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Grain Quality Assessment of Scented and Non Scented Rice Varieties under Organic Nutrient Management

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A B S T R A C T

Global demand for organically grown foods is increasing and organic agriculture is growing fast in recent years. Organic farming encourages the reduction of agrochemicals and promotes soil conservation principles. Field experiment was conducted at Krishi Nagar, Research Farm, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (MP) during *kharif* season 2018. Experiment was carried out using randomized complete block design involving twelve scented and non scented rice (*Oryza sativa* L.) varieties with three replications. An improved scented varieties *viz.*, Pusa Sugandha 5, Pusa Sugandha 4, Pusa Sugandha 3, Pusa Basmati 1, Madhumati & Sahyadri and non scented varieties *viz.*, BVD 109, JR 201, Dhanteshwari, IR 36, MTU 1010 & IR 64 were included as a test variety. A uniform dose of organic manures *i.e.* 1/3rd Nitrogen through each of Farm yard manure, Neem cake and Vermicompost were applied to all the varieties. Results of the study revealed that Pusa Sugandha 3 has recorded significantly higher grain yield (3298 kg ha^{-1}) among all the varieties. Pusa Sugandha 5 recorded maximum Physico-chemical quality parameters *viz.*, Paddy length- breadth ratio (5.21), Milled rice L: B ratio (7.23), Hulling per cent (76.80%), Milling per cent (67.90%), Head Rice Recovery (59.94%), Alkali spreading value (6.67) and Elongation ratio (1.95) fallowed by Pusa Sugandha 4 and Pusa Sugandha 3. The minimum grain quality parameters were recorded in non scented rice varieties.

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops of the world, grown in different areas over the world. It is grown in more than hundred countries, with a total area of 158 million hectares, producing more than 700 million tonnes (MT) annually. India is not only a leading consumer of rice crop but also its second largest producer in the world (115.60 million tonnes), lagging behind only China. In India total area under rice cultivation is 43.86 million ha. and rice is grown in almost half the states, with West Bengal leading the way in terms of production with 15.75 million tonnes, followed by Uttar Pradesh (12.22 million tonnes) and Punjab (11.57 million tonnes) as per the Agricultural Statistics 2018-19, Ministry of Agriculture & Farmers Welfare of the Government of India. In Madhya Pradesh, rice is grown in around 2.02 million ha area with the production of 3.58 MT and with average yield of 1768 kg/ha (Agriculture research data book, 2017*).* India has earned more than Rs 18,000 crore foreign exchange per year from the export of basmati rice; especially from the variety Basmati rice developed by the country's top agri-institute ICAR. Organic farming is gaining momentum during recent times due to awareness of people towards environment and food safety. Production of high quality organic aromatic rice by the farmers for domestic as well as export purpose is a major concern of future agricultural strategy. Organic food markets in India are expanding quite fast owing to growing demand for organic food and the high premium it fetches (Patnaik, 1996). Basmati and fine grain aromatic rice have tremendous export value. Organic and inorganic produce differ in quality parameters (Artur and Kjellenberg, 1997; Bourn and Prescott, 2002; Wszelaki *et al.,* 2005). Basmati rice commands high premium in market due to its exclusive nature and quality traits such as linear kernel elongation with least breadth-wise swelling, intensity of aroma, fluffiness, palatability and longer shelf life. Scented rice has a special place in the world rice market and is generally the highest priced rice (Efferson, 1985). Aromatic rice has great potential to attract rice consumer for its taste and deliciousness, and high price to boost up the economic condition of the rice grower in the country. Because of its natural chemical compounds which give it a distinctive scent or aroma when cooked, aromatic rice commands a higher price than non- aromatic rice. (Singh *et al.,* 2001). Kernel shape and L/B ratio are important features for grain quality assessment (Rita and Sarawgi, 2008). Aroma, hardness and roughness are depends on temperature and variety specific which affects the sensory properties of cooked rice (Yau and Huang, 1996) The present investigation was therefore, undertaken to Grain quality assessment of scented and non scented rice varieties under organic nutrient management.

Materials and Methods

The experiment was conducted at Krishi Nagar, Research Farm, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (MP) during *kharif* season 2018. The soil of the experimental site was neutral in reaction (pH 7.27) with normal EC (0.36 dS m^{-1}), medium in OC contents (0.84%), low in available N (267.83 kg ha^{-1}), medium in available P (12.96 kg ha^{-1}), and medium in available K (300.03 kg ha^{-1}) contents. The rainfall was less 1092.10 mm and other weather conditions were normal for better growth and development of the crop. The treatments consisted of twelve varieties of rice were divided into two groups scented and non scented. Scented varieties *viz.,* Pusa Sugandha 5, Pusa Sugandha 4, Pusa Sugandha 3, Pusa Basmati 1, Madhumati & Sahyadri and non scented varieties *viz.,* BVD 109, JR 201, Dhanteshwari, IR 36, MTU 1010 & IR 64 were tested in randomized block design with

three replications. A uniform dose of organic manures *i.e.* 1/3rd N through each of FYM, Neem cake and Vermicompost and rock phosphate were applied to all varieties. Organic manures were applied based on their nutrient content and incorporated two weeks before planting. Twenty days old seedlings were transplanted on 10th July 2018 by using of two seedlings per hill with the planting geometry of 20 cm x 20 cm. Weeds were controlled by two hands weeding at 20 and 40 days after transplanting (DAT).Yield parameters were recorded along with grain and straw yield. Quality tests of grain *viz.*, length and breadth of paddy, brown rice and milled rice, hulling, milling and head recovery were done by using a composite sample in thrice replication. The observations were recorded and techniques were employed in present investigation are summarized as under:

The length and breadth of ten randomly selected paddy, brown rice and milled rice kernels were measured with the help of a graph paper or screw gauge. Average of length and breadth was taken in millimeters and Length- Breadth ratio (L: B ratio) was calculated (Dela Cruz and Khush, 2000).

Hulling percentage

The mud lumps, rice stems, leaves and other foreign matter from the sample were removed and then 100 g of grain sample was weighed. The clean sample was shelled with the Satake Sheller. The samples were hulled and weights of de-hulled grains were recorded. The formula is as follows Hulling percentage-

$$= \frac{\text{weight of brown rice(g)}}{\text{weight of paddy(g)}} \times 100$$

Milling percentage

The hulled samples were milled and weight of milled grains was recorded. The formula is as follow;

Milling percentage

$$= \frac{\text{weight of milled rice(g)}}{\text{weight of paddy(g)}} \times 100$$

Head rice recovery percentage

After milling the whole and broken grains were separated. The per cent of head rice or unbroken rice grain were determined based on the initial weight of the rough rice per cent of total rice or sum total of head rice and all classes of broken rice. The formula is as follow

Head rice recovery percentage

$$= \frac{\text{Weight of head polished rice(g)}}{\text{Weight of milled rice(g)}} 100$$

Determination of aroma

Aroma content was estimated by using method developed by IRRI (1971) and subsequently improved by Sood and Siddiq (1978).

The method consists of adding about 10 ml of 1.7 per cent potassium hydroxide solution to a small petri plate containing about 2 g finely minced sample of grain. Then petri plates are covered immediately after addition of alkali and left at room temperature for about 10 minutes. The plates are then opened and the contents smelled. The samples possessing the scent as one could easily feel, produce a sharp and readily recognizable aroma.
SS = strongly scented; MS = mild scented; NS = non scented

Alkali spreading value (Gelatinization temperature)

The Gelatinization temperature was measured in terms of alkali disintegration using a (7) point numerical spreading scale as suggested

by Little *et al.,* (1958). Six milled rice kernels were evenly placed in Petridis containing 1.7 per cent 10 ml KOH solution at 30 ±1°C for 23 hours and the scoring was recorded.

Elongation ratio

Elongation ratio (ER) of cooked kernels was determined by dividing the length of cooked kernel to length of uncooked kernel (Juliano and Betchel, 1985). This was calculated by the following formula:

Elongation ratio

$$= \frac{\text{Length of cooked kernel (mm)}}{\text{Length of raw kernel (mm)}}$$

Data collected and recorded from various observations were tabulated and subjected to their statistical analysis as per the procedure suggested by Panse and Sukhatme (1967).

Results and Discussion

Data pertaining to grain quality parameters were presented in table 1. Among the different varieties, paddy length was widely ranged from 12.33 to 6.33 mm. The significantly highest paddy length (12.33 mm) measured in the Pusa Sugandha 5 which was significantly superior over other varieties of rice. The lowest paddy length (6.33 mm) was measured for the variety JR 201. Paddy breadth of rice varieties there were no significant difference among the all varieties. Paddy length- breadth ratio (L: B ratio) varied significantly for different rice varieties and ranged from 5.21 to 2.33. Pusa Sugandha 5 calculated significantly highest L: B ratio (5.21) which was at par with Pusa Sugandha 4 and Pusa Sugandha 3. The lowest L: B ratio (2.33) was calculated under variety JR 201.

The length and breadth of dehulled rice of all the varieties were measured (Table 1) and brown rice length ranged from 8.53 to 5.63 mm. Brown rice L: B ratio of different rice varieties greatly varied from 4.59 to 2.37.

The length and breadth of white rice (milled rice) of all the varieties were measured, length ranged from 7.23 to 4.87 mm amongst the varieties. The significantly highest milled rice length (7.23 mm) measured in the Pusa Sugandha 5 which was significantly superior over other varieties of rice except Pusa Sugandha 4 and Pusa Sugandha 3. The lowest milled rice length (4.87 mm) was measured for the variety JR 201. L: B ratio of different milled rice varieties greatly varied from 4.16 to 2.25 with highest value (4.16) for Pusa Sugandha 5 which was at par with Pusa Sugandha 4 (3.92) and Pusa Sugandha 3 (3.77). The lowest value of milled rice L: B ratio was calculated in JR 201 (2.25).

Data on hulling percentage are presented in table 2. All the varieties had average 72.90 (%) hulling percent and ranged from 76.80 to 66.63 per cent for different rice varieties. The highest hulling percentage was calculated in Pusa Sugandha 5 (76.80%) which was at par with Pusa Sugandha 4, Pusa Sugandha 3, Dhanteshwari, Madhumati and Pusa Basmati 1.

The lowest hulling percentage was calculated in Sahyadri (66.63%). Variation in hulling percentage may be due to differences in genetic potential and moisture content. Similar findings have also been reported by Subudhi *et al.,* (2012).

Table.1 Physical quality parameters of scented and non scented rice varieties under organic nutrient management

T. No.	Varieties	Paddy grain			Brown rice			Milled rice		
		Length (mm)	Breadth (mm)	L: B ratio	Length (mm)	Breadth (mm)	L: B ratio	Length (mm)	Breadth (mm)	L: B ratio
T_1	Pusa Sugandha 5	12.33	2.37	5.21	8.53	1.87	4.59	7.23	1.75	**4.16**
T_2	Sahyadri	7.47	2.33	3.21	6.03	2.03	3.01	5.17	1.85	**2.84**
T_3	Pusa Sugandha 4	11.50	2.38	4.84	7.83	1.87	4.20	6.83	1.75	**3.92**
T_4	BVD 109	8.00	2.37	3.39	6.57	2.00	3.32	5.63	1.82	**3.13**
T_5	JR 201	6.33	2.73	2.33	5.63	2.37	2.37	4.87	2.19	**2.25**
T_6	Dhanteshwari	7.27	2.13	3.40	6.60	1.90	3.47	5.63	1.72	**3.27**
T_7	Madhumati	8.00	2.40	3.34	7.27	2.03	3.57	6.43	1.85	**3.47**
T_8	IR 36	7.33	2.30	3.19	6.13	2.00	3.07	5.20	1.84	**2.83**
T_9	MTU 1010	8.23	2.27	3.64	6.83	2.00	3.43	6.30	1.84	**3.43**
T_{10}	IR 64	8.00	2.40	3.34	6.33	2.07	3.06	5.40	1.89	**2.86**
T_{11}	Pusa Basmati 1	8.33	2.40	3.55	7.27	2.07	3.55	6.23	1.95	**3.22**
T_{12}	Pusa Sugandha 3	11.33	2.38	4.78	7.72	1.89	4.08	6.67	1.77	**3.77**
	SEm±	**0.47**	**0.11**	**0.27**	**0.29**	**0.09**	**0.20**	**0.26**	**0.09**	**0.18**
	CD (P=0.05)	**1.39**	**-**	**0.79**	**0.85**	**-**	**0.59**	**0.77**	**-**	**0.53**

Table.2 Physico-chemical parameters of scented and non scented rice varieties under organic nutrient management

T.No.	Varieties	Hulling (%)	Milling (%)	Head rice recovery (%)	Alkali spreading value	Elongation ratio	Grain yield (kg ha^{-1})
T_1	Pusa Sugandha 5	76.80	67.90	59.94	6.67	1.95	**3082**
T_2	Sahyadri	66.63	59.31	51.82	4.67	1.78	**2691**
T_3	Pusa Sugandha 4	75.73	67.39	56.99	5.67	1.94	**2986**
T_4	BVD 109	67.13	64.39	51.66	4.67	1.77	**2916**
T_5	JR 201	71.17	63.71	52.63	4.33	1.74	**2750**
T_6	Dhanteshwari	75.10	60.07	53.66	1.33	1.74	**2796**
T_7	Madhumati	75.03	65.14	52.46	1.67	1.80	**2535**
T_8	IR 36	71.13	64.02	48.64	2.00	1.51	**2774**
T_9	MTU 1010	73.80	62.92	52.05	1.67	1.68	**2845**
T_{10}	IR 64	72.57	62.91	49.07	1.67	1.44	**2786**
T_{11}	Pusa Basmati 1	74.27	63.98	52.24	5.67	1.74	**2823**
T_{12}	Pusa Sugandha 3	75.40	66.69	54.06	4.67	1.81	**3298**
	SEm±	**1.20**	**0.12**	**1.45**	**0.33**	**0.07**	**37.23**
	CD (P=0.05)	**3.53**	**0.36**	**4.26**	**0.98**	**0.19**	**109.74**

Milling percent of all rice varieties (Table 2) differed significantly and ranged between 67.90(%) to 59.31(%) among the varieties. Significantly highest milling percentage was calculated in Pusa Sugandha 5 (67.90%) followed by Pusa Sugandha 4.

The lowest milling percentage was calculated in Sahyadri (59.31%). The head rice recovery of the varieties was calculated in table 2 and it was clear that all the rice varieties showed a significant difference with each other in terms of head rice recovery.

Maximum head rice recovery (59.94%) was calculated in Pusa Sugandha 5 whereas minimum head rice recovery calculated in IR 36 (48.64%).

Variation in head rice recovery in different varieties is closely related with moisture content and force of the milling machine. Similar results were recorded by Babu *et al.*, (2013).

Aroma in rice was influenced by genetic character of variety and it is a very important character judging rice quality around the world. Characteristics pertaining to aroma in rice quality of scented rice varieties it was observed that only three varieties are strongly scented class of aroma and those were Pusa Sugandha 5, Pusa Sugandha 4 along with Pusa Sugandha 3, three varieties are mildly scented *viz.*, Pusa Basmati1, Madhumati and Sahyadri whereas, rest of the rice varieties were found to be non scented *viz.*, BVD 109, JR 201, Dhanteshwari, MTU 1010, IR 64 and IR 36. Nadaf *et al.*, 2007 reported that Basmati rice contains more aroma than the traditionally cultivated scented rice varieties.

Gelatinization temperature (GT) of rice is measured in terms of alkali spreading value (ASV). The data on alkali spreading value are presented in Table 2.

It ranged from 1.33 to 6.67. Pusa Sugandha 5 scored the highest alkali spreading value (6.67) which was found to be significantly superior over rest of the varieties except Pusa Sugandha 4 and Pusa Sugandha 3.

All the twelve rice varieties significantly varied with each other in length and breadth of rice kernel after cooking. Elongation ratio of different rice varieties (Table 2) ranged from 1.44 to 1.95. Pusa Sugandha 5 calculated the highest elongation ratio (1.95) closely followed by Pusa Sugandha 4, Pusa Sugandha 3 and Madhumati. The least elongation ratio was calculated in IR 64 (1.44) which was comparable with IR 36 (1.51). The results of the present investigation unveil that evolved scented varieties were better than non scented varieties. Pusa Sugandha 3 proved better as compared to Pusa Sugandha 5 and Pusa Sugandha 4 especially in terms of grain yield. Pusa Sugandha 5 and Pusa Sugandha 4 varieties were mostly superior in quality parameters to non scented varieties. Hence, using easily available local natural resources, organic farming can be practiced with a view to protect/preserve/safe guard our own natural resources and environment for a fertile soil, healthy crop and quality food and let our future generations enjoy the benefits of non-chemical agriculture.

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