PERFORMANCE OF AROMATIC RICE VARIETIES AS INFLUENCED BY SPACING

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ABSTRACT


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 V1: Kalizira, V2: Badshabhog and V3: Tulshimala and four different spacing viz., S1: 8 cm × 25 cm, S2: 12 cm × 25 cm, S3: 16 cm × 25 cm and S4: 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 pola(, 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 × 25 cm, 12 cm × 25 cm, 16 cm × 25 cm and 20 cm × 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°C 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

\[
\text{Nitrogen} = \frac{0.14 \times \text{Normality of HCl}(0.01) \times 75 \times 100 \times V}{10W(g)} = 0.105 \frac{V}{W(g)}
\]
Where,
\[ V = \text{Final volume of HCl.} \]
\[ W = \text{Weight of sample (g)} \]

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 \textit{et al.} (1991). Cooking time of rice was described by Juliano \textit{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.

\section*{RESULTS AND DISCUSSION}

\subsection*{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 \textit{et al.} (1998), who recorded variable nitrogen content and protein percentage among varieties. Varietal 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. Varietal differences regarding aroma might be due to their difference in genetic make-up. Dutta \textit{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.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline
\textbf{V} & \textbf{Grain} & \textbf{Straw} & \textbf{Nitrogen content} & \textbf{Nitrogen uptake} & \textbf{Protein} & \textbf{Germination} & \textbf{Vigour index} & \textbf{Aroma} & \textbf{Cooking time} & \textbf{Nitrogen content} & \textbf{Nitrogen uptake} \\
& & & \textbf{(\%)} & \textbf{(kg ha}^{-1}) & \textbf{(\%)} & \textbf{(\%)} & \textbf{index} & \textbf{(numerical)} & \textbf{(min)} & \textbf{(\%)} & \textbf{(kg ha}^{-1}) \\
\hline
V1: Kalizira & 1.45 & 33.92 & 8.62 & 86.55 & 27.35 & 3.26 & 14.25 & 0.49 & 31.21 \\
V2: Badshabhog & 1.43 & 41.82 & 8.50 & 86.87 & 27.58 & 1.28 & 14.20 & 0.49 & 33.43 \\
V3: Tulshimala & 1.44 & 37.91 & 8.57 & 86.32 & 27.63 & 2.16 & 14.55 & 0.49 & 34.28 \\
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 \\
\hline
\end{tabular}
\caption{Effect of variety on qualitative characters of aromatic rice}
\end{table}

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

\subsection*{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

<table>
<thead>
<tr>
<th>Spacing (cm×cm)</th>
<th>Nitrogen content (%)</th>
<th>Nitrogen uptake (kg ha⁻¹)</th>
<th>Protein (%)</th>
<th>Germination (%)</th>
<th>Vigour index</th>
<th>Aroma (numerical)</th>
<th>Cooking time (min)</th>
<th>Nitrogen content (%)</th>
<th>Nitrogen uptake (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S₁: 8×25</td>
<td>1.21d</td>
<td>27.82c</td>
<td>7.20d</td>
<td>82.46d</td>
<td>23.62d</td>
<td>2.18</td>
<td>14.72</td>
<td>0.34d</td>
<td>25.02d</td>
</tr>
<tr>
<td>S₂: 12×25</td>
<td>1.47c</td>
<td>40.51b</td>
<td>8.74c</td>
<td>86.11c</td>
<td>24.76c</td>
<td>2.20</td>
<td>14.48</td>
<td>0.47c</td>
<td>32.18c</td>
</tr>
<tr>
<td>S₃: 16×25</td>
<td>1.52b</td>
<td>43.07a</td>
<td>9.04b</td>
<td>87.52b</td>
<td>28.91b</td>
<td>2.31</td>
<td>14.15</td>
<td>0.53b</td>
<td>35.77b</td>
</tr>
<tr>
<td>S₄: 20×25</td>
<td>1.59a</td>
<td>40.13b</td>
<td>9.34a</td>
<td>89.69a</td>
<td>30.81a</td>
<td>2.27</td>
<td>14.10</td>
<td>0.61a</td>
<td>38.92a</td>
</tr>
<tr>
<td>SE(±)</td>
<td>0.0029</td>
<td>0.2224</td>
<td>0.0185</td>
<td>0.1546</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0007</td>
<td>0.0503</td>
</tr>
</tbody>
</table>

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 V₁S₄ and V₃S₄. The lowest (1.20%) nitrogen content was recorded from V₁S₁. The maximum nitrogen uptake was obtained from V₂S₄ (46.63kg ha⁻¹). The minimum nitrogen uptake was found by V₁S₁ (24.57kg ha⁻¹). The highest protein percentage (9.54) was recorded from V₁S₄. The lowest protein percentage (7.15%) was obtained from V₃S₁ which was statistically similar with V₁S₁ and V₂S₁. The highest germination percent (90.09%) was recorded from V₂S₄ which was statistically similar to V₁S₁ and V₂S₁. The lowest of germination percent (82.04%) was obtained from V₁S₁ which was statistically at par V₃S₁ and V₂S₁. The highest vigor index (31.21) was obtained at V₂S₄ which was statistically similar with V₁S₄. The lowest value (23.22) was recorded from V₁S₁ which was statistically similar with V₂S₁.

The highest nitrogen content of straw (0.62%) was recorded from V₂S₄ while the lowest value (0.34%) was recorded from V₁S₁ and V₃S₁. The highest nitrogen uptake of straw (40.67 kg ha⁻¹) was recorded from V₃S₄ and the lowest value (23.46 kg ha⁻¹) was recorded from S₁V₁.

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

<table>
<thead>
<tr>
<th>Interaction (Variety × Spacing)</th>
<th>Grain</th>
<th>Straw</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nitrogen content (%)</td>
<td>Nitrogen uptake (kg ha⁻¹)</td>
</tr>
<tr>
<td>V₁S₁</td>
<td>1.21 h</td>
<td>24.57 h</td>
</tr>
<tr>
<td>V₁S₂</td>
<td>1.46 fg</td>
<td>35.94 e</td>
</tr>
<tr>
<td>V₁S₃</td>
<td>1.54 c</td>
<td>38.54 d</td>
</tr>
<tr>
<td>V₁S₄</td>
<td>1.58 a</td>
<td>36.53 e</td>
</tr>
<tr>
<td>V₂S₁</td>
<td>1.21 h</td>
<td>24.24 f</td>
</tr>
<tr>
<td>V₂S₂</td>
<td>1.47 f</td>
<td>44.52 b</td>
</tr>
<tr>
<td>V₂S₃</td>
<td>1.50 e</td>
<td>46.63 a</td>
</tr>
<tr>
<td>V₂S₄</td>
<td>1.55 b</td>
<td>43.89 b</td>
</tr>
<tr>
<td>V₃S₁</td>
<td>1.20 I</td>
<td>26.55 g</td>
</tr>
<tr>
<td>V₃S₂</td>
<td>1.46 g</td>
<td>41.06 c</td>
</tr>
<tr>
<td>V₃S₃</td>
<td>1.51 d</td>
<td>44.05 b</td>
</tr>
<tr>
<td>V₃S₄</td>
<td>1.58 a</td>
<td>39.97 c</td>
</tr>
<tr>
<td>SE(±)</td>
<td>0.0049</td>
<td>0.3853</td>
</tr>
</tbody>
</table>

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
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.

REFERENCES


