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Grain Characteristics And Cooking Quality Of Indigenous Aromatic And Non-Aromatic Genotypes Of Rice (*Oryza sativa* L.)

Srivastava A K*, Jaiswal H K

Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi 221 005.

ABSTRACT

Twenty four indigenous aromatic cultivars including indigenous aromatic short grain cultivars of eastern Uttar Pradesh, basmati type varieties and five high yielding varieties of rice (*Oryza sativa* L.) were analyzed for their grain characteristics and physico-chemical quality attributes. The lines exhibited a great variability for all the traits studied ranging from 9.1 to 25.2g for1000 grain weight, 3.33 to 8.02 mm for kernel length, 1.68 to 2.38 mm for kernel breadth, 5.25 to 14.68 mm for kernel length after cooking, 2.17 to 3.67 mm for kernel breadth after cooking, 1.68 to 6.06 for L/B ratio (after cooking), 0.9 to 1.4 for elongation index, 1.3 to 1.9 for lengthwise elongation ratio and 1.1 to 1.6 for breadth-wise elongation ratio. Basmati rice types exhibited excellent grain and physico-quality characters. After cooking, the basmati rice showed equivalent breadth wise expansion but better length wise expansion that gives it a finer look and a coarser look to other types of rice. The L/b ratio further improves after cooking for basmati types and short grained aromatic genotypes. The short grain aromatic lines occupied intermediate position to basmati types and non aromatic lines regarding physical characteristics of grains like kernel length, kernel breadth and other related traits although they excel in having intermediate amylose content and gelatinization temperature. These lines can be further improved regarding their grain quality attributes by devising breeding strategies including selection or hybridization with similar lines. These lines can serve as an alternative to the aromatic basmati types by improving their yield level keeping their physico-chemical properties intact.

KEY WORDS: Rice, grain characteristics, cooking quality

Corresponding Author:
AK Srivastava
Scientist
Central Potato Research Station (ICAR),
Shillong – 793009
E Mail: bhu.avinash@gmail.com
Mobile: +919436706348

INTRODUCTION

Indian farmers grow a large number of rice varieties which include some of the finest quality aromatic rice. Aromatic rices of all shapes and sizes available in the country represent the stupendous genetic diversity witnessed in the various agro climatic regions. Among them, the basmati rice constitute a unique group with excellent quality features and enjoy a special status, historical significance and believed to be the nature's gift to the Indian sub-continent[1]. Besides basmati, the country also abounds with hundreds of indigenous aromatic short grain cultivars and land races grown in pockets of different states which possess excellent grain cooking quality. These are usually low yielding, and susceptible to pests and diseases and lodging. The farmers grow them for their own consumption although some domestic markets do exist for these lines and they are highly remunerative. As an aftermath of the green revolution and growing demand for high yielding rice varieties, many of them are either lost or are on the verge of extinction. There is a need to conserve and use these in breeding better quality rice varieties[2]. Consumer preference is a major factor in determining the preferred characters to be incorporated in the varieties. With India becoming self sufficient in rice production and increasing income of the populace, the focus is slowly but surely shifting towards quality food. This is reason enough for breeders to take up improvement in these cultivars.

In the present study, an attempt has been made to characterize some short grain aromatic lines in comparision to basmati types and non-aromatic high yielding varieties for various physico-chemical quality attributes. The knowledge generated can be utilized for devising breeding strategies for improving their yield keeping their physico-chemical quality intact.

MATERIALS AND METHODS

The experimental material of the study undertaken during Kharif 2006 consisted of 12 indigenous aromatic short grain cultivars collected from 4 districts of eastern Uttar Pradesh, 12 basmati type varieties and 5 high yielding varieties. 25 days old seedlings were planted singly at a spacing of 15 x 20 cm within and between rows. Each entry was transplanted in 3 rows, each 5m in length in a randomized block design with 2 replications. All the recommended agronomic practices were followed. Milled rice was used to evaluate various physico-chemical and cooking properties viz., Kernel length, Kernel breadth, Kernel length after cooking, Kernel breadth after cooking, Length wise elongation ratio, Breadth wise elongation ratio, L/B (before cooking) and L/B (after cooking). Elongation index was calculated as the ratio of L/B (after cooking) and L/B (before cooking).The gelatinization temperature was estimated based on the Alkali spread value of the milled rice[3]. Simplified procedure of Juliano[4] was used for the estimation of amylose content. Five hundred grains from each line were weighed in duplicate and the mean weight was doubled to represent 1000 grain weight. The classification of the lines regarding grain size, gelatinization temperature and amylose content was done following Shobha Rani *et al*[5].

RESULTS AND DISCUSSION

The kernel length ranged from 3.33 to 5.76mm for short grain type (Table 1), 6.34 to 8.02mm for basmati types (Table 2) and 4.65 to 6.34mm among non-aromatic genotypes (Table 3). Based on the L/B (before cooking), the short grain types were classified as either short bold or medium slender types. The basmati types were long slender or extra long slender while non-aromatic types were short slender, medium slender or long slender. The 1000 grain weight ranged from 9.1 to 19.3 g for short grain types, 13.4 to 23.2g for high yielding varieties and 19.4 to 25.2g for basmati type lines. Grain length, shape, size and uniformity determine the consumer preference. Generally, rice with more linear elongation and less breadth wise expansion is preferred. The linear elongation ratio for short grain types varied from 1.36 to 1.70 while the breadth wise elongation ratio varied from 1.12 to 1.54. The basmati types showed length wise elongation of 1.70 to 1.91 while the breadth wise elongation of 1.25 to 1.61. The non-aromatic types showed linear elongation ratio from 1.27 to 1.52 and breadth wise elongation ratio of 1.30 to 1.54. If rice elongates more lengthwise, it gives a finer appearance and if it expands girth wise, it gives coarse look. As is evident, all the rices show equivalent breadth wise expansion. It is the length wise expansion that gives basmati types a finer look and a coarser look to other types of rice. The elongation index provides an idea about the grain size after cooking. As can be seen, the values of elongation index were close to one for non-aromatic types, it reached up to 1.36 for short grained types and showed a highest value of 1.41 for basmati types. This indicates that the L/b ratio further improves after cooking for basmati types and short grained genotypes while it remained the same for the non-aromatic cultivars. The alkali spread value ranged from 2 to 6 for short grained aromatic varieties although majority of these have intermediate scores. For basmati types, it ranged from 2 to 7 with majority showing a score of 7. High alkali spread value corresponds to low gelatinization temperature. The non-aromatic lines showed alkali scores ranging from 3 to 7. Varieties with intermediate gelatinization temperature are desired. Amylose content is the major factor for eating quality of rice[6]. It is an indicator of volume expansion and water absorption during cooking and correlates with hardiness, whiteness and dullness of cooked rice. Most of the basmati type lines and non-aromatic varieties have high amylose content. High amylose variety cooks dry, flaky, and fluffy and has high volume expansion but becomes hard on cooling[7]. Most of the short grained aromatic lines have intermediate amylose content. Intermediate amylose rice cooks fluffy and remains soft on cooling and is the most preferred one.

Table 1. Grain characteristics of aromatic short grain lines.

Genotypes	1000 GW (g)	KL (mm)	KB (mm)	KLAC (mm)	KBAC (mm)	L/B (BC)	L/B (AC)	EI	LER	BER	ASV	Amylose (%)
Kalanamak 5	16.3	4.98	1.86	7.17	2.5	2.68(MS)	2.87	1.1	1.4	1.3	2(L)	22.68(I)
JuhiBengal 21	12.3	3.7	1.98	5.42	2.33	1.87(SB)	2.33	1.2	1.5	1.2	3(I/L)	23.92(I)
JuhiBengal 23	11.4	3.71	1.84	5.83	2.67	2.02(SB)	2.18	1.1	1.6	1.5	4(I)	16.84(L)
KanakJeera28	18.1	4.2	2.38	6.17	3.67	1.76(SB)	1.68	1	1.5	1.5	5(I)	22.3(I)
GR-32	10.9	3.93	2.01	5.67	2.83	1.96(SB)	2.01	1	1.4	1.4	4(I)	24.6(I)
Kalanamak 6	18.2	5.19	2.02	7.58	2.58	2.57(MS)	2.94	1.1	1.5	1.3	5(I)	23.06(I)
Kalanamak11	16.2	4.7	1.89	7.17	2.33	2.49(SB)	3.08	1.2	1.5	1.2	5(I)	26.19(H)
Kalanamak 2	17.3	4.78	1.99	7.5	2.5	2.40(SB)	3	1.3	1.6	1.3	4(I)	21.54(I)
Basmati -73	19.3	5.76	2.305	8.75	2.58	2.50(MS)	3.39	1.4	1.5	1.1	6(H)	22.67(I)
BadshahBhog	9.1	3.85	1.84	5.25	2.5	2.09(SB)	2.1	1	1.4	1.4	5(I)	20.94(I)
Katarni	11	4.51	1.69	6.67	2.17	2.67(MS)	3.07	1.2	1.5	1.3	3(I/L)	24.75(I)
Adamchini	10.1	3.33	2.05	5.67	2.58	1.62(SB)	2.2	1.4	1.7	1.3	4(I)	21.41(I)

1000GW: Test weight, KL: Kernel length, KB: Kernel breadth, KLAC: Kernel length after cooking, KBAC: Kernel breadth after cooking, L/B (BC): L/B (before cooking) and L/B (AC): L/B (after cooking, EI: Elongation index, LER: Length wise elongation ratio, BER: Breadth wise elongation ratio, ASV: Alkali spread value.
H=High, I=Intermediate and L=Low
SB=Short bold, MS=Medium slender

Table 2 Grain characteristics of basmati lines.

Genotypes	1000 GW (g)	KL (mm)	KB (mm)	KLAC (mm)	KBAC (mm)	L/B (BC)	L/B (AC)	EI	LER	BER	ASV	Amylose (%)
Type-3	21.2	6.76	1.76	12.55	2.58	3.84(LS)	4.86	1.3	1.9	1.5	5(I)	23.14(I)
Kasturi	21.1	6.64	1.74	12.15	2.75	3.82(LS)	4.42	1.2	1.8	1.6	2(L)	13.76
Basmati 370	19.4	6.48	1.75	12.4	2.42	3.70(ELS)	5.12	1.4	1.9	1.4	5(I)	26.11(H)
Pusa Basmati 1	19.6	7.51	1.68	13.82	2.28	4.47(LS)	6.06	1.4	1.8	1.4	7(H)	26.11(H)
Mugadsugandh	20.4	7.03	1.74	12.07	2.33	4.04(ELS)	5.18	1.3	1.7	1.3	7(H)	30.68(VH)
P 2517	20.6	7.99	1.82	13.6	2.5	4.39(ELS)	5.44	1.2	1.7	1.4	7(H)	21.34(I)
HUR PB-1S-97	20.2	7.96	1.84	14.68	2.6	4.33(ELS)	5.65	1.3	1.8	1.4	7(H)	30.76(VH)
Pusa Sugandh 2	25.2	8.02	1.84	14.18	2.67	4.36(LS)	5.31	1.2	1.8	1.5	7(H)	28.21(H)
Taraori Basmati	23.3	7.44	1.74	13.05	2.17	4.28(LS)	6.01	1.4	1.8	1.3	3(I/L)	20.99(I)
Pusa 44	19.4	6.34	1.86	11.42	2.83	3.41(LS)	4.03	1.2	1.8	1.5	7(H)	23.25(I)
Super Basmati	21.3	7.2	1.84	12.29	2.28	3.91(LS)	5.39	1.4	1.7	1.2	3(I/L)	26.20(H)
Mahisugandha	20.4	6.64	1.71	11.89	2.75	3.88(LS)	4.32	1.1	1.8	1.6	7(H)	24.41(I)

1000GW: Test weight, KL: Kernel length, KB: Kernel breadth, KLAC: Kernel length after cooking, KBAC: Kernel breadth after cooking, L/B (BC): L/B (before cooking) and L/B (AC): L/B (after cooking, EI: Elongation index, LER: Length wise elongation ratio, BER: Breadth wise elongation ratio, ASV: Alkali spread value.
VH=very high, H=High, I=Intermediate and L=Low
LS=Long slender; ELS=Extra long slender

Table 3. Grain characteristic of non-aromatic lines.

Genotypes	1000 GW (g)	KL (mm)	KB (mm)	KLAC (mm)	KBAC (mm)	L/B (BC)	L/B (AC)	EI	LER	BER	ASV	Amylose (%)
Jaya	23.2	5.74	2.29	8	3	2.51(MS)	2.67	1.1	1.4	1.3	7(H)	29.20(H)
Sarjoo-52	20.3	5.5	2.16	7.75	3	2.55(MS)	2.58	1	1.4	1.4	7(H)	26.05(H)
HUR-105	21.2	6.34	1.86	8.08	2.42	3.41(LS)	3.34	1	1.3	1.3	3(I/L)	25.66(H)
BPT-5204	13.4	4.65	1.69	7.08	2.5	2.75(MS)	2.83	1	1.5	1.5	3(I/L)	24.48(I)
HUR-3022	20.3	5.87	1.73	8.08	2.67	3.39(SS)	3.03	0.9	1.4	1.5	4(I)	27.17(H)

1000GW: Test weight, KL: Kernel length, KB: Kernel breadth, KLAC: Kernel length after cooking, KBAC: Kernel breadth after cooking, L/B (BC): L/B (before cooking) and L/B (AC): L/B (after cooking, EI: Elongation index, LER: Length wise elongation ratio, BER: Breadth wise elongation ratio, ASV: Alkali spread value.
H=High, I=Intermediate and L=Low
SS=Short slender, MS=Medium slender; LS=Long slender

CONCLUSIONS

From the present study, it is quite evident that the short grain aromatic lines are placed at an intermediate position to basmati types and non-aromatic lines regarding physical characteristics of grain like kernel length, kernel breadth and other related traits although they excel in having intermediate amylose content and gelatinization temperature. Further, these lines also exhibit a great variability for all the traits. Thus, they can be further improved regarding their grain quality attributes by devising appropriate breeding strategies including selection or hybridization with other lines with similar characteristics. Also, due emphasis should be laid upon the improvement in their yield level keeping their physico-chemical properties intact.

REFERENCES

1. Thakrar R and Ahuja SC. “Potential prospects for export of basmati rice”. In: Muralidharan K and Siddiq EA. (eds.) New frontiers in rice research, DRR (ICAR) Hyderabad, 1990: 382-87.
2. Nene YL. Basmati rice: a distinct variety (cultivar) of the Indian sub-continent. Asian Agri-history 1998; 2: 175-188.
3. Little RR, Hilder GB and Dawson EH. Different effect of dilute alkali on 25 varieties of milled white rice. Cereal. Chem. 1958; 35: 111-126.
4. Juliano BO. A simplified assay for milled rice amylose. Cereal Science Today, 1971; 16: 334-338.
5. Shobha Rani N, Subba Rao LV, Viraktamath BC and Mishra B. National guidelines for the conducts of tests for distinctness, Uniformity and stability- rice (*Oryza sativa* L.). DRR technical bulletin no. 8, 2004.
6. Juliano BO. Rice in human nutrition. Food and Agriculture Organization of the United Nations, Rome; 1993: 35-59.
7. Latha R, Senthilvel K and Thiyagarajan K. Grain and cooking quality characteristics of two-line hybrids in rice (*Oryza sativa* L.). Indian J. Genet. 2005; 65: 45-46.