PERFORMANCE OF AROMATIC RICE VARIETIES AS INFLUENCED BY SPACING

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ABSTRACT

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An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during July to December 2001 to investigate the influence of spacing on the qualitative characters of aromatic rice. The experiment comprised of three varieties namely V_1: Kalizira, V_2: Badshabhog and V_3: Tulshimala and four different spacing viz., S_1: 8 cm × 25 cm, S_2:12 cm × 25 cm, S_3:16 cm × 25 cm and S_4:20 cm × 25 cm. Among three varieties Kalizira was found significantly superior to Tulshimala and Badshabhog with respect to nitrogen content, protein and aroma of grain. Quality of aromatic rice increase with increasing spacing up to 20 cm × 25 cm. Experimental result revealed that the variety Kalizira may be grown following 20 cm × 25 cm spacing for getting better quality of aromatic rice.

Key words: Spacing, performance of aromatic rice, qualitative characters

INTRODUCTION

Spacing is the key factor that needs to be considered for transplant *aman* (T.aman) rice. The growth and development of T *aman* rice are greatly influenced by plant spacing. Optimum plant density ensures the plants to grow properly with their both aerial and under ground parts through efficient utilization of solar radiation and nutrients (Miah *et al*., 1990). In densely populated rice, the inter-plant competition is very high usually results in mutual shading, lodging and thus favors more straw yield than grain yield. Wider spacing can produce more tillers when soil water and nutrient are sufficiently available. As the tiller production in aromatic rice is very low and most of them are low yielding. The maximum benefit can be derived from rice, if the crop is properly spaced. In Bangladesh, rice dominates over all other crops and covers 75% of the total cropped area (Rekabdar, 2004) of which around 27% is occupied by fine rice varieties (BBS, 2003).

Consumer demand for the fine rice varieties is high due to its good nutritional quality, palatability and due to special flavor and test aromatic rice is highly favored. Bangladesh produces several fine aromatic rice varieties with excellent eating qualities for regular consumption as steamed rice as well as for *polau, biryani, jarda, khir, finny* type preparations which are served on special occasions. Basmati rice of India and Pakistan is well known in the world market whereas Bangladeshi aromatic rice is virtually unknown due to insufficient production and lack of storage trade linkage (Das and Baqui, 2000). In the near future, there is a possibility that Bangladesh may export aromatic rice, but the competition in terms of quality and price would be very stiff in the world market (World Bank, 1995). So, it is essential to find out the suitable spacing for the aromatic rice varieties to get better quality.

MATERIALS AND METHODS

The research work was carried out at the agronomy field laboratory, Bangladesh Agricultural University, Mymensingh during the period from July to December 2001 (*Amon* season). The experimental plot was a medium high land with silt loam soil having a pH value of 6.4 and having 1.29% organic matter. Four spacing viz., 8 cm x 25 cm, 12 cm x 25 cm, 16 cm x 25 cm and 20 cm x 25 cm were included in the experiment. Three aromatic rice varieties namely, Kalizira, Tulshimala and Badshabhog were used as experimental crop. The experiment was laid out in a split-plot design while varieties in the main plot and spacing in sub plot with three replications. The unit plot was 4.0m x 2.5m. Urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied at the rate of 100, 50, 60, 35 and 5 kg ha^{-1}, respectively. One-third urea and whole amount of other fertilizer were applied at final land preparation. The rest of the urea was top dressed in two equal splits, at 25 and 50 days after transplanting (BRRI, 2001). Thirty-six days old seedlings were transplanted in the experimental plot with three seedlings per hill on 12 August 2001. All intercultural operations were done as when necessary. The crop was harvested on 12 December 2001, at full maturity. Grain and straw samples from each plot were taken and separately oven dried at 65^0C over night to grind in a grinding machine. Total nitrogen content determine by Micro-kjeldahl method. The nitrogen percentage was collected by the following formula with the help of titration value

$$\text{Nitrogen} = \frac{0.14 \times \text{Normality of HCl}\,(0.01) \times 75 \times 100 \times \text{V}}{10\text{W (g)}} = 0.105\,\frac{\text{V}}{\text{W (g)}}$$

Where,

V = Final volume of HCl.
W = Weight of sample (g)

After determination of nitrogen in both rice grain and straw, nitrogen uptake by both rice grain and straw and total nitrogen uptake were determined by the following formula

$$\text{Nitrogen uptake by grain (kg ha}^{-1}) = \frac{\%\ \text{N in grain} \times \text{Grain yield (kg ha}^{-1})}{100}$$

$$\text{Nitrogen uptake by straw (kg ha}^{-1}) = \frac{\%\ \text{N in grain} \times \text{Straw yield (kg ha}^{-1})}{100}$$

Protein content of the grain was determined by multiplying the nitrogen content of grain by 6.25. For germination test, seeds were placed on the Petridish following the rules and procedures of ISTA (ISTA, 1976). The vigor index was calculated by counting the number of normal seedlings 7 days of setting the test up to 14 days after placement of seed and using the following formula:

$$\text{Vigour index} = \frac{\text{No. of seed germinated at first count}}{\text{Duration of first count}} + - - - + \frac{\text{No. of seed germinated at last count}}{\text{Duration of last count}}$$

Aroma of rice was detected by olfactory test by taking smell following the method developed by Nagaragu *et al.* (1991). Cooking time of rice was described by Juliano *et al.,* 1969. The collected data were analyzed following the ANOVA-technique and the mean differences were adjudged with Duncan's Multiple Range Test using a statistical computer package MSTAT.

RESULTS AND DISCUSSION

Effect of Variety

Variety showed significant influence on nitrogen content, nitrogen uptake, protein and aroma of grain. Kalizira grain contained the highest nitrogen content (1.45%) and protein (8.62%). The lowest nitrogen content (1.43%) and protein (8.50%) were recorded from Badshabhog which was statistical similar to Tulshimala. This result was consistent to Dutta *et al.* (1998), who recorded variable nitrogen content and protein percentage among varieties. Varietals differences regarding the nitrogen content and percentage of protein were probably due to their differences in genetic make-up. Table 1 showed that the highest nitrogen uptake (41.82%) was recorded from Badshabhog while the lowest value (33.92%) was recorded from Kalizira. The highest aroma (3.26) was recorded from Kalizira and the lowest aroma (1.28) was recorded from Badshabhog. Varietals differences regarding aroma might be due to their difference in genetic make-up. Dutta *et al.* (1998) reported that aroma varied among the varieties. Variety had no significant effect on germination, vigour index and cooking time of grain and nitrogen content of straw.

The nitrogen uptake of straw was significantly affected by variety. Table 1 indicated that maximum nitrogen uptake of straw (34.28 kg ha^{-1}) was recorded from Tulshimala and the minimum nitrogen uptake of straw (31.21 kg ha^{-1}) was recorded from Kalizira.

Table 1 Effect of variety on qualitative characters of aromatic rice

Variety	Grain							Straw	
	Nitrogen content (%)	Nitrogen uptake (kg ha^{-1})	Protein (%)	Germination (%)	Vigour index	Aroma (numerical)	Cooking time (min)	Nitrogen content (%)	Nitrogen uptake (kg ha^{-1})
V_1: Kalizira	1.45a	33.92c	8.62a	86.55	27.35	3.26a	14.25	0.49	31.21c
V_2: Badsshabhog	1.43b	41.82a	8.50b	86.87	27.58	1.28c	14.20	0.49	33.43b
V_3: Tulshimala	1.44b	37.91b	8.57b	86.32	27.63	2.16b	14.55	0.49	34.28a
SE(±)	0.0031	0.1687	0.015	-	-	0.0457	-	-	0.0301
Level of significance	0.01	0.01	0.01	NS	NS	0.01	NS	NS	0.01

In a column, figures bearing same or no letter (s) do not differ significantly at 5% level of significance by Duncan's Multiple Range Test, NS=Not significant

Effect of spacing

The result revealed that all the parameters of plant studied were significantly influenced by spacing except aroma and cooking time of grain. An increasing trend of nitrogen content, protein, germination and vigour index of grain

was found with increasing of spacing up to 20 cm × 25 cm. It might be due to absorption of more light, air and food material in wider spacing. The maximum nitrogen uptake (43.07%) was recorded from 16 cm × 25 cm spacing and the lowest nitrogen uptake (27.82%) was obtained from closest (8 cm × 25 cm) spacing. Nitrogen content and nitrogen uptake of straw was found to be highly responsive to spacing and had similar pattern as was found in grain.

Table 2 Effect of spacing on qualitative characters of grain and straw of aromatic rice

Spacing (cm×cm)	Grain							Straw	
	Nitrogen content (%)	Nitrogen uptake (kg ha^{-1})	Protein (%)	Germination (%)	Vigour index	Aroma (numerical)	Cooking time (min)	Nitrogen content (%)	Nitrogen uptake (kg ha^{-1})
S_1: 8×25	1.21d	27.82c	7.20d	82.46d	23.62d	2.18	14.72	0.34d	25.02d
S_2: 12×25	1.47c	40.51b	8.74c	86.11c	24.76c	2.20	14.48	0.47c	32.18c
S_3: 16×25	1.52b	43.07a	9.04b	87.52b	28.91b	2.31	14.15	0.53b	35.77b
S_3: 20×25	1.59a	40.13b	9.34a	89.69a	30.81a	2.27	14.10	0.61a	38.92a
SE(±)	0.0029	0.2224	0.0185	0.3608	0.1546	-	-	0.0007	0.0503
Level of Significance	0.01	0.01	0.01	0.01	0.01	NS	NS	0.01	0.01

In a column, figures bearing same or no letter (s) do not differ significantly at 5% level of significance by Duncan's Multiple Range Test, NS = Not significant

Interaction effect of Variety and Spacing

The Interaction effects of Variety and Spacing on different qualitative characters studied were highly significant except aroma and cooking time of grain (Table 3). The highest nitrogen content (1.58%) was given by V_1S_4 and V_3S_4. The lowest (1.20%) nitrogen content was recorded from V_3S_1. The maximum nitrogen uptake was obtained from V_2S_3 (46.63kgha^{-1}). The minimum nitrogen uptake was found by V_1S_1 (24.57kgha^{-1}). The highest protein percentage (9.54) was recorded from V_1S_4. The lowest protein percentage (7.15%) was obtained from V_3S_1 which was statistically similar with V_1S_1 and V_2S_1. The highest germination percent (90.09%) was recorded from V_1S_4 which was statistically similar to V_2S_4 and V_3S_4. The lowest of germination percent (82.04%) was obtained from V_1S_1which was statistically at par V_3S_1 and V_2S_1. The highest vigor index (31.21) was obtained at V_2S_4 which was statistically similar with V_1S_4. The lowest value (23.22) was recorded from V_1S_1 which was statistically similar with V_2S_1.

The highest nitrogen content of straw (0.62%) was recorded from V_2S_4 while the lowest value (0.34%) was recorded from V_1S_1 and V_3S_1. The highest nitrogen uptake of straw (40.67 kg ha^{-1}) was recorded from V_3S_4 and the lowest value (23.46 kg ha^{-1}) was recorded from S_1V_1.

Table 3 Effect of interaction of variety and spacing on qualitative characters of grain and straw of aromatic rice

Interaction (Variety × Spacing)	Grain							Straw	
	Nitrogen content (%)	Nitrogen uptake (kg ha^{-1})	Protein (%)	Germination (%)	Vigour index	Aroma (numerical)	Cooking time (min)	Nitrogen content (%)	Nitrogen uptake (kg ha^{-1})
V_1 S_1	1.21 h	24.57 h	7.23 f	82.04 d	23.22 f	3.03	14.60	0.34 h	23.46 k
V_1 S_2	1.46 fg	35.94 e	8.72 e	86.20 c	26.51 d	3.26	14.30	0.48 f	31.13 h
V_1S_3	1.54 c	38.54 d	9.18 c	87.87b c	28.59 c	3.42	14.12	0.55 c	34.33 e
V_1 S_4	1.58 a	36.53 e	9.54 a	90.09 a	31.08 a	3.35	14.00	0.61 b	35.93 d
V_2 S_1	1.21 h	32.24 f	7.23 f	82.81 d	23.41 f	1.43	14.40	0.35 g	26.42 I
V_2 S_2	1.47 f	44.52 b	8.78 e	86.09 c	26.60 d	1.20	14.30	0.47 f	31.44 g
V_2 S_3	1.50 e	46.63 a	8.92 d	86.99 bc	29.10 c	1.25	14.13	0.52 e	35.71 d
V_2 S_4	1.55 b	43.89 b	9.23 c	89.99 a	31.21 a	1.25	14.00	0.62 a	34.15 b
V_3 S_1	1.20 I	26.55 g	7.15 f	82.55 d	24.23 e	2.07	14.17	0.34 h	25.20 j
V_3 S_2	1.46 g	41.06 c	8.72 e	86.05 c	27.16 d	2.13	14.83	0.47 f	33.96 f
V_3 S_3	1.51 d	44.05 b	9.02 d	87.71 bc	29.03 c	2.26	14.20	0.53 d	37.27 c
V_3 S_4	1.58 a	39.97 c	9.41 b	88.98 ab	30.12 b	2.20	14.30	0.60 b	40.67 a
SE(±)	0.0049	0.3853	0.0320	0.6249	0.2678	-	-	0.0012	0.0871
Level of Significance	0.01	0.01	0.01	0.01	0.05	NS	NS	0.01	0.01

In a column, figures bearing same or no letter (s) do not differ significantly at 5% level of significance by Duncan's Multiple Range Test, NS = Not significant

CONCLUSION

The highest nitrogen content, protein, aroma was found in Kalizira then Tulshimala and Badshabhog. The spacing 20 cm × 25 cm produced significantly highest quality aromatic rice. Kalizira should be planted at 20 cm × 25 cm spacing for getting better quality products.

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