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Yield and quality performance of some aromatic rice varieties of Bangladesh

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The study was conducted at the Hajee Mohammad Danesh Science and Technology University Farm, Dinajpur, Bangladesh in *aman* season (July-December) of 2007 to observe the yield and quality of ten popular aromatic rice varieties of Bangladesh. The varieties were Kataribhog (Philippines), Kataribhog (Deshi), Badshabhog, Chinigura, Radhunipagal, Kalizera, Zirabhog, Madhumala, Chiniatab and Shakhorkora. The experiment was laid out in a randomized complete block design with four replications. All the yield contributing attributes and quality parameters varied significantly among the aromatic rice varieties.The highest grain yield was obtained from Kataribhog (Philippines) which identically followed by Badshabhog. In respect of quality, Zirabhog gave the highest head rice outturn that was statistically similar to Badshabhog and Chiniatab. All the tested varieties had bold type shape. Grain protein content ranged from 6.6-7.0 % in brown rice. The cooking time of tested varieties varied from 12 to 16 minutes. Aroma intensity differed due to variety. Kalizera, Badshabhog, Chiniatab contained high level of aroma while, rests of the varieties had moderate type aroma.
Key words: Yield, yield attributes, quality parameters, aromatic rice

Introduction

Ninety percent global rice production occurs in tropical and sub tropical Asian countries (Mejia, 2006). Worldwide, rice provides 27% of dietary energy supply and 20% dietary protein (Kueneman, 2006). It constitutes 95% of the cereal consumed and supplies more than 80% of the calories and about 50% of the protein in the diet of the general people of Bangladesh (Yusuf, 1997). Being the 4th largest rice producer of the world, Bangladesh comprises an area of about 11.10 million hectares for rice production (FAO, 2003) of which around 27 % is occupied by fine rice varieties (BBS, 2003). Consumer demand for the fine rice varieties is higher due to its good nutrition quality, palatability, taste, cooking quality and fragrance (Kaul *et al*., 1982). Most of the consumers prefer fine rice varieties with good cooking quality that have aroma. Due to special flavor and taste, aromatic rice is highly favored. This quality of rice receives a premium price in the market and has export potential (Arumugachamy *et al*., 1992). An aromatic rice variety may grow and yield satisfactorily in a wide area but its quality traits are expressed in its native area of cultivation (Singh *et al*., 2000). Bangladesh produces several fine aromatic rice varieties with excellent eating quality for regular consumption as steamed rice as well as for *polao, biriani, jarda, firni* type preparations which are served on special occasions.Yield and quality of rice depends on the genetic potential of cultivars, it surrounding environment and management practices. Selection of right type of variety is most important factors for maximizing rice production. Yield of rice changes due to growing environment, such as different locations, seasonal fluctuations, different dates of planting *etc*. (Sarker, 2002). It is, therefore, to evaluate the performance of aromatic rice varieties through appropriate cultural practices to get maximum yield and quality.

Materials and Methods

The experiment was conducted at the Hajee Mohammad Danesh Science and Technology University Farm, Dinajpur, Bangladesh during *aman* season (July-December) of 2007.The experimental site was a medium high land with loamy soil having slightly acidic in reaction. The experiment was laid out in a randomized complete block design with four replications. Locally popular ten aromatic rice varieties namely, Kataribhog (Philippines), Kataribhog (Deshi), Badshabhog, Chinigura, Radhunipagal, Kalizera, Zirabhog, Madhumala, Chiniatab and Shakhorkora seeds were collected from progressive farmers of different aromatic rice growing areas of Bangladesh. The unit plot size was 4.0m x 2.5m. The plot were uniformly fertilized as per recommendation with urea, TSP, MP, gypsum and zinc sulphate at the rate of 120,50,60,45 and 3 kg ha^{-1} as source of N, P_20_5, K_20, S and Zn, respectively. All P, K, S and Zn fertilizers were applied as basal dose during final land preparation. Urea was top dressed in two equal splits at 20 and 45 days after transplanting. All the cultural practices were done as and when necessary. The 30 days old seedlings were transplanted at 25cm x 20cm spacing using 3 seedlings per hill. Five hills from each plot were taken out randomly to record yield contributing attributes and the whole plots harvested to obtain grain and straw yield. After drying, required of grain samples of appropriate sizes from each plot were taken randomly to record quality parameters. Samples were milled raw and analyzed for milling and physicochemical properties. Milled rice outturn was determined by dehulling 200g rough rice in a Satake Rice Mill, followed by 75 second polishing in Satake Grain Testing Mill TM-05. Head rice outturn was determined by separating broken rice by hand. Milled rice outturn and head rice outturn were expressed as percentage of rough and milled rice respectively. Grain length and breadth were measured by digital slide calipers. Amylose content was determined by procedure of Juliano (1971). Protein content was calculated from nitrogen and it was determined by the micro Kjeldahl method (AOAC, 1970). Aroma of cooked rice was tested by the procedure of IRRI (1971).Volume of cooked and milled rice was measured by water displacement. Data were analyzed

following the ANOVA technique and mean differences were adjudged with Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effect of variety on the yield contributing attributes and yield:

Variety exhibited significant influence on the yield contributing characters and yield of aromatic rice (Table 1). Plant heights at maturity of the tested varieties showed significant variation. Highest plant height (165.8cm) was observed in Chinigura and the lowest (137.1cm) in Chiniatab. Lodging of local aromatic rice varieties at maturity stage was observed due to higher plant height. These may be due to genetic characteristics of the varieties. Results showed that the total number of tillers hill^{-1} ranged from 8.8 to 12.5. Maximum number tillers hill^{-1} (12.5) was obtained from Chinigura and it was identically followed by Radliunupagal. The highest number of fertile tillers hill^{-1} (10.5) was found in Badshabhog, which was statistically similar to Kataribhog (Philippines), Chinigura and Radhunipagal. The maximum panicle length (25.4cm) was obtained from Kataribhog (Deshi) that was statistically similar to Chiniatab. The minimum panicle length (20.7cm) was recorded from Kataribhog (Philippines). This variation might be due to heredity that was directly related genetic characteristics of varieties. Similar result was recorded by ldris and Motin (1990).The maximum number of spikelets per panicle (154.5) was observed in Badshabhog and the minimum (93.3) was obtained from Madhumala. The highest number of grains panicle^{-1} (136.8) was observed in Badshabhog and the lowest number of grains panicle^{-1} (78.1) was counted from Kataribhog (Deshi). It was observed that short bold type (small) grains densely arranged higher number in a panicle. The number of grains per panicle is the most important criteria of high yield in rice cultivars (Venkateswaslu *et al.*, 1986).The highest 1000 grains weight (15.18g) was found in Kataribhog (Deshi) and the lowest (10.2g) in Zirabhog, and Chiniatab. Among, the ten aromatic rice varieties the highest grain yield (3.2 t ha^{-1}) was obtained from Kataribhog (Philippines) that was statistically similar to Badhabhog. Kataribhog (Philippines) gave higher yield due to higher numbers fertile tillers per hill and higher individual seed weight whereas Badshabhog due to higher number fertile tillers and grains per panicle. The lowest grain yield (1.68 t ha^{-1}) was obtained from Shakhorkora under Dinajpur conditions. The highest straw yield (8.5 t ha^{-1}) was obtained from Chinigura due to higher plant height and total tillers hill^{-1}.

Table 1. Yield and yield contributing attributes of ten local aromatic rice varieties of Bangladesh

Treatment (Variety)	Yield and yield contributing attributes								
	Plant height (cm)	Total tillers hill^{-1}	Fertile tillers hill^{-1}	Panicle length (cm)	Spikelets Panicle^{-1}	Grains Panicle^{-1}	1000-grain weight(g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
V_1	159.3b	9.5b	9.0a-c	20.7e	108.5e	100.8d	15.18a	3.2a	7.23c
V_2	142.1ef	9.3b	8.5b-c	25.4a	86.82	78.1e	13.98b	2.3ef	4.217
V_3	144.4e	10.3b	10.5a	21.8d	154.5a	136.8a	10.68e	3.1ab	7.9b
V_4	165.8a	12.5a	10.3ab	22.8c	134.5c	125.3b	10.80e	2.6cd	8.5a
V_5	148.4d	12.Oa	9.0a-c	21.3d	147.1 b	124.3b	11.5d	2.8bc	8.4a
V_6	150.7cd	9.8b	8.5bc	23.1 c	147.8b	121.8b	12.4c	2.4dc	5.5d
V_7	138.0gh	9.3b	7.5c	23.7b	120.3d	108.2c	10.18f	2.2cf	4.4f
V_8	140.2	8.8b	8.3c	23.2bc	93.3E f	80.5e	11.25d	1.9g	4.5ef
V_9	137.1h	10.3b	7.8c	25.2a	106.3e	99.1 d	10.2f	2.2f	4.1 f
V_{10}	151.6c	8.8b	8.Oc	23.3bc	121.0d	110.8c	12.15c	1.71h	4.8e
Level of significanc	0.01	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.01
CV(%)	1.22	11.89	13.99	1.76	3.14	3.81	2.31	7.20	3.88

Figures in a column followed by different letter (s) differ significantly but common letter (s) do not differ significantly at 5% level of probability as adjusted by DMRT. V_1= Kataribhog (Philippines), V2= Kataribhog (Deshi), V_3= Badshabhog, V_4= Chinigura, V_5= Radhunipagal, V_6=Kalizira, V_7=Zirabhog, V_8=Madhumala, V_9=Chiniatab, V_{10}=Shakhorkora.

Effect of variety on the grain quality parameters:
All the grain quality parameters were significantly influenced by variety (Table 2). Milling outturn ranged from 70.0- 72.1% among the tested varieties. The highest milling outturn (72.1%) was recorded in Zirabhog. Zirabhog gave the highest head rice outturn (69.5%) and it was statistically similar to Badshabliog and Chiniatab. Head rice outtum was dependent on grain size and shape, moreover it is a varietals characteristic (Ferdous *et al.*, 2004). Grains of short to medium length usually, but not always, break than long grains during milling. Highest grain length (5.2mm) and length breadth ratio (2.3) was obtained from Kataribhog (Philippines).The grain elongation of the tested varieties varied from 1.9-2.1. Maximum volume expansion ratio (4.1) was observed in Kataribhog (Philippines). Grain protein content ranged from 7.1 to 6.5% in brown rice among the tested varieties. Highest protein content (7.1 %) was obtained from Zirabhog that was identical to Badshabhog, Chiniatab and Chinigura. Amylose content of the tested varieties varied from 23.5-24.7%. All tested varieties was intermediate type. Intermediate amylose (20-25%) rice is the preferred type in most of the rice growing areas in the world (Mannan, 2005). The cooking time of the tested varieties varied from 12.0-16.0 minutes. The highest cooking time (16.0 min.) was required for cooking of Kataribhog (Philippines). The cooking time of rice depends on coarseness and gelatinization temperature of the grain (BRRI, 2004). Aroma intensity differed due to variety. The variety Kalizera, Badshabhog contained higher level of aroma among the tested varieties, while, rests of the varieties had moderate type aroma. The result agreed with the earlier findings of Tsuzuki *et al.* (1977).
It is concluded that among the tested aromatic rice varieties under Dinajpur conditions, kataribhog (Philippines) and Badshabhog are suitable in respect of yield. Kataribhog is preferred due to its medium size and short bold Badshabhog is suitable in respect of higher head rice outturn, protein content and strong aroma.

Table 2. Quality performances of ten local aromatic rice varieties of Bangladesh

Treatment (Variety)	Quality parameters									
	Milling outturn (%)	Head rice outturn (%)	Grain length (mm)	Length: breadth	Grain elong-ation ratio	Volume expansion ratio	Protein (%)	Amylose (%)	Cooking time (min.)	Aroma intensity
V_1	71.1a-c	66.3d	5.2a	2.3a	1.9c	4.1a	6.5d	24.6ab	16.0a	Moderate(++)
V_2	71.8ab	66.8c	4.9b	2.5b	1.9c	3.8b	6.6cd	24.3bc	14.3b	Moderate(++)
V_3	71.3ab	68.3ab	3.7e	2.2c	2.1 a	3.6b-d	6.8ab	23.6e	12.0de	Strong(+++)
V_4	70.c	67.3b	3.7e	2.1c	2.0a-c	3.7bc	7.0a	23.5e	13.0cd	Moderate(++)
V_5	71.0a-c	67.0b	3.7e	2.1c	2.0bc	3.5cd	6.7bc	24.7a	13.8bc	Moderate(++)
V_6	71.3ab	67.2b	3.8cd	2.0c	2.1 a	3.8b	6.5cd	24.6ab	12.0e	Strong(+++)
V_7	72.1 a	69.5a	3.8cd	2.1c	2.0bc	3.5d	7.1a	24.23cd	12.3de	Moderate(++)
V_8	70.8bc	67.5b	3.7e	2.2c	1.9bc	3.5d	6.7bc	24.0d	12.3de	Moderate(++)
V_9	7I.0a-c	69.1ab	3.6e	2.1c	1.9bc	3.7b	7.0a	24.6ab	12.5de	Moderate(++)
V_{10}	70.0c	67.3b	3.9c	2.0c	2.0ab	3.7b	6.6b-d	24.4a-c	12.3de	Moderate(++)
Level of significance	0.05	0.01	0.01	0.01	0.05	0.01	0.01	0.01	0.01	
CV (%)	1.05	1.50	2.29	3.12	4.55	2.91	1.93	0.80	5.56	

Figures in a column followed by different letter (s) differ significantly but common letter (s) do not differ significantly at 5% level of probability as adjusted by DMRT. V_1= Kataribhog (Philippines), V2= Kataribhog (Deshi), V_3= Badshabhog, V_4= Chinigura, V_5= Radhunipagal, V_6=Kalizira, V_7=Zirabhog, V_8=Madhumala, V_9=Chiniatab, V_{10}=Shakhorkora.

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