ISSN 0258-7122
Bangladesh J. Agril. Res. 37(4): 551-558, December 2012

VARIABILITY IN GRAIN QUALITY TRAITS OF AROMATIC RICE *(Oryza sativa' L.*)

M. PARIKH[1], N. K. RASTOGI[2] AND A. K. SARAWGI[3]

Abstract

The present study involved the evaluation of physio-chemical characters and cooking quality of 36 rice genotypes from Madhya Pradesh and Chhattisgarh. The fine grain genotypes like Rajim-12, Kalimuchh, and Munibhog were found good for moderate kernel length and L:B ratio; Rajabhog, Jhulari, and Baghmuchha for kernel length after cooking and L:B ratio of cooked rice Kalajira and Bikoni for head rice recovery%; Barang, Bantaphool, Gangabalu, and Bikoni for elongation ratio; Barang, Rajabhog, Gangabalu, Bikoni, and Chirainikhi for elongation index; Sonth, Rajim-12, Jhulari, Gangabalu, Jhilli Safri, and Bikoni for intermediate alkali values. These genotypes may be utilized as donors for improvement of quality traits. In the present study, superior genotypes were Rajm-12 for grain yield, kernel length, L:B ratio and kernel length after cooking; Rajabhog for grain yield, kernel length after cooking, L:B of cooked rice and elongation index; Bikoni for head rice recovery, elongation ratio, elongation index, and intermediate alkali values.

Keywords: Aromatic rice, grain quality, variability.

Introduction

Rice crop is interwoven in the cultural, social and economic lives of millions of Indians and it holds the key for food and nutritional security of the country. India has the largest area and got second rank in rice production among the rice growing countries. However, its share for export in international market is less than five percent due to lacking in grain quality characteristics. Rice quality includes head rice recovery, kernel size, kernel shape, kernel length after cooking, elongation ratio, elongation index, and aroma. Scented rice has important place to earn more foreign currency due to its pleasant aroma, superfine grain, excellent cooking and eating quality. Hence, it is necessary to impiove grain quality of modern rice varieties to fulfill the demand of the consumers in domestic as well as in international markets. In the present study, attempts have been made to characterize a set of aromatic rice germplasm for various physico-chemical characters and estimate the variabilities available in the collections, which can be utilized as donors in quality improvement for domestic as well as for export purpose.

[1,2&3] Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Krishi Vishwavidhalaya, Raipur (Chhattisgarh)-492006

Materials and Method

The material included 36 native cultivars and landraces some of which were collected from tribal community of Madhya Pradesh and Chhattisgarh region (Table 1). The materials were grown in randomized complete block design in three replications during Kharif 2008. A single seedling of each genotype was transplanted in 2 m row length adopting 20 cm distance between rows and 15 cm between plants. All the recommended agronomic practices were followed to raise a good crop.

A composite sample of five randomly selected plants from each plot was used to record observations on seed yield and quality characters *viz.*, kernel length: breadth ratio (L:B), kernel length after cooking (KLAC), length: breadth ratio of cooked rice, milling %, head rice recovery % (HRR %), elongation ratio, elongation index, alkali spreading value, and 100-seed weight.

The seed samples were hulled and milled by Satake huller and miller. Unbroken kernels obtained from milling were used to calculate head rice recovery. Kernel length and breadth were measured by dial micrometer and then ratio of kernel length to kernel breadth (L:B ratio) was computed. Similarly, for kernel length after cooking, ten cooked rice were taken and individual length was measured ratio of length of cooked rice to breadth of cooked rice was also computed. Elongation ratio was computed as length of cooked kernel to length of kernel and kernel elongation index was also computed as length: breadth ratio of cooked rice to length: breadth ratio of milled rice. Alkali spreading value was measured by standard method of Little *et al.* (1958). Statistical analysis was undertaken for 11 quantitative traits to estimate the genetic parameters. Genotypic and phenotypic coefficients of variability were calculated following a method of Burton (1952). Heritability and genetic advance were estimated as suggested by Johnson *et al.* (1955).

Results and Discussion

The aromatic rice genotypes under study showed a wide range of differences for all the characters indicating the existence of high variability among the varieties. Thus, there is an ample scope for selection of seed yield and different quality characters. Enormous variations were also reported in majority of quality characters by Shahidullah *et al.* (2009). A perusal of GCV revealed that maximum value of variation was recorded for 100-seed weight (26.93%) followed by seed yield per plant (23.98%), kernel length: breadth ratio (18.16%), and length: breadth ratio of cooked rice (14.06%) (Table 2). These results were in conformation with the findings of Pandey and John Anurag (2010) and Rathi *etal.* (2010).

Table 1. Details of rice accessions.

S. No.	Genotypes	Source			
		Acc. No.	Distt.	Block	Village
1	Bikoni	B:525II	Rajnandgaon	Kawardha	-
2	Bantaphool	B:10841	Sidhi	Devsar	Niwap
3	Bantaphool	B:1090	Sidhi	Sihabal	Sabin
4	Bagmuchha	B:1689	Seoni	Barghat	Dhamakala
5	Banspatri	B:2357	Raipur	Mainpur	Idagaon
6	Barang	B:1166	Raipur	Deobhog	Kodevan
7	Badshahbhog	B:323II	Bastar	Gidam	Kasoli
8	Bhantaphool	B:1087	Sidhi	Rampurnekin	Sanda
9	Chhatri	C:808	Seoni	Barghat	Takhakala
10	Chinikapoor	C:340	Bastar	Bhanupratabpur	Jampara
11	Chirainikhi	C:751	Bastar	Lohandikada	Ennur
12	Dudgi	D:1205	Raigarh	Gharboda	Pusslada
13	Dudaga	D:1161I	Bilaspur	Katghora	Chhinpur
14	Dumarphool	D:822	Bastar	Kanker	Bewatri
15	Dumarphool	D:1004	Bastar	Bastanar	Gotiapal
16	Ganga Balu	G:751	Raipur	Saraipali	Bodalawali
17	Ganga Barud	G:397	Bastar	Dantewada	Kawalnar
18	Ganga Prasad	G:433	Durg	Soj a	Padubhsara
19	Garrakat	G:1 13111	Raipur	Tilda	Modhi
20	Jhiili Safri	J:109IV	Rajnanadgaon	Dongargaon	-
21	Jhulari	J:28	Jabalpur	Majholi	Kharma
22	Jira	J:214IV	Bastar	Gidarn	Ronje
23	Jiradhan	J:50	Jhabua	Bhabra	Bhabra
24	Kalajira	K:1445	Raigarh	Bagicha	Gaylunga
25	Krishnabhog	K:1019	Durg	Durgikondal	Chaurgaon
26	Kalimuchh	K:2533	Bhind	Gohad	Dhimka
27	Kubri Mohar	K:1242I	Raipur	Simga	Kesada
28	Kubri Moharaji	K:1317	Raipur	Devbhog	Amlipadar
29	Munibhog	M:1III	Raipur	Bilaigarh	Purgaon
30	Ramjira	R:440	Bilaspur	Champa	Madanpur
31	Rajim-12	R:169111	Raipur	Fingeshwar	Raj im
32	Ramkali	R:273III	Raipur	Tilda	Mohra
33	Rajabhog	R:399	Raigarh	Duldula	Bagvvudri
34	Sonth	S:715	Shahadol	Sohagpur	Jodhpur
35	Safri-11	S:342II	Durg	Dhamdha	Pendari
36	Wasmati	W:48	Sidhi	Majholi	Khadora

Table 2. Mean performances and estimates of genetic components of grain quality traits in aromatic rice.

S.L. No.	Genotypes	Seed yield (t/ha)	Hundred seed wt (g)	Kernel length (mm)	Kernel length: breadth ratio	Kernel length after cooking (mm)	Length: breadth ratio of cooked rice	Milling (%)	Head rice recovery (%)	Elongation ratio	Elongation index	Alkali spreading value
1.	Bikoni	2.19	1.36	4.52	2.08	7.82	2.73	71.86	68.77	1.73	1.31	3.87
2.	Bantaphool	1.53	1.32	4.15	1.82	7.32	1.95	70.79	55.55	1.76	1.07	3.32
3.	Bantaphool	1.92	1.32	4.40	2.11	7.52	2.33	68.80	54.59	1.76	1.10	3.13
4.	Bagmuchha	2.79	1.91	5.78	2.64	8.55	2.83	65.65	61.64	1.47	1.06	3.83
5.	Banspatn	2.04	1.73	5.63	3.10	7.72	2.95	73.27	52.21	1.36	0.95	3.55
6.	Barang	1.89	1.24	4.07	1.91	7.32	2.26	70.94	60.49	1.80	1.71	3.50
7.	Badshahbhog	2.07	1.21	5.90	2.76	8.02	2.53	64.77	58.58	1.35	0.91	3.47
8.	Bhantaphool	1.86	1.37	4.52	2.15	6.50	2.47	63.68	52.91	1.43	1.15	3.61
9.	Chhatri	2.13	1.90	5.62	2.43	8.80	2.74	64.41	51.63	1.56	1.12	3.18
10.	Chinikapoor	1.86	1.43	4.25	2.05	6.73	2.23	67.93	59.82	1.58	1.08	3.17
11.	Chirainikhi	2.13	1.26	4.27	1.72	6.38	2.17	70.49	62.07	1.49	1.26	3.05
12.	Dudgi	1.98	1.53	4.42	1.93	6.93	2.38	70.41	61.53	1.56	1.23	3.15
13.	Dudaga	2.46	1.68	5.42	2.64	7.58	2.60	64.92	67.35	1.39	0.98	3.07
14.	Dumarphool	2.16	1.20	3.97	1.87	6.22	2.13	60.90	51.93	1.56	1.14	3.32
15.	Dumarphool	2.73	2.68	5.61	2.76	7.42	2.72	68.28	57.98	1.32	0.98	3.19
16.	Ganga Balu	1.68	1.11	4.42	2.12	7.72	2.86	74.84	50.22	1.74	1.34	4.31
17.	Ganga Barud	3.12	1.23	4.02	1.80	6.18	1.92	68.75	61.15	1.53	1.06	3.33
18.	Ganga Prasad	2.46	1.28	4.31	1.97	6.42	2.12	73.04	43.12	1.49	1.07	4.16
19.	Garrakat	2.34	1.69	5.57	2.76	7.82	2.67	67.82	51.62	1.40	0.96	3.82
20.	Jhiili Safri	1.89	1.66	5.54	2.76	8.02	2.09	69.79	61.70	1.44	0.75	4.17
21.	Jhulari	2.31	1.72	5.32	2.78	8.04	2.95	67.63	57.34	1.50	1.05	4.52

Table 2. Cont'd.

S.L. No.	Genotypes	Seed yield (t/ha)	100-seed wt (g)	Kernel length (mm)	Kernel length: breadth ratio	Kernel length after cooking (mm)	Length: breadth ratio of cooked rice	Milling (%)	Head rice recovery (%)	Elongation ratio	Elongation index	Alkali spreading value
22.	Jira	1.89	0.99	4.23	1.95	6.32	2.17	71.58	59.85	1.49	1.11	3.37
23.	Jiradhan	2.04	1.22	4.32	1.05	6.02	2.06	67.71	51.56	1.39	1.00	3.52
24.	Kalajira	1.98	1.48	3.82	1.98	5.90	2.16	75.46	68.81	1.54	1.09	3.52
25.	Krishnabhog	2.82	0.85	3.92	1.94	4.92	1.57	61.24	57.20	1.25	0.81	3.31
26.	Kalimuchh	1.83	1.69	5.76	2.86	7.51	2.66	66.71	53.00	1.30	0.93	3.62
27.	Kubri Mohar	1.86	1.78	5.37	2.64	8.42	2.99	71.00	50.68	1.56	1.13	3.19
28.	Kubri Moharaji	1.92	1.63	5.42	2.82	8.02	2.81	68.71	53.661	1.47	0.99	3.31
29.	Munibhog	1.98	1.70	5.72	2.81	7.93	2.45	69.51	62.15	1.38	0.87	3.49
30.	Ramjira	2.19	0.94	4.52	1.94	6.37	2.26	71.87	54.98	1.40	1.15	3.11
31.	Rajim-12	3.18	1.70	5.91	2.79	8.62	2.76	62.15	54.86	1.45	0.98	4.83
32.	Ramkali	2.31	1.49	5.51	2.72	8.02	2.84	67.25	51.45	1.45	1.04	3.64
33.	Raj abhog	3.96	1.70	5.22	2.58	8.41	3.08	66.28	53.62	1.61	1.40	3.33
34.	Sonth	2.43	1.90	5.83	2.40	7.71	2.13	65.07	56.78	1.32	0.88	4.97
35.	Safri-11	2.16	1.47	5.42	2.55	7.81	2.50	65.56	50.72	1.44	0.98	3.00
36.	Wasmati	1.77	1.23	4.82	2.72	6.55	2.50	72.43	59.25	1.36	0.91	3.52
Mean		2.21	1.48	4.93	2.33	7.32	2.46	68.37	56.68	1.48	1.07	3.56
Range	Min.	1.53	0.85	3.82	1.05	5.90	1.57	60.90	50.22	1.25	0.75	3.00
	Max.	3.96	2.68	5.91	3.10	8.80	3.08	75.46	68.81	1.80	1.40	4.97
GCV		23.98	26.93	13.70	18.16	12.66	14.06	5.13	11.30	8.59	12.72	12.75
PCV		24.44	27.71	13.75	18.27	12.67	14.54	5.22	11.35	8.70	14.34	12.95
h^2		0.963	0.944	0.993	0.988	0.999	0.934	0.985	0.993	0.975	0.786	0.970
GA as % of mean		48.46	53.84	28.14	37.44	26.07	27.93	15.78	25.33	17.56	23.58	25.91
CV (%)		4.71	6.75	1.11	1.91	0.43	3.63	0.93	1.03	1.35	5.91	2.17
CD at 5%		0.828	0.162	0.456	0.072	0.281	0.145	2.18	2.08	0.102	0.125	0.145

In the present study, high broad sense heritability was observed for all the traits. High heritability coupled with high genetic advance was recorded for 100-seed weight followed by seed yield per plant, kernel length: breadth ratio, and kernel length, suggesting preponderance of additive gene action in the expression of these characters. Therefore, selection may be effective for the improvement of those characters.

The highest seed yield per plant was recorded in Rajabhog (3.96 t/ha) followed by Rajim-12 (3.18 t/ha) and Ganga Barud (3.12t/ha). The 100-seed weight ranged from 2.68 to 0.85 g. The maximum 100-seed weight was recorded in Dumarphool (2.68g) followed by that of Bagmuchha (1.91g) and Sonth (1.90 g) which can be used for developing varieties with bold seeds. Seed size and shape are the important quality characters in determining market value of rice. Extra long to medium slender are much more preferred by the growers, traders and consumers. Besides this, the physical appearance of rice as an important factor determines its acceptability. Genotypes showed low variation for kernel length with the range from 5.91 to 3.82 mm. Chauhan *et al.* (1991) also reported low variability for kernel length. Kernel length of Rajim-12 (5.91 mm) was maximum followed by Badshahbhog (5.90 mm), Sonth (5.83 mm), Bagmuchha (5.78 mm), and Kalimuchh (5.76 mm). Whereas, kernel L:B ratio was maximum for Banspatri (3.10) followed by that in Kalimuchh (2.86), Kubri Moharaji (2.82), Munibhog (2.81), and Rajim-12 (2.79). The genotypes with high kernel length and L:B ratio may be utilized as donors for breeding long grain varieties viz., Rajim-12, Kalimuchh, and Munibhog. Shahidullah *et al.* (2009) also reported enormous variation in kernel length and L/B ratio. Similarily, kernel length after cooking and L:B of cooked rice are also important cooking quality characters and its higher values are more desirable. Genotypes in the present study showed moderate variation for the kernel length after cooking with the range from 8.80 to 5.90 mm and high for L:B ratio of cooked rice from 3.08 to 1.57. The maximum kernel length after cooking was registered by Chhatri followed by that in Rajim-12, Baghmuchha, and Kubrimohar, whereas maximum L: B ratio of cooked rice was shown by Rajabhog followed by that of Kubrimohar, Banspatri, and Jhulari. Considering both of these traits, genotypes Rajabhog, Jhulari, and Baghmuchha may be utilized as donors in quality rice breeding programme.

The milling %, head rice recovery %, and 100-seed weight being the important quality traits increase the market value from commercial point of view. The range of milling recovery was between 75.46 to 60.90 percent. The moderate milling % was observed in the genotypes under study indicating little scope for improvement in these traits through selection. The moderate variability for milling recovery was also observed by Chauhan *et al.* (1991). The highest milling % was observed in Kalajira followed by that in Ganga Balu, Banspatri, and Ganga Prasad.

The HRR ranged from 50.22 to 68.81%. The higher head rice recovery (HRR %) was recorded in Kalajira followed by Bikoni, Dudaga, Chirainikhi, and Jhilli Safri. The genotypes Kalajira and Bikoni can be used as donors for breeding varieties of quality rice from the commercial point of view.

The elongation ratio and elongation index are the important cooking quality traits of rice. The higher values of these traits are desirable and much preferred by the consumers. Moderate variability was observed for elongation ratio and elongation index with range between 1.80 to 1.25 and 1.40 to 0.75, respectively. Maximum kernel elongation ratio was observed in Barang followed by that in Bantaphool, Ganga-Bain, and Bikoni, whereas highest elongation index was registered by Barang, Rajabhog, Ganga Balu, Bikoni, and Chirainikhi confirming the results of Shahidullah *et al.* (2009) and Rathi *etal.* (2010).

Alkali spreading value is also one of the important cooking quality traits and its intermediate scores (4-5) indicate intermediate amylose content. It ranged from 4.97 to 3.00 confirming the results of Rathi *et al.* (2010). The people of India prefer varieties with intermediate amylose content. The genotypes Sonth, Rajim12, Jhulari, Ganga Balu, Jhilli Safri, and Bikoni had intermediate alkali spreading values which can be utilized as donors in quality rice breeding programme.

The present study evaluated the yield performance, physico-chemical characters, and cooking quality traits of aromatic rice genotypes representing different eco-graphical conditions of Chhattisgarh and Madhya Pradesh. This will be helpful in assessing the varietal characters for selecting parents viz., Rajim-12, Kalimuchh, Munibhog as fine grain genotypes for moderate kernel length and L:B ratio; Rajabhog, Jhulari, Baghmuchha for kernel length after cooking and L:B ratio ; Bikoni for head rice recovery %; Barang, Bantaphool, Gangabalu, Bikoni for elongation ratio; Barang Rajabhog, Gangabalu, Bikoni, Chirainikhi for elongation index; Sonth, Rajim-12, Jhulari, Gangabalu, Safri, Milli and Bikoni for intermediate alkali value towards improvement of respective traits in quality rice breeding programme.

References

Burton G.W. 1952. Quantitative inheritance in grasses. In proceedings of 6th International Grassland Congress Ames, Iowa, USA Pp. 227-283.

Chauhan J. S., V. S. Chauhan,and S. G. Lodh. 1991. Abstr. Golden Jubilee symposium on Genetic Research and Education: Current Trends and Next Fifty Years. 1: 16.

Little R. R., G. S. Hildser and E. H. Dawson. 1958. Differential effect of dilute alkali on 25 varieties of milled white rice. *Cereal Chem.* 35: 111-126.

Johnson H. W., H. F. Robinson and R. E. Comstock. 1955. Estimates of genetic and environment variability in soyabean. *Agron. J.* 47: 314-318.

Pandey Praveen and P. John Anurag. 2010. Estimation of genetic parameters in indigenous rice. *Advances in Agriculture and Botanics* **2**(1): 79-83.

Shahidullah S. M., M. M. Hanafi, M. Razi Ashrafuzzaman Ismail and A. Khair. 2009. Genetic diversity in grain quality and nutrition of aromatic rices. *African Journal of Biotechnology* **8**(7): 1238-1246.

Rathi S., R. N. S. Yadav and R. N. Sarma. 2010. Variability in grain quality characters of upland rice of Assam, India. *Rice Science* **17**(4): 330-333.