeding programme.

Table 4. Estimates of phenotypic and genotypic correlation coefficient studies among 12 quality characters.

Characters		Hull%	Mill%	HRR%	KL	KB	L/B	ASV	WU	KLAC	VER	ER	AC%
Hull%	P	1.00	0.570**	0.47	0.068	0.175	-0.027	0.22*	0.205	0.177	-0.24*	0.076	-0.236
	G		0.848	0.535	0..086	0.187	-0.003	0.267	0.206	0.229	-0.371	0.96	-0384
Mill%	P		1.00	0.326**	0.114	0.059	0.046	0.066	0.114	0.137	-0.243*	-0.046	-0.075
	G			0.504	0.217	0.046	0.131	0.148	0.156	0.305	-0.457	0.008	-0.114
HRR%	P			1.00	-0.219*	-0.18	-0.07	0.388**	0.32**	0.005	0.004	0.351**	-0.375**
	G				-0.239	-0.216	-0.06	0.412	0.354	0.016	0.075	0.41	-0.454
KL	P				1.00	-0.168	0.803**	-0.093	-0.028	0.779**	-0.228*	-0.58**	0.396**
	G					-0.174	0.823	-0.097	-0.034	0.798	-0.295	-0.599	0.495
KB	P					1.00	-0.701**	0.013	0.099	-0.098	-0.089	0.07	0.106
	G						-0696	.014	0.086	-0.093	-0.126	0.085	0.096
L/B	P						1.00	-0.056	-0.09	0.606**	-0.147	-0.476**	0.232
	G							-0.057	-0.083	0.619	-0.176	-0.497	0.310
ASV	P							1.00	0.379**	0.107	-0.16	0.245*	-0.104
	G								0.407	0.101	-0.198	0.246	-0.134
WU	P								1.00	-0.005	0.114	0.112	0.038
	G									-0.010	0.14	0.112	-0.022
KLAC	P									1.00	-0.103	0.0008	0.133
	G										-0.13	-0.022	0.151
VER	P										1.00	0.329**	-0.072
	G											-.438	-0.074
ER	P											1.00	-0470**
	G												-0.605
AC%	P												1.00

*,** significant at 5% and 1% level of probability respectively. Hull%:hulling percentage, Mill%:milling percentage, HRR: Head rice recovery, KL: Kernel length, KB: kernel breadth, L/B Ratio: kernel length and kernel breadth ratio, ASV: Alkali spreading ratio, WU: Water uptake, KLAC: kernel length after cooking, VER: Volume expansion ratio, ER: elongation ratio, AC% :Amylase content.

The value for phenotypic and genotypic correlation are presented in table-4. The genotypic correlation is higher than phenotypic correlation indicating high degree association among the characters. There fore selection based on phenotypic traits would be effective in achieving genetic gain. The hulling % showed significant and positive correlation with milling%, HRR% and alkali spreading value but significant negative correlation with volume expansion ratio. This indicates that more hulling % will give more milling recovery and head rice. The milling % was significantly and positively correlated with HRR% and negatively correlated with volume expansion ratio. Similar result was reported by Chauhan *et al* (1995). The HRR showed negative significant correlation with kernel length, amylase content and positive correlation with alkali spreading value, water uptake, elongation ratio. More HRR% will be produced in low kernel length. Kernel length was significantly positively correlated with L/B ratio, kernel length after cooking, amylase content and negatively correlated with volume expansion ratio, amylase content. High kernel length will give high L/B ratio and high kernel length after cooking. Kernel breadth is negatively correlated with L/B ratio. L/B ratio showed significant positive correlation with kernel length after cooking and negative association with elongation ratio. Kernel length after cooking will be more with high L/B ratio. Alkali spreading value showed significant positive correlation with water uptake and elongation ratio. Volume expansion ratio also was significantly and positively correlated with elongation ratio. High elongation ratio will give more volume expansion ratio. Elongation ratio showed positive significant correlation with amylase content.

Table 5. Direct (diagonal) and Indirect(off-diagonal) effect of quality characters on amylase content in rice

Characters	Hull%	Mill%	HRR%	KL	KB	L/B	ASV	WU	KLAC	VER	ER
Hull%	-0.295 (0.591)	-0.168 (0.502)	-0.139 (0.316)	-0.020 (0.051)	-0.051 (0.111)	0.008 (-0.002)	-0.065 (0.158)	-0.060 (0.122)	-0.052 (0.135)	0.072 (-0.219)	-0.022 (0.057)
Mill%	0.041 (-0.356)	0.072 (-0.420)	0.023 (-0.212)	0.008 (-0.091)	0.004 (-0.019)	0.003 (-0.055)	0.004 (-0.062)	0.008 (-0.065)	0.009 (-0.128)	-0.017 (0.192)	-0.003 (-0.003)
HRR%	-0.046 (-0.187)	-0.032 (-0.176)	-0.098 (-0.350)	0.021 (0.084)	0.017 (0.075)	0.007 (0.021)	-0.038 (-0.144)	-0.032 (-0.124)	-0.001 (-0.005)	-0.001 (-0.026)	-0.034 (-0.144)
KL	-0.007 (0.864)	-0.012 (2.161)	0.024 (-2.384)	-0.112 (9.945)	0.019 (-1.739)	-0.090 (8.193)	0.010 (-0.964)	0.003 (-0.340)	-0.088 (7.940)	0.025 (-2.937)	0.065 (-5.963)
KB	0.112 (-0.885)	0.038 (-0.220)	-0.116 (1.019)	-0.108 (0.824)	0.643 (-4.710)	-0.450 (3.282)	0.008 (-0.069)	0.063 (-0.406)	-0.063 (0.441)	-0.057 (0.594)	0.047 (-0.400)
L/B	-0.021 (0.030)	0.034 (-1.130)	-0.053 (0.518)	0.607 (-7.085)	-0.529 (5.993)	0.755 (-8.600)	-0.042 (0.495)	-0.068 (0.720)	0.458 (-5.323)	-0.111 (1.517)	-0.360 (4.279)
ASV	0.010 (0.137)	0.003 (0.076)	0.018 (0.212)	-0.004 (-0.050)	0.001 (0.007)	-0.002 (-0.029)	0.047 (0.515)	0.018 (0.210)	0.005 (0.052)	-0.007 (-0.102)	0.011 (0.127)
WU	0.025 (-0.066)	0.013 (-0.050)	0.040 (-0.114)	-0.003 (0.011)	0.012 (-0.027)	-0.011 (0.027)	0.046 (-0.131)	0.121 (-0.322)	-0.001 (0.003)	0.013 (-0.045)	0.013 (-0.036)
KLAC	-0.022 (-0.675)	-0.017 (-0.899)	-0.001 (-0.047)	-0.099 (-2.348)	0.012 (0.275)	-0.077 (-1.821)	-0.013 (-0.299)	0.001 (0.030)	-0.127 (-2.941)	0.013 (0.385)	-0.001 (0.064)
VER	-0.016 (0.024)	-0.016 (0.029)	0.0003 (-0.004)	-0.015 (0.019)	-0.005 (0.008)	-0.009 (0.011)	-0.010 (0.012)	0.007 (-0.009)	-0.006 (0.008)	0.066 (-0.064)	0.021 (-0.028)
ER	-0.016 (0.129)	0.009 (0.012)	-0.073 (0.591)	0.122 (-0.864)	-0.015 (0.122)	0.100 (-0.717)	-0.051 (0.355)	-0.023 (0.162)	-0.003 (-0.031)	-0.069 (0.631)	-0.210 (1.441)
AC	-0.236 (-0.384)	-0.075 (-0.114)	-0.375 (-0.454)	0.396 (0.495)	0.106 (0.096)	0.232 (0.310)	-0.104 (-0.134)	0.038 (-0.022)	0.133 (0.151)	-0.072 (-0.074)	-0.470 (-0.605)
Partial R^2	0.069 (-0.227)	-0.005 (0.048)	0.037 (0.159)	-0.044 (4.929)	0.068 (-0.454)	0.175 (-2.667)	-0.005 (-0.069)	0.004 (0.007)	-0.017 (-0.444)	-0.004 (0.004)	0.098 (-0.873)

Phenotypic path (R^2=0.3776, Residual effect = 0.77889), Genotypic path (R^2=0.412, Residual effect =0.7668), values in the parenthesis are genotypic path value.

Path analysis study revealed that hulling %, kernel length, alkali spreading value and elongation ratio had significant positive direct effect for amylase content (Table 5). But kernel length only showed positive correlation with amylase content indicating close association with the two characters. This may indicate that direct selection of kernel length would likely be effective in increasing the amylase content. But correlation studies did not reveal any significant relation with alkali spreading value and elongation ratio. This may be due to high negative indirect effect. L/B ratio and kernel length after cooking had high negative direct effect but positive correlation, which may be due to positive indirect effects.

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