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Effect of planting method and weeding regime on the performance of transplant *Aman* rice

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Abstract

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during July to December 2014 to evaluate the effect of planting method and weeding regime on the performance of transplant *Aman* rice. Two planting methods viz. line transplanting and haphazard transplanting and six weed control treatments viz. no weeding, one hand weeding at 21 DAT, two hand weeding at 21 and 42 DAT, pre-emergence herbicide Rifit 500 EC at 7 DAT, pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT and weed free were used as experimental treatments with three replications in a randomized complete block design (RCBD). Planting methods, weeding treatment and their interaction significantly influenced most of the crop characters and yield components of transplant *Aman* rice. The highest effective tillers hill^{-1} (9.30),grain panicle^{-1} (185.4), grain yield (3.89 t ha^{-1}), straw yield (5.57 t ha^{-1}), biological yield (9.54t ha^{-1}) and harvest index (41.08) were obtained from line transplanting. Complete weed free treatment produced the highest total tillers hill^{-1} (12.37), effective tillers hill $^{-1}$ (9.89), grain yield (4.11 tha^{-1}) and biological yield (9.94 t ha^{-1}).The highest total tillers hill^{-1}(13.07), effective tillers hill $^{-1}$(10.70), grain yield (4.50t ha^{-1}) and biological yield (10.79 t ha^{-1}) were obtained from line transplanting under weed free treatment. Results revealed that line transplanting with pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT might be used to control weeds effectively and to get higher yield of transplant *Aman* rice.

Key words: Planting method, weeding regime, transplant *Aman* rice, yield

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Introduction

Rice (*Oryza sativa L.*) is the staple food crop of nearly half of the total population of the world. In Bangladesh, about 85% cropped area are under rice production (BBS, 2013). *Aman* rice covers 5.53 million ha of lands (48.97% of the total rice area) with a production of 13.19 million tons (BBS, 2015). The average yield of *Aman* rice is 2.9 tons ha^{-1} (BBS, 2015). The increasing rate of population is 1.37% (BBS, 2014) and decreasing rate of agricultural land by 1% per annum (Hussain *et al.*, 2006) limit the horizontal expansion of rice area.

Planting methods has tremendous impacts on grain yield. Rice cultivation in Bangladesh is predominantly practiced in transplanting method. If we go for intensive rice cropping, then seedlings must be raised in the nursery bed for transplanting in order to provide three rice crops per year per field. In main field, plant can be transplanted in two ways- transplanting in line and transplanting haphazardly. In line transplanting,

seedlings are planted at uniform distance and number per hill. Intercultural operations like weeding and harvesting can be done easily with shorter time in line transplanting. So, higher yield can be obtained. In haphazard transplanting method, seedlings are planted haphazardly without any specific distance where weeding cannot be done easily. Weed infestation becomes higher. Competition between crop and weed will be higher and thus reduce crop yield. So, to avoid weed competition and to get maximum yield from rice, appropriate planting method should be selected.

Weed is one of the destructive pests in crops. Weed infestation reduces 30-40% grain yield of transplant *Aman* rice in Bangladesh (BRRI, 2008). Mamun (1990) reported that weed growth reduced the grain yield by 68-100% for direct seeded *Aus* rice, 14-48% for *Aman* rice and 22.36% for modern *Boro* rice. Therefore, proper weed management is essential for satisfactory rice production in Bangladesh. This can be achieved by removing the weeds by mechanical, cultural or chemical means or by their combinations. Herbicidal weed control methods offer an advantage to save labour and money, as a result, regarded as cost effective (Ahmed *et al.,* 2000). Chemical weed control has been gaining popularity in Bangladesh in recent years (Hossain, 2006) leading to high growth rate in herbicide use in rice cultivation (BBS, 2015). The main reasons are scarcity of labour during peak growing season, and also lower weeding cost by using herbicides. The present study was, therefore, undertaken to evaluate the effect of planting method ad weeding regime on the performance of transplant *Aman* rice.

Materials and Methods

An experiment was carried out at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh, during the period from July to December 2014. The experimental area was medium high land belonging to the Sonatola Soil Series under the Old Brahmaputra Floodplain, Agro-ecological Zone 9 (FAO and UNDP, 1988). The experiment included two factors (A) Planting methods viz. (i) line transplanting (M_1) (ii) haphazard transplanting (M_2) (B) Weeding regime viz. (i) no weeding (W_0),(ii) one hand weeding at 21 DAT (W_1), (iii) two hand weeding at 21 and 42 DAT (W_2), (iv) pre-emergence herbicide Rifit 500 EC at 7 DAT (W_3), (v) pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT (W_4) (vi) weed free (W_5). The experiment was laid out in a randomized complete block design (RCBD) with three replications. The size of the individual plot was 4.0m x 2.5m. Treatments were assigned to unit plots at random.

The plots were fertilized with 170-115-70-25 kg ha^{-1} urea, triple superphosphate, muriate of potash and gypsum, respectively. The entire amounts of triple superphosphate, muriate of potash and gypsum were applied at the time of final land preparation. Urea was applied in three installments at 10, 20 and 30 days after transplanting (DAT). Thirty days old seedling of transplant *Aman* rice cv. Binadhan-12 was transplanted on 10 July 2014; at the rate of two seedlings $hill^{-1}$ maintaining row and hill spacing of 25 cm × 15 cm, respectively. Other cultural operations were done properly depending upon the requirements. Weeding was done as per the experimental treatments. Weeds from selected plots were collected by using 1 m^2 quadrate. Dry weight of weeds were recorded after drying in an oven at 80° C for 72 hr. Five hills were selected randomly from each unit plot and uprooted before harvesting for recording necessary data. The crops were harvested at full maturity. Then the harvested crops of each plot were threshed and the fresh weights of grain and straw were recorded plot-wise. The grains were cleaned and finally the weight was adjusted to moisture content of 14%. The straw was sun dried and the yields of grain and straw $plot^{-1}$ were recorded and converted to t ha^{-1}.The collected data were compiled and analyzed statistically with the help of computer package program MSTAT-C and the mean differences were performed by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Effect of planting method

Plant height varied significantly between the planting methods (Table 1). The tallest plant (98.75 cm) was recorded in line transplanting and the shortest plant (94.16 cm) was obtained in haphazard transplanting. Similar results were found by Sarkar *et al.* (2012), who reported that the taller plant was found from transplanting in line and the shorter one from haphazard transplanting. The Higher number of total tillers hill^{-1} (11.96) was observed in line transplanting and the lower number of tillers hill^{-1} (10.50) was found in haphazard transplanting. The higher number of effective tillers hill^{-1} (9.30) was found in line transplanting than haphazard transplanting (7.60). Similar research findings were also reported by Sarkar *et al.* (2012). The higher number of non-effective tillers hill^{-1} (2.899) was found in haphazard transplanting (M_2) and lower was observed in line transplanting (M_1) (2.657).

Panicle length was significantly affected by different planting methods. The longer panicle (22.80 cm) was recorded in line transplanting and shorter panicle (21.98 cm) was recorded in haphazard transplanting. Higher number of filled grains panicle^{-1} (185.4) was observed in line transplanting and lower one was found (170.9) in haphazard transplanting. Higher number of sterile spikelets panicle^{-1} (28.50) was observed in haphazard transplanting and lower one was found (27.18) in line transplanting. This finding is in conformity with that of Sarkar *et al.* (2012). Numerically the higher number of thousand grain weight (13.62) was found in line transplanting and lower one was found (13.54) in haphazard transplanting.

The planting method studied differed significantly in respect of grain yield. Higher grain yield (3.89 t ha^{-1}) was obtained in line transplanting. Lower grain yield (3.04 t ha^{-1}) was obtained in haphazard planting. Sarkar *et al.* (2012) also reported that the higher grain yield was found from line transplanting and the lower one from haphazard transplanting. Higher straw yield (5.57 t ha^{-1}) was found in line transplanting and lower straw yield (4.36 t ha^{-1}) was found in haphazard planting. Higher biological yield (9.45 t ha^{-1}) was found in line transplanting and lower biological yield (7.40 t ha^{-1}) was found in haphazard transplanting. Harvest index was not significantly affected by planting method. Apparently higher harvest index (41.08%) was found in line transplanting and lower harvest index (41.05%) was found in haphazard transplanting.

Effect of weeding regime

Plant height was significantly affected by different weeding regimes (Table 2). The tallest plant (100.1cm) was found in weed free (W_5) treatment which was statistically similar with W_4 (Pre-emergence herbicide Rifit 500 EC at 7 DAT + One hand weeding at 42 DAT) and the shortest plant (92.45 cm) was found in no weeding (W_0) which was statistically similar with one hand weeding at 21 DAT (W_1). Weed competition was severe in no weeding condition and thus plant height in rice was reduced. The highest number of total tillers hill^{-1}(12.36) was observed in weed free (W_5) while the lowest total tillers hill^{-1} (9.365) was observed in no weeding (W_0). In no weeding treatment weed crop competition was higher and weed suppressed the rice plant growth ultimately tiller number was reduced. The highest number of effective tillers hill^{-1} (9.89) was produced by weed free (W_5) treatment. The lowest number of effective tillers hill^{-1} (6.35) was produced by no weeding (W_0) treatment. Similar research findings were also reported by Chowdhury and Thakuria (1998) and Islam (2003). The highest number of non-effective tillers hill^{-1} (3.02) was found in no Weeding (W_0)and the lowest number of non-effective tillers hill^{-1} (2.485) was found in weed free ($W_{5)}$ treatment.

Panicle length was significantly influenced by weeding regime. The longest panicle length (23.80 cm) was observed in weed free (W_5) treatment and the smallest one (21.52 cm) was observed in no weeding (W_0) treatment. The highest number of grains panicle^{-1}

(203.3) was produced by weed free (W_5) treatment while the lowest number of grains panicle^{-1} (159.8) was produced by no weeding (W_0). The highest number of sterile spikelets panicle^{-1} (29.04) was produced by W_0 (No weeding) treatment, while the lowest number of sterile spikelets panicle^{-1} (26.65) was produced by weed free (W_5). The highest weight of 1000 grains (13.71 g) was recorded in weed free (W_5) treatment which was statistically similar with pre-emergence herbicide Rifit 500 EC at 7 DAT (W_3) and pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT (W_4). The lowest weight of 1000-grain (13.40) was recorded in no weeding (W_0) which was statistically similar with one hand weeding at 21 DAT (W1).

Table 1. Effect of planting method on yield contributing characters of transplant *Aman* rice

Planting methods	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle length (cm)	Grain panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
M_1	98.75a	11.96a	9.30a	2.657b	22.80a	185.4a	14.79b	13.62	3.89a	5.57a	9.45a	41.08
M_2	94.16b	10.50b	7.60b	2.899a	21.98b	170.9b	16.07a	13.54	3.04b	4.36b	7.40b	41.05
CV (%)	2.53	1.02	1.08	2.32	1.12	2.09	4.55	1.50	5.08	3.19	4.57	3.69
Level of significance	**	**	**	**	**	**	**	NS	**	**	**	NS

Table 2. Effect of weeding regime on yield contributing characters of transplant *Aman* rice

Weeding regime	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle length (cm)	Grain panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
W_0	92.45c	9.37f	6.35f	3.02a	21.52e	159.8e	24.24a	13.40b	2.73e	3.99e	6.72e	40.67
W_1	92.97c	10.40e	7.48e	2.93b	21.71de	167.4d	16.66b	13.44b	3.16d	4.55d	7.70d	41.06
W_2	96.20b	11.40d	8.54d	2.86b	21.99cd	172.7c	14.84c	13.55ab	3.40c	4.93c	8.33c	40.81
W_3	97.58ab	11.82c	9.09c	2.72c	22.25c	175.7c	13.80d	13.65a	3.62b	5.20b	8.83b	41.05
W_4	99.42a	12.03b	9.38b	2.66c	23.06b	190.1b	12.35e	13.70a	3.75b	5.30b	9.05b	41.45
W_5	100.1a	12.37a	9.89a	2.49d	23.80a	203.3a	10.71f	13.71a	4.11a	5.83a	9.94a	41.34
CV (%)	2.53	1.02	1.08	2.32	1.12	2.09	4.55	1.50	5.08	3.19	4.57	3.69
Level of significance	**	**	**	**	**	**	**	**	**	**	**	NS

In a column, values having the same letters do not differ significantly whereas values with dissimilar letter differ significantly as per DMRT. ** = Significant at 1% level of probability, NS = Not significant

Grain yield was significantly influenced by different weeding regimes. The highest grain yield (4.11 t ha^{-1}) was produced by weed free (W_5) treatment followed by W_4 (Pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT) (3.75 t ha^{-1}) and W_3 (Pre-emergence herbicide Rifit 500 EC at 7 DAT) (3.62 t ha^{-1}) while the lowest grain yield (2.73 ha^{-1}) was produced by no weeding (W_0). The highest straw yield (5.83 t ha^{-1}) was observed in weed free (W_5) treatment and the lowest straw yield (3.99 t ha^{-1}) was observed in no weeding (W_0) treatment. The highest biological yield (9.94 t ha^{-1}) was obtained in weed free (W_5). The lowest biological yield (6.71 t ha^{-1}) was obtained in no weeding (W_0). The highest harvest index (41.45%) was

observed in W_4 (Pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT) and the lowest harvest index (40.67%) was observed in W_0 (No weeding) treatment.

Effect of interaction between planting method and weeding regime

The effect of interaction between planting method and weeding regime was not significant for plant height (Table 3). Apparently the tallest plant (100.9 cm) was obtained from line transplanting method in weed free (M_1W_5)and haphazard transplanting produced the shortest plant (88.30 cm) in no weeding (M_2W_0) treatment. The highest number of total tillers hill^{-1} (13.07) was produced by line transplanting method in weed free (M_1W_5) while the lowest number of total tillers hill^{-1} (8.53) was produced by haphazard transplanting in no weeding (M_2W_0). The highest number of effective tillers hill^{-1} (10.70) was produced by line transplanting in weed free(M_1W_5) while the lowest number of effective tillers hill^{-1} (5.41) was produced by haphazard transplanting in no weeding (M_2W_0).The highest number of non-effective tillers hill^{-1} (3.12) was produced by haphazard transplanting in no weeding (M_2W_0) and the lowest number of non-effective tillers hill^{-1} (2.37) was produced by line transplanting in weed free (M_1W_5) which was statistically similar with line transplanting in pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT (M_1W_4). The longest panicle (24.24 cm) was observed in M_1W_5 (Line transplanting × weed free) treatment which was statistically similar with M_1W_4 (Line transplanting × pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT) and the shortest (21.13 cm) one was found in M_2W_0 (Haphazard transplanting × no weeding) treatment which was statistically similar with M_2W_1 (haphazard transplanting × one hand weeding at 21 DAT).

The highest number of grains panicle^{-1} (206.0) was produced by M_1W_5 (Line transplanting × weed free) treatment which was statistically similar to M_1W_4 (Line transplanting × pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT) and M_2W_5 (Haphazard transplanting × weed free) while the lowest number of grains panicle^{-1} (153.00) was produced by M_2W_0 (Haphazard transplanting × no weeding) treatment which was statistically similar with M_2W_1 (Haphazard transplanting × one hand weeding at 21 DAT). The highest number of sterile spikeletspanicle^{-1} (30.10) was produced by haphazard transplanting in no weeding (M_2W_0) treatment and the lowest one (26.15) was produced by line transplanting in weed free (M_1W_5). Weight of 1000-grain was not significantly affected by the interaction between planting method and weeding regime (Table 3). Apparently the highest weight of 1000 grains (13.71 g) was recorded in M_1W5 (Line transplanting × weed free) treatment and the lowest value (13.31 g) was recorded in M_2W_0 (Haphazard transplanting × no weeding) treatment.

Grain yield was significantly influenced by the interaction between planting method and weeding regime (Table 3). The highest grain yield (4.50 t ha^{-1}) was produced by M_1W_5 (Line transplanting × weed free) treatment while the lowest grain yield (2.06 t ha^{-1}) was produced by M_2W_0 (Haphazard transplanting × no weeding) treatment. Treatments M_1W_3 (Line transplanting × pre-emergence herbicide Rifit 500 EC at 7 DAT) and M_1W_4 (Line transplanting × pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT) were statistically identical. The integrated approach like herbicides + hand weeding performed better than herbicides or hand weeding alone, such as application of pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT. Similar results were also observed by Gogoi *et al*. (2000), Islam (2001), Attalla and Kholosy (2002). The highest straw yield (6.29 t ha^{-1}) was produced by M_1W_5 (Line transplanting × weed free) treatment, while the lowest straw yield (3.00 t ha^{-1}) was produced by M_2W_0 (Haphazard transplanting × no weeding) treatment. The Highest biological yield (10.79 t ha^{-1}) was produced by M_1W_5 (Line transplanting × weed free) treatment while the lowest

Table 3. Effect of interaction between planting method and weeding regime on yield contributing characters of T. *Aman* rice

Planting method× Weeding regime	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle length (cm)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
M_1W_0	96.60	10.20h	7.28h	2.92bc	21.92de	166.5c	22.46b	13.50	3.40de	4.96c	8.36d	40.67
M_1W_1	97.07	11.20f	8.35f	2.85cd	22.14cde	177.1b	16.78c	13.51	3.70bcd	5.38b	9.09bc	40.76
M_1W_2	97.93	12.13d	9.35d	2.78d	22.25cd	180.4b	14.47de	13.56	3.80bc	5.54b	9.34b	40.67
M_1W_3	99.77	12.43c	9.857c	2.57e	22.44c	181.4b	13.23ef	13.71	3.90b	5.58b	9.48b	41.16
M_1W_4	100.3	12.73b	10.28b	2.45f	23.82a	201.2a	11.60g	13.71	4.01b	5.65b	9.66b	41.51
M_1W_5	100.9	13.07a	10.70a	2.37f	24.24a	206.0a	10.22h	13.71	4.50a	6.29a	10.79a	41.71
M_2W_0	88.30	8.53j	5.41j	3.12a	21.13f	153.0d	26.01a	13.31	2.06h	3.00f	5.07g	40.67
M_2W_1	88.87	9.60i	6.60i	3.00b	21.28f	157.7d	16.53c	13.38	2.61g	3.70e	6.32f	41.35
M_2W_2	94.47	10.67g	7.72g	2.95bc	21.74e	165.1c	15.20d	13.54	2.99f	4.32d	7.31e	40.96
M_2W_3	95.40	11.20f	8.33f	2.87cd	22.06cde	170.0c	14.37de	13.60	3.34e	4.82c	8.16d	40.94
M_2W_4	98.57	11.33f	8.47f	2.86cd	22.29cd	179.0b	13.10f	13.70	3.49cde	4.94c	8.44cd	41.39
M_2W_5	99.37	11.67e	9.07e	2.60e	23.36b	200.5a	11.20gh	13.71	3.72bcd	5.36b	9.08bc	40.97
CV (%)	2.53	1.02	1.08	2.32	1.12	2.09	4.55	1.50	5.08	3.19	4.57	3.69
Level of significance	NS	*	*	*	*	*	*	NS	**	**	**	NS

In a column, values having the same letters do not differ significantly whereas values with dissimilar letter differ significantly as per DMRT, * = Significant at 5% level of probability, ** = Significant at 1% level of probability, NS = Not significant.

biological yield (5.07 t ha^{-1}) was produced by M_2W_0 (Haphazard transplanting × no weeding) treatment. Harvest index was not significantly influenced by the interaction between planting method and weeding regime. Numerically the highest harvest index (41.71%) was observed in M_1W_5 (Line transplanting × weed free) treatment. The lowest harvest index (40.67%) was observed in M_1W_0 (Line transplanting × no weeding) and M_2W_0 (Haphazard transplanting ×no weeding) treatment.

From this study, it is observed that line transplanting with weed free treatment produced highest grain yield but it is not possible to keep the field weed free all times. It is revealed from the results that pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding performed better in obtaining considerable amount of grain yield. In conclusion, it can be said that to control weed effectively and to obtain higher grain yield in transplant *Aman* rice, line transplanting with pre-emergence herbicide Rifit 500 EC at 7 DAT + one hand weeding at 42 DAT could be used.

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