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Influence of planting methods and weed control measures on the yield and yield attributes of aromatic rice in *aman* season

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Abstract: An experiment was carried out at the Agronomy Field Laboratory, Hajee Mohammad Danesh Science and Technology University, Dinajpur during the *aman* season of 2007 to study the effect of planting methods and weed control measures on the yield of aromatic rice (cv. BRRI dhan34) in *aman* season. The experiment was laid out in a split plot design with three replications accommodating planting methods in main plot and weed control measures in split plot. The yield attributes were significantly influenced by planting method and weed control measures. The grain and straw yield were higher in direct seeding thick row sowing by drum seeder than those of transplanted rice. The highest plant height, number of total tillers m^{-2}, fertile tillers m^{-2}, panicle length, spikelets $panicle^{-1}$, grains $panicle^{-1}$, 1000-grain weight, grain yield and straws yield were found with the application of pre-emergence herbicide application plus one hand weeding at 42 DAS/DAT.
Key words: Planting method, weed control measures, rice

Introduction

Aromatic rice is rated best in quality and fetches much higher price than high quality non-aromatic rice in the domestic and international market. The demand of aromatic rice for internal consumption and also for export is increasing day by day (Das and Baqui 2000). Dinajpur region is a native area of some indigenous aromatic rice cultivars. About 30% of rice land in Dinajpur is covered by aromatic rice varieties during '*Aman'* season (Baqui *et al.,* 1997). Due to low yield and limited market facilities, farmers seem to have little interest to continue growing these aromatic rice cultivars. Among the various cultural practices, planting method and weed control measures are the important practices which are needed to be considered for rice cultivation. There are three major methods of rice crop establishment, namely transplanting, wet seeding and dry seeding (Pandey, 1994). Nearly 80% of the global rice growing area is under transplanted method. Direct seeding of sprouted seeds by using drum seeder in wet puddled field is an alternative method of rice cultivation. The weeds have higher competitive abilities and serious negative effect on crop production and responsible for marked losses in crop yield (Mamun *et al*., 1993). Weeds reduced grain yield by 16-48% in transplant *aus* rice, 68-100% in direct seeded *aus* rice, 45% in transplant *aman* rice and 22.36% of modern *boro* rice (Mamun, 1990). Weed infestation of associated rice plants are strongly influenced by weed control measures. So, a suitable weed control measure is needed to be adopted with a view to reduce the cost of production for maximizing rice yield through less weed infestation. In Bangladesh, weeds are traditionally controlled by hand weeding but it is time-consuming, uneconomic and becoming more difficult day-by-day due to scarcity of labours. The hand weeding is effective but it is highly expensive. Moreover, heavy demand of labour during peak period and its scarcity necessitates the use of alternative method of weed control. Chemical weed control being cost effective and less labour dependent may be recommended to overcome these constraints under direct seeded puddle rice field. Therefore, proper weed management is essential for successful rice production in Bangladesh. Research works is limited on planting method and weeding practices of aromatic rice cultivation. In view of the above, the present investigation was undertaken to study the effect of planting method and weed control measures on the yield of aromatic rice (cv.BRRI dhan34) in *aman* season.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory, Hajee Mohammad Danesh Science and Technology University, Dinajpur, during *aman* season (July to December) of 2007 to study the effect of planting method and weed control measures on the yield and yield contributing characters of aromatic rice (cv. BRRI dhan34). The experimental field is a medium high land having sandy loam soil with pH 5.35. The initial soil (0-15 cm depth) test revealed that the soil contained 0.10% total nitrogen, 1.06 % organic matter, 24.00 µg/g available phosphorus, 0.26 me/100g available potassium, 3.2 µg/g available sulphur and 0.27 µg/g boron. BRRI dhan34 rice was taken as a test crop. Two factors were included in the experiment namely, planting method and weed control measures. The treatments were designated as: Planting Method: Transplanting method (P_1), Direct seeded thin row (P_2) and Direct seeded thick row (P_3). Weed control measures: Two hand weeding at 21 and 42 DAS/DAT (W_1), One weeding by Japanese rice weeder at 21 DAS/DAT + one hand weeding at 42 DAS/DAT (W_2) and Pre-emergence herbicide application at 4 DAS/DAT + one hand weeding at 42 DAS/DAT (W_3). Direct sowing of seed was done by drum seeder on 7 July, 2007 in the specified plots. In case of transplanting 25 day old seedlings were uprooted from the nursery bed and transplanted on 1 August 2007 with three seedlings $hill^{-1}$ and a spacing of 25 cm × 15 cm. The experiment was laid out in a split-plot design with three replications accommodating planting method in main plot and weed control measures in split plot. The plot size was 4.0 m × 2.5 m. According to the BRRI recommendation urea, TSP, MOP, gypsum and zinc sulphate were applied at the rate of 150, 100, 70, 60 and 10 kg ha^{-1}, respectively. The whole amount of TSP, MP, gypsum and zinc sulphate was applied as basal dose in each unit plot at the time of final land preparation and thoroughly incorporated with soil by the help of a spade. Urea was top dressed in equal three splits at 15, 30 and 45 DAS /DAT. Weeding of the rice field was done as per experimental treatments. From planting to harvesting, the crops were kept under constant observation. After harvest, grains were threshed, cleaned and sun dried to record the grain yield $plot^{-1}$. The grain

drying was adjusted to 14% moisture content. The straw was also sun dried to record the straw yield plot^{-1}. Grain and straws yield plot^{-1} were converted to t ha^{-1}.The collected data were compiled and tabulated before statistical analysis. Analysis of variance (ANOVA) was done following factorial Split-plot design with the help of a computer package MSTAT-C (Russel, 1986). Differences among the treatment means were determined using the Duncan's Multiple Range Test (DMRT) comparison method (Gomez and Gomez, 1984).

Results and Discussion

Effect of planting method: Tallest plant (107.1cm) was obtained from direct sowing method and shortest plant (99.78cm) was obtained from transplanting method (Table 1). Plant height significantly reduced due to transplanting shock in transplanted rice. The findings corroborate the finding reported by Ali *et al.* (1993) and Ali (2005). Number of total tillers m^{-2} (371.0) was higher in the crop raised in direct seeding thick row method than direct seeded thin row and transplanting method (Table 1). This was due to higher preliminary crop stand and avoidance of transplanting shock in the active tillering stage. Similar results were found by Ali (2005) and BRRI (2005). Number of effective tillers m^{-2} was higher (333) in the crop raised in direct seeded thick row method and lowest (212) in transplanting (Table 1). This might be due to higher primary plant stands in direct seeding thick row and having lower primary plant stands in transplanted rice that could not compensate plant population by producing tillers. Similar result was found by Ali (2005). Highest panicle length (23.72cm) was obtained at transplanting method and the shortest panicle length (22.2cm) was obtained from the direct seeding thick row (Table1). It was evident from the result that the panicle length increased with increasing of spacing. This observation was in agreement with Ali (2005), who reported that closer spacing decreased panicle length of rice compared to wider spacing. Higher number of spikelets panicle^{-1} (238.7) was found in transplanted rice and lower number of spikelets panicle^{-1} (147.3) was found in direct seeding thick row planted rice that was statistically similar to direct seeding thin row. Highest number of grains panicle^{-1} (225.9) was found in transplanted rice. Higher thousand grain weight (13.43g) was found in transplanting method and lower thousand grain weight (12.32g) was found in direct seeding thick row which was statistically similar with direct seeding thin row (Table 1). Results revealed that the grain yield was significantly influenced by planting method. Higher grain yield (3.43 t ha^{-1}) was achieved from direct seeding thick row cultivated rice and lower grain yield (2.57 t ha^{-1}) was achieved from transplanting that was statistically identical with direct seeding thin row. It might be due to the higher number of fertile tiller m^{-2}. Highest straw yield (6.32 t ha^{-1}) was achieved from direct seeding thick row cultivated rice due to higher number of total tillers m^{-2}. Similar result was reported by Bari (2004) who stated that direct seeded line sowing method produced higher straw yield over transplanted method.

Table 1. Effect of planting method and weed control measures on the yield and yield contributing attributes of aromatic rice varieties

Treatment	Yield and yield components								
	Plant height (cm)	Total tillers m^{-2}	Fertile tillers m^{-2}	Panicle length (cm)	Spikelets panicle^{-1}	Grains panicle^{-1}	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Planting method									
P1	99.78c	257.9c	212.0c	23.72a	238.7a	225.9a	13.43a	2.57b	5.74b
P2	107.1a	285.8b	238.0b	22.87b	148.1b	134.6b	12.51b	2.65b	5.79b
P3	103.1b	371.0a	333.0a	22.20c	147.3b	133.7b	12.32b	3.43a	6.32a
CV (%)	2.52	5.93	8.17	2.80	2.60	2.85	3.14	6.55	1.56
Weed control measures									
W1	99.22b	275.3b	234.0b	22.42b	176.9b	163.0b	12.72b	2.80b	5.91b
W2	99.56b	259.2b	201.9c	21.71c	169.0b	154.2c	12.27c	2.70b	5.85b
W3	111.2a	380.1a	348.7a	24.67a	188.2a	176.9a	13.28a	3.15a	6.10a
CV (%)	2.52	5.93	8.17	2.80	2.60	2.58	3.14	6.55	1.56

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: P_1= Transplanting method, P_2= Direct seeded thin row, P_3= Direct seeded thick row; W_1= Two hand weeding at 21 and 42 DAS/DAT, W_2= One weeding by Japanese rice weeder at 21 DAS/DAT + one hand weeding at 42 DAS/DAT, W_3= Pre-emergence herbicide application at 4 DAS/DAT + one hand weeding at 42 DAS/DAT

Effect of weed control measure: The longest plant (111.2cm) was obtained from pre-emergence herbicide + one hand weeding at 42 DAS/DAT and the shortest plant (99.22cm) was obtained from two hand weeding at 21 and 42 DAS/DAT, which was statistically similar to one weeding by Japanese rice weeder + one hand weeding at 42 DAS/DAT (Table1). This might be due to the competition of weeds with plants for space, light, water and nutrient which reduced growth, development and ultimately the plant height. Similar result was obtained by Hossain (2000). The highest number of total tillers m^{-2} (380.1) obtained in pre-emergence herbicide + one hand weeding at 42 DAS/DAT and the lowest number of total tillers m^{-2} (259.2) was obtained in one weeding by Japanese rice weeder + one hand weeding at 42 DAS/DAT which was statistically similar to two hand weeding at 21 and 42 DAS/DAT (Table 1). The highest number of fertile tillers m^{-2} (348.7) obtained in pre-emergence herbicide + one hand weeding at 42 DAS/DAT and the lowest number of effective tillers m^{-2} (201.9) was obtained in one weeding by Japanese rice weeder + one hand weeding at 42 DAS/DAT (Table 1). A similar result was also obtained

by Haque (1993). The highest panicle length (24.67cm) was obtained at pre-emergence herbicide + one hand weeding at 42 DAS/DAT due to effective control of weed and minimum crop weed competition. The shortest panicle length (21.71cm) was obtained from the one weeding by Japanese rice weeder + one hand weeding at 42 DAS/DAT. The highest number of spikelets panicle^{-1} (188.2) was found in pre-emergence herbicide + one hand weeding at 42 DAS/DAT. The lowest number of spikelets panicle^{-1} (169.0) was found in one weeding by Japanese rice weeder at 21 DAS/DAT + one hand weeding at 42 DAS/DAT. The highest number of grains panicle^{-1} (176.9) was found in pre-emergence herbicide + one hand weeding at 42 DAS/DAT. The lowest number of grains panicle^{-1} (154.2) was found in one weeding by Japanese rice weeder + one hand weeding at 42 DAS/DAT. The result revealed that minimum crop weed competition increased the grains panicle^{-1}. Thousand grain weights statistically varied due to weed control measures. The highest thousand grain weight (13.28g) was obtained by pre-emergence herbicide + one hand weeding at 42 DAS/DAT and the lowest thousand grain weight(12.27g) was produced in one weeding by Japanese rice weeder + one hand weeding at 42 DAS/DAT (Table 1). Grain yield of *aman* rice (cv. BRRI dhan34) was significantly influenced due to weed control measures. The highest grain yield (3.15 t ha^{-1}) was obtained from pre-emergence herbicide + one hand weeding at 42 DAS/DAT due to higher number of fertile tiller m^{-2}, number of grains panicle^{-1} and 1000 grain weight. The lowest grain yield (2.70 t ha^{-1}) was obtained from one weeding by Japanese rice weeder + one hand weeding at 42 DAS/DAT which was statistically similar with two hand weeding at 21 and 42 DAS/DAT. Severe weed infestation thus affected the yield attributes resulting in the lowest grain yield in one weeding by Japanese rice weeder + one hand weeding at 42 DAS/DAT.

Interaction of planting method and weed control measures: Plant height, number of total tiller m^{-2}, number of fertile tiller m^{-2}, Panicle length, number of spikelets panicle^{-1}, number of grains panicle^{-1}, 1000 grain weight, grain yield and straw yield were significantly affected by interaction between planting method and weed control measures at harvest (Table 2). The highest grain yield (3.55 t ha^{-1}) was produced by the interaction of direct seeding thick row and pre-emergence herbicide + one hand weeding at 42 DAS/DAT (P_3W_3). The lowest grain yield (2.17 t ha^{-1}) was produced by the interaction of transplanting and one weeding by Japanese rice weeder + one hand weeding at 42 DAS/DAT (P_1W_2). Highest straw yield (6.58 t ha^{-1}) was achieved from direct seeding thick row cultivated rice. It might be due to the tallest plant and higher number of total tiller m^{-2}. Similar result was observed by Bari (2004) who stated that direct seeded line sowing method produced higher straw yield over transplanted method. Therefore, it may be concluded that maximum benefit and higher productivity of *aman* rice can be obtained if the crop is planted in direct seeded thick row and weeds are controlled by pre-emergence herbicide + one hand weeding at 42 DAS/DAT.

Table 2. Interaction effect of planting method and weed control measures on the yield and yield contributing attributes of aromatic rice varieties

Treatment (Planting method x Weed control measures)	Yield and yield components								
	Plant height (cm)	Total tillers m^{-2}	Fertile tillers m^{-2}	Panicle length (cm)	Spikelets panicle^{-1}	Grains panicle^{-1}	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
P1 W1	100.7cd	237.7e	191.3e	23.20c	236.0b	223.0b	13.53ab	2.61d	5.76de
P1 W2	98.67de	209.3f	157.3f	22.13d	229.0c	214.0c	12.87c	2.17f	5.65e
P1 W3	110.0b	326.7c	288.7c	25.83a	251.0a	240.7a	13.89a	2.92c	5.82cd
P2 W1	102.0c	260.7d	203.7e	22.18d	146.7e	131.7e	12.40de	2.39e	5.75de
P2 W2	103.0c	241.7e	181.7e	22.00d	139.3f	124.7f	12.0ef	2.60d	5.75de
P2W3	116.3a	355.0b	330.0b	24.43b	158.3d	147.3d	13.13bc	2.97c	5.88c
P3 W1	95.0f	327.7c	307.0c	21.87d	148.0e	134.3e	12.23ef	3.40ab	6.24b
P3 W2	97.0ef	326.7c	266.7d	21.00e	138.7f	124.0f	11.93f	3.33b	6.16b
P3W3	107.3b	458.7a	427.3a	23.73c	155.3d	142.7d	12.80cd	3.55a	6.58a
CV (%)	2.52	5.93	8.17	2.80	2.60	2.85	3.14	6.55	1.56

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: P_1= Transplanting method, P_2= Direct seeded thin row, P_3= Direct seeded thick row; W_1= Two hand weeding at 21 and 42 DAS/DAT, W_2= One weeding by Japanese rice weeder at 21 DAS/DAT + one hand weeding at 42 DAS/DAT, W_3= Pre-emergence herbicide application at 4 DAS/DAT + one hand weeding at 42 DAS/DAT

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