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Performance of aromatic rice varieties under different transplanting date in *aman* season

M.F. Hossain and M.S.I. Sikdar
Department of Agronomy, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh

Abstract: A field experiment was conducted to determine the optimum transplanting date to get maximum yield and quality of three local and two modern aromatic rice varieties of Bangladesh at the Hajee Mohammad Danesh Science and Technology University farm, Dinajpur, Bangladesh during *aman* season of 2005. The varieties Kataribhog, Radhunipagal, Badshabhog, BRRI dhan 34 and BRRI dhan 38 were transplanted from 15 July to 14 August with 10 day intervals. All the varieties gave the maximum grain yield when transplanted on 15 July. Among the aromatic rice varieties the highest grain yield was obtained from BRRI dhan 34 followed by Kataribhog and the lowest grain yield was obtained from Radhunipagal. Milling outturn (%), head rice outturn (%), grain elongation ratio and protein content (%) is affected by date of transplanting in T. *aman* season. The aromatic rice transplanted on 25 July to 14 August produced significantly better quality grain in terms of high milling outturn, head rice outturn, grain elongation ratio and protein content. Delayed transplanting increased the protein % in brown rice of aromatic rice. Among the varieties Badshabhog had the highest milling and head rice outturn.Grain length was higher in BRRI dhan38. Highest protein and amylose content were found in Radhunipagal and BRRI dhan34, respectively. Badshabhog was strong in aroma. Suitable transplanting time is 25 July to 14 August in *aman* season in respect of grain quality. Transplanting during 15-25 July gave the highest yield. Delayed transplanting improved some quality parameter but reduced the yield significantly in almost all varieties
Key word: Transplanting date, yield, grain quality, aromatic rice

Introduction

Aromatic rice varieties are rated best in quality and fetch much higher price than non-aromatic rice. The demands of aromatic rice for internal consumption and for export are increasing day by day (Das and Baqui, 2000). Most of the aromatic rice varieties in Bangladesh are traditional type photo-period sensitive and grown during *aman* season (Baqui *et al*, 1997). For selection of right type of variety, suitable date of transplanting is most important factors for maximizing rice production. Response to planting date varies with change in varieties for high yield. Yield of rice changes with environment, such as different locations, seasonal fluctuations, different dates of planting etc. (Sarker, 2002). Transplanting of *aman* rice generally started from mid July and continued through September and even early October (Ahmed, 1976). The yield of rice markedly declined with delayed planting time (Surender and Bucha, 1992; Mannan and Siddique, 1991). The information is limited on varietal response to date of planting particularly in respect of yield and quality of aromatic rice. Therefore, the present investigation was undertaken to study the effect of transplanting dates on the yield and quality of aromatic rice.

Materials and Methods

The experiment was conducted at Hajee Mohammad Danesh Science and Technology University farm, Dinajpur, Bangladesh during *aman* season of 2005. The experimental site was a medium high land with sandy loam soil having a pH value of 6.0. The experiment was laid out in a randomized complete block design with three replications. Four dates of transplanting were 15 July (D_1), 25 July (D_2), 4 August (D_3) and 14 August (D_4). Three local and two modern aromatic rice varieties namely, Kataribhog (V_1), Radhunipagal (V_2), Badshabhog (V_3), BRRI dhan34 (V_4) and BRRI dhan38 (V_5) were used in this study. The unit plot size was 4.0m x 2.5m. The unit plots were uniformly fertilized with urea, TSP and MP at the rate of 120, 50, 60 kg ha^{-1} as source of N, P and K, respectively. All P and K fertilizers were applied as basal dose during final land preparation. Urea was top dressed in 2 equal splits at 20 & 45 days after transplanting. All other cultural practices were done uniformly. Seedlings were grown in different seedbed stared from 15 June with 10 days intervals. The 30 day old seedlings were transplanted at a spacing of 20 cm X 15 cm using three seedlings $hill^{-1}$. At harvest, 10 hills from each plot were taken out randomly to record yield parameters. Whole plots were harvested to obtain grain yield. After drying, required of grain samples of appropriate sizes from each plot were taken randomly to record quality parameters.

Rice samples were milled raw and analyzed for physicochemical properties. Physical and chemical properties of grains were measured at Grain Quality and Nutrition Division laboratory, Bangladesh Rice Research Institute, Gazipur. Milled rice outturn was determined by dehulling 200g rough rice in a Satake Rice Mill, followed by 75 second polishing in a Satake Grain Testing Mill TM-05. Head rice outturn was determined by separating broken rice from milled rice by hand. Milled rice outturn and head rice outturn were expressed as percentage of rough and milled rice, respectively. Grain length was measured by slide calipers. Amylose content was determined by the procedure of Juliano (1971). Protein content was calculated from nitrogen and it was determined by the micro Kjeldahl method (Juliano *et al.*, 1968; AOAC, 1970). Aroma of cooked kernels was tested by the procedure of Sood and Siddiq (1978). Data were analyzed following the ANOVA technique and mean differences were adjudged with Duncan's Multiple Range Test (DMRT).

Results and Discussion

Date of transplanting on the yield and yield attributes of aromatic rice: Transplanting date exerted significant influences on grain yield together with all studied parameters. It was observed that the earlier planting dates had higher response, which gradually decreased with the delays in planting dates (Table 1). The plant height was significantly influenced by date of transplanting. Longest plant height (142.4 cm) was obtained from 15 July and the shortest (117.05cm) from 14 August transplanting. Plant height gradually decreased with the delay in planting date (Table 1). This result is in agreement with that of Kulkarni *et al.* (1989) and BRRI (2000). Delayed transplanting reduced the number of fertile tillers $hill^{-1}$ (Table 1). A similar observation was made by Ashraf *et al.* (1989).

Table 1. Effect of transplanting date on the yield and quality of aromatic rice

Treatment	Yield and yield components					Grain quality parameters					
	Plant height (cm)	Fertile tillers hill^{-1} (no.)	Grains panicle^{-1} (no.)	1000 grain wt. (g)	Grain yield (t ha^{-1})	Milling outturn (%)	Head rice outturn (%)	Grain length (mm)	Grain elongation ratio	Protein (%)	Amylose (%)
Transplanting date											
D_1	142.40a	9.67a	99.85a	13.19ab	2.79a	68.87b	64.27b	4.39	2.00c	6.14b	24.62
D_2	137.7b	8.26b	102.11a	13.35a	2.38b	70.60a	64.93ab	4.38	2.07a	6.22b	24.37
D_3	126.07c	8.50b	72.41b	12.90b	2.25c	71.00a	65.53a	4.41	1.95c	6.16b	24.46
D_4	117.05d	7.97b	64.25c	12.96b	1.85d	71.27a	64.67b	4.43	2.03ab	6.43a	24.56
Variety											
V_1	146.05a	8.29ab	14.52b	14.52b	2.48ab	70.50	66.25ab	5.14b	1.79d	6.11b	24.51bc
V_2	133.01b	9.07a	11.51c	11.51c	1.99d	70.67	65.67b	3.81c	1.97c	6.46a	24.78b
V_3	134.22b	9.20a	10.44d	10.44d	2.38b	70.58	67.08a	3.73c	2.05b	6.44a	23.83c
V_4	131.46b	7.44b	10.44d	10.44d	2.59a	70.75	66.33ab	3.80c	2.30a	6.36a	25.54a
V_5	107.95c	9.01a	18.59a	18.59a	2.16c	69.67	58.2c	5.53a	1.96c	5.83c	23.85c
CV (%)	4.33	12.40	3.39	3.39	7.13	3.59	3.71	4.55	3.26	4.01	3.44

Figures in a column followed by different letters differ significantly but with common letter (s) do not differ significantly at 5% level of probability

Note: D_1-15 July, D_2-25 July, D_3-04 August, D_4 -14 August; V_1-Kataribhog, V_2-Radhunipagal, V_3-Badshabhog, V_4-BRRI dhan34, V_5-BRRI dhan38

The effect of transplanting date on grains panicle^{-1} was much more pronounced. Transplanting of seedlings on 15 July produced highest grains panicle^{-1} (102.11) and it was identical to 15 July transplanting and lowest grains panicle^{-1} (64.25) was recorded from 14 August**.** Om *et al*. (1993) made a similar observation**.** Thousand grain weight gradually decreased from 25 July transplanting. Significantly higher 1000 grain weight (13.35g) was observed in 25 July transplanting, which was statistically similar to 15 July. Transplanting on 15 July (D_1) recorded significantly higher grain (2.79 t ha^{-1}) yield compared with that on 25 July (D_2), 4 August (D_3), 14 August (D_4) respectively. These could happen due to the longer vegetative period received by the early planted crop, which facilitated the higher utilization of growth factor like higher temperature and nutrient uptake. Reduction in grain yield may be attributed to significant reduction in fertile tiller hill^{-1}, grains panicle^{-1} and 1000-grain weight (table1). Similar result was also reported by Chowdhury (1995). The maximum fertile tillers hill^{-1} (9.67) was recorded in 15 July transplanting. Grains panicle^{-1} and 1000 grain weight could not bring significant differences between the first 2 dates of transplanting (Table 1). Grain yield differed significantly with different varieties (Table 1).Among the five aromatic varieties the highest grain yield (2.59 t ha^{-1}) was obtained from BRRI dhan 34 and the lowest grain yield (1.99 t ha^{-1}) was obtained from Radhunipagal. The interaction between transplanting dates and varieties was significant in respect of yield components (Table 2). Interaction between date of transplanting and varieties showed that all the cultivars gave the maximum grain yield when transplanted on 15 July. BRRI dhan 34 gave the highest yield (3.4 t ha^{-1}) when transplanted on 15 July. Kataribhog (2.73 t ha^{-1}), Radhunipagal (2.5 t ha^{-1}), Badshabhog (2.53 t ha^{-1}) and BRRI dhan 38 (2.77 t ha^{-1}) gave the highest yield on 15 July. A delay transplanting on 14 August reduced the yield compared with the transplanting on dates. Such a reduction was attributed mainly due to restricted tillering and crop growth.

Date of transplanting on the grain quality of aromatic rice: Milling outturn (%), head rice outturn (%), grain elongation ratio and protein content (%) were affected by date of transplanting (Table 1).Transplanting on 14 August (D_4) resulted in highest percentage of milling outturn (71.27%) and it was identical with that of transplanting on 25 July and 4 August. Highest head rice outturn (65.53%) was found in 4 August transplanting and it was identical with that of transplanting on 25 July. Higher grain elongation ratio (2.07) was found on 25 July transplanting. Transplanting dates significant influence on protein percentage in brown rice. Delayed transplanting increased the protein percentage in brown grain. Transplanting after 4 August, the variation of protein % was statistically significant. The highest protein % was found on 14 August transplanting and the lowest was found on 15 July, which was identical with transplanting on 25 July and 4 August. Transplanting on 15 July to 14 August had showed no significant influence on grain length and amylose content (Table 1).There was not much variation in aroma in the cooked rice due to different transplanting dates but variation was observed due to varieties as evident from the sensory evaluation method , used. The aromatic rice transplanted on 25 July to 14 August produced significantly better quality grain in terms of high milling outturn, head rice outturn, grain length and protein content. Among the three local and two modern aromatic varieties, head rice outturn was the highest (67.08%) in

Badshabhog and it was identical with that of BRRI dhan34 and Kataribhog. Grain elongation ratio was higher (2.30) in the BRRI dhan34. BRRI dhan38 was medium slender type varieties. Protein content of the varieties varied from 5.83 % to 6.46 % in brown rice (Table 1). Highest amylose content (25.54%) in BRRI dhan34. Badshabhog were more aromatic than other varieties.The interaction between transplanting dates and varieties were significant in respect of head rice outturn, grain length and protein content (Table 2).

From the study it may be concluded that transplanting during 15-25 July gave the highest yield but 25 July to 4 August transplanting is the optimum in respect of higher grain quality of aromatic rice. Delayed transplanting increased the some quality parameter but reduced the yield significantly in almost all varieties

Table 2. Interaction effect of transplanting date and variety on the yield and quality of aromatic rice

Treatment (T. date x Variety)	Yield and yield components					Grain quality parameters					
	Plant height (cm)	Fertile tillers hill^{-1}	Grains panicle^{-1}	1000 grain wt. (g)	Grain yield (t ha^{-1})	Milling outturn (%)	Head rice outturn (%)	Grain length (mm)	Grain elongation	Protein (%)	Amylose (%)
D_1V_1	156.73	8.43	94.97de	14.65c	2.73bc	69.67	66.67a-c	5.20	1.67f	5.80gl	24.77
D_1V_2	145.97	10.37	96.67c-e	11.43d-f	2.50c-f	69.67	65.00cd	3.87	2.03b	6.27d-g	25.43
D_1V_3	141.90	10.53	110.73bc	10.49g	2.53cd	67.67	65.33cd	3.67	2.00bc	6.57a-d	23.67
D_1V_4	144.85	9.27	122.93b	10.31g	3.40a	68.07	66.00b-d	3.73	2.30a	6.40b-e	25.57
D_1V_5	121.73	9.73	73.93g-i	19.09a	2.77bc	68.67	58.33fg	5.47	2.00bc	5.67 l	23.67
D_2V_1	154.80	8.83	99.63cd	14.57c	2.53cd	70.67	65.67b-d	5.06	1.83de	5.87f-i	24.77
D_2V_2	143.97	8.77	100.93cd	12.02d	2.20ef	71.33	67.67ab	3.77	2.03b	6.27d-g	24.30
D_2V_3	139.60	8.93	94.33de	10.67f-g	2.17f	71.67	67.67ab	3.63	2.10b	6.77a-c	23.57
D_2V_4	143.17	6.33	142.57a	10.23g	2.90b	70.67	67.00a-c	3.83	2.33a	6.43b-e	25.53
D_2V_5	108.03	9.43	73.07g-i	19.27a	2.10f	68.67	56.67g	5.60	2.07b	5.77hi	23.67
D_3V_1	141.10	8.03	74.43g-i	14.57c	2.50c-f	71.00	67.00a-c	5.20	1.83de	6.47b-e	24.50
D_3V_2	129.03	8.73	67.57h-l	11.60de	2.17f	70.33	65.67b-d	3.73	1.77ef	6.37b-e	24.77
D_3V_3	129.40	10.07	83.40e-g	10.33g	2.53cd	71.67	68.67a	3.87	2.03b	6.17d-h	23.80
D_3V_4	125.10	7.37	90.40d-f	10.80f-g	2.37d-f	71.33	66.67a-c	3.77	2.27a	5.77h-l	25.30
D_3V_5	105.70	8.30	46.23j-k	17.18b	1.70g	70.67	59.67ef	5.50	1.87de	6.03e-l	23.93
D_4V_1	131.57	7.85	66.33h-l	14.30c	2.13f	70.67	65.67cd	5.10	1.83de	6.30c-f	24.00
D_4V_2	113.06	8.40	54.73i-j	10.97e-g	1.10h	71.33	64.33d	3.87	2.03b	6.93a	24.63
D_4V_3	125.97	8.27	72.23g-i	10.29g	2.27ef	71.33	66.67a-c	3.73	2.07b	6.27d-g	24.27
D_4V_4	118.73	6.80	79.33f-h	10.41g	1.70g	72.33	65.67b-d	3.87	2.30a	6.89ab	25.77
D_4V_5	96.07	8.53	43.63	18.83a	2.07f	70.67	61.00e	5.57	1.90cd	5.83f-i	24.13
CV (%)	4.33	12.40	9.79	3.32	7.13	3.59	3.71	4.55	3.26	4.01	3.44

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