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Effect of weed management practices on the performance of transplanted *aman* rice varieties

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Abstract

A field experiment was carried out to study the effect of weed management practices on the performance of transplanted *aman* rice varieties. The experimental treatments comprised three varieties viz. BR11, BRRI dhan39 and Binadhan7 and seven weeding treatments viz., weedy check, hand weeding at 15 and 35 DATs, application of early post-emergence herbicide Manage (Pyrazosulfuron ethyl), application of pre-emergence herbicide Rifit (Pretilachlor), Manage + one hand weeding at 35 DAT, application of Rifit + one hand weeding at 35 DAT and weed free. The experiment was laid out in a randomized complete block design with three replications. The results reveal that varieties should significant variation on plant height, number of total tillers hill^{-1}, number of effective tillers hill^{-1}, number of non-effective tillers hill^{-1}, panicle length, number of grains panicle^{-1}, number of sterile spikelets penicle^{-1}, 1000-grain weight, grain yield, straw yield and harvest index. Grain yield was the highest in BRRI dhan39. Weeding regime had also significant effect on all the studied crop parameters except 1000-grain weight. The highest grain yield was obtained from weed free condition followed by hand weeding at 15 and 35 DATs. Interaction between variety and weeding regime had significant influence on all the studied crop parameters except 1000-grain weight. The highest grain yield was obtained from the interaction of BRRI dhan39 × weed free condition which was statistically identical (5.50 t ha^{-1}) with interaction of variety BR11 × two hand weedings at 15 and 35 DATs. Therefore it may be concluded that BR11 rice could be cultivated using two hand weedings at 15 and 35 DATs for obtaining higher yield.

Keywords: Transplanted *aman* rice, Variety, Weeding regime, Herbicide, Yield

Introduction

In Bangladesh about 75.61% of the total cropped area and over 80% of the total irrigated area are planted rice (BBS, 2013). Food shortage was one of the major problems here due to over population and low yield of food crops. To reach the goal, it was necessary either to increase the crop area or to increase yield unit^{-1} area. But due to high population pressure, horizontal expansion of land was not possible. So, increasing yield unit^{-1} was the only means. In Bangladesh, agriculture is characterized by rice based cropping systems. Rice is extensively grown here in *aus*, *aman*, and *Boro* seasons. Variety itself is a genetic factor which contributes a lot in producing yield components and yield of a particular crop. Yield components such as number of effective tillers hill^{-1}, number of grains panicle^{-1} and weight of individual grain contribute to increase or decrease the yield. Weeds are the major source of yield loss in upland rice and its control is labor intensive. The climate as well as the edaphic condition of Bangladesh is favorable for the growth of weeds. So, the rice crop is usually infested heavily with weeds resulting in grain yield reduction by 70-80% for direct seeded *aus* rice, 30-40% for transplanted *aman* rice and 22-36% for modern *boro* rice varieties (Mamun, 1990; BRRI, 2008). Weeds compete with crops for nutrients, space and water and thus reduce crop yield. Weeds also exert allelopathic effect on the growth of rice plant (Ismail and Siddique, 2010). Weeding has a great influence on the performance of the associated crop. Salam *et al.* (2014) obtained higher yield of *boro* rice using a pre-emergence herbicide + one hand weeding at 35 DAT. Thus the best weeding needs to be adopted by the farmers with a view to reducing weed infestation and maximizing rice yield. Proper weed management ensures higher yield. Weeding keeps the land clean and soil becomes well aerated and this facilitates the absorption of more nutrients, moisture and higher reception of solar radiation for better growth and yield of rice. The present study was therefore, undertaken to observe the effect of variety, different weeding regimes and interaction effects of variety and different weeding regimes on the performance of transplanted *aman* rice.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh during the period from June to December 2013 to study the effect of weed management practices on the performance of transplanted *aman* rice varieties. The experimental area is characterized by non-calcareous dark grey floodplain soil belonging to the Sonatala Soil Series under the Old Brahmaputra Floodplain, Agro-Ecological Zone 9 (UNDP and FAO, 1988). The experimental field was medium high land having silty loam soil with pH 6.8. The experiment included two factors, three varieties viz V_1 (BR11), V_2 (BRRI dhan39) and V_3 (Binadhan-7) and seven weeding treatments viz. W_1 (weedy check), W_2 (hand weeding at 15 and 35 DATs), W_3 (application of early post-emergence herbicide Manage (1 L/ha), W_4 (application of pre-emergence herbicide Rifit (185 g/ha)), W_5 (application of manage + one hand weeding at 35 DAT), W_6 application of Rifit + one hand weeding at 35 DAT) and W_7 (weed free). The experiment was laid out in a randomized complete block design (RCBD) with three replications. Total number of unit plots was 3×7×3=63 and each plot size was 4.0 m × 2.5 m. The distance maintained between the individual unit plots was 0.5 m and that between the replications was 1.0 m. The sprouted seeds were sown in the nursery bed on 15 June 2013. The land was thoroughly prepared with the help of country plough and ladder and was uniformly fertilized with urea, triple superphosphate, muriate of potash, gypsum and zinc sulphate @ 200, 115, 125, 100 and 12 kg ha^{-1}, respectively (BRRI, 2011). All the fertilizers were applied at the time of final land preparation but urea was applied at three equal splits at 15, 30 and 45 DATs. The layout of the field was made after final land preparation. The seedlings were uprooted on 16 July 2013 and they were immediately transferred to the main field. Rice was transplanted on 16 July 2013. The intercultural operations were done whenever it necessary. When 90% of the spikelets become golden yellow in color the crops were harvested. BRRI dhan39 and Binadhan7 were harvested on 20 November and BR11 was harvested on 11 December 2013. The harvested crop of each plot was separately bundled, properly tagged and then brought to (21 days earlier than that of variety BR11) threshing floor. The grains were cleaned and sun dried and straws were also sun dried properly. Finally grains and straw yields plot^{-1} were recorded and converted to t ha^{-1}. The recorded data were compiled and tabulated for statistical analysis. Analysis of variance was done with the help of computer package, MSTAT. The mean differences among the treatments were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Effect of variety on yield and yield components of transplanted *aman* rice

Varieties of transplanted *aman* rice should significant variation on plant height, number of total tillers hill^{-1}, number of effective tillers hill^{-1}, number of non-effective tillers hill^{-1}, panicle length, number of grains panicle^{-1}, number of sterile spikelet's penicle^{-1}, 1000-grain weight, grain yield, straw yield and harvest index (Table 1). Variety BR11 produced the tallest plants (107.90 cm) while Binadhan-7 produced the shortest plants (91.70 cm). Binadhan-7 produced the highest number (8.77) of total tillers and effective tillers hill^{-1} (6.17) and number of effective tillers hill^{-1} was statistically similar with BR11. While BRRI dhan39 produced the lowest number (5.41) of total tillers hill^{-1} and lowest number (7.381) of effective tillers hill^{-1}. The longest panicle (23.91) was recorded in BRRI dhan39 and the shortest (21.63) was recorded in Binadhan-7. The highest number of grains panicle^{-1} (115.1) was produced by the variety BRRI dhan39 and the lowest one (82.72) by Binadhan7. Kamal *et al*. (1988) also reported variable number of grains panicle^{-1} among the varieties. Varietal variations regarding the number of grains panicle^{-1} might be due to their variation in genetic constituents. The variety Binadhan-7 produced the highest number of sterile spikelet's panicle^{-1} (21.01) while the lowest one (15.51) was attained by the variety BRRI dhan39. The highest weight (27.13 g) of 1000 grains was observed in BR11 and the lowest one (20.17 g) was observed in BRRI dhan39 which was statistically similar with that of variety Binadhan-7. The highest grain yield (4.72 t ha^{-1}) was obtained in BRRI dhan39 which was statistically identical (4.62 t ha^{-1}) with that of variety BR11 and the lowest grain yield (4.52 t ha^{-1}) was obtained in Binadhan-7. This variation in grain yield might be due the characteristics of the cultivars. These results are in conformity with that obtained by Siddeque *et al.* (2002) and BRRI (1995) who reported the differences of grain yield due to varieties.

The highest straw yield (5.25 t ha^{-1}) was found in BR11 and the lowest straw yield (4.24 t ha^{-1}) was found in Binadhan-7 which was statistically identical with BRRI dhan39. The highest harvest index (54.78%) was found in Binadhan-7 which was statistically similar with BRRI dhan39 and the lowest one (46.86%) was found in BR11. It was reported that variety had a great influence on harvest index (Tyeb *et al.*, 2013).

Table 1. Effect of variety on the yield and yield components of transplanted *aman* rice

Variety	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 spikelet panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
BR11	107.9a	7.67b	5.85a	2.54b	23.09b	105.4b	18.08b	27.13a	4.62a b	5.25a	46.86b
BRRI dhan-39	99.96b	7.38b	5.41b	2.25c	23.91a	115.1a	15.51c	20.17b	4.72a	4.46b	51.50a
Binadhan-7	91.70c	8.77a	6.17a	2.84a	21.63c	82.72c	21.01a	20.54b	4.52b	4.24b	51.78a
CV (%)	3.25	10.86	10.31	12.14	4.40	5.87	9.44	4.49	4.01	9.12	5.65
Level of significance	**	**	**	**	**	**	**	**	**	**	**

In a column figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT.
** = Significant at 1% level of probability

Effect of weeding regime on yield and yield components of transplanted *aman* rice

All the yield and yield contributing characters except 1000-grain weight were significantly influenced by weeding regimes (Table 2). The tallest plant (103.3 cm) was found in W_4 (herbicide Manage + one hand weeding at 35 DAT) treatment which was statistically identical with W_1 (Two hand weedings at 15 and 35 DATs), W_2 (Application of early post-emergence herbicide Manage), W_3 (Pre-emergence herbicide Rifit), W_5 (Rifit + one hand weeding at 35 DAT) and W_6 (Weed free) treatments. The shortest plant (90.20 cm) was found in W_0 (No weeding) treatment. Weed competition was severe in no weeding condition and thus plant height of rice was reduced. The highest number of total tillers hill-1 (8.64) was observed from W_4 (herbicide Manage + one hand weeding at 35 DAT) treatment which was statistically identical with W_1 (Tow hand weedings at 15 and 35 DATs), W_2 (Application early post-emergence herbicide Manage), W_3 (Pre-emergence herbicide Rifit), W_5 (Rifit + one hand weeding at 35 DAT) and W_6 (Weed free) treatments. The lowest number of total tillers hill^{-1} (5.49) was obtained from W_0 (No weeding) treatment. The highest number of non-effective tillers hill-1 (3.38) was produced by W_0 (No weeding) treatment, while the lowest number of non-effective tillers hill^{-1} (2.22) was produced by W_3 (Application of pre-emergence herbicide Rifit) treatment. The longest panicle (24.36 cm) was observed in W_2 (Application early post-emergence herbicide Manage) treatment which was statistically identical with that of W_1 (Two hand weedings at 15 and 35 DATs) and the shortest one (20.55 cm) was observed in W_0 (No weeding) treatment. The highest number of grains panicle^{-1} (110.4) was produced by W_6 (Weed free) treatment which was statistically identical with W_4 (Application of Manage + one hand weeding at 35 DAT) and the lowest number of grains panicle^{-1} (80.41) was produced by W_0 (No weeding) treatment. In this study weed free treatment produced the highest number of grains panicle^{-1} which might be attributed due to vigorous growth of rice plant without crop-weed competition in this treatment. The highest number of sterile spikelet's panicle^{-1} (22.55) was produced by W_0 (No weeding) treatment, while the lowest one (15.16) was produced by W_6 (weed free) treatment. The highest grain yield (5.05 t ha^{-1}) was produced by W_6 (Weed free) treatment which was statistically identical with W_1 (Hand weeding at 15 and 35 DATs) treatment, while the lowest grain yield (3.72 t ha^{-1}) was produced by W_0 (No weeding) treatment. Under weed free condition, plants got maximum nutrients, light and water, which resulted in maximum grain yield. The highest straw yield (5.56 t ha^{-1}) was observed in W_6 (Weed free) treatment and the lowest one (4.11 t ha^{-1}) was observed in W_3 (Application of pre-emergence herbicide Rifit) treatment which was statistically identical with W_0 (No weeding). The highest harvest index (52.12%) was observed in W_2 (Application of early post-emergence herbicide Manage) treatment which was statistically identical to W_3 (Application of pre-emergence herbicide Rifit) and W_5 (Rifit + one hand weeding at 35 DAT). The lowest straw yield (4.11t ha^{-1}), and the lowest harvest index (47.22%) were found from W_0 (No weeding) treatment.

Table 2. Effect of weeding regime on the yield and yield components of transplanted *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)	Grains panicle^{-1} (no.)	Sterile spikelet panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
W_0	90.20b	5.49b	4.54d	3.38a	20.55c	80.41c	22.55a	21.10	3.72d	4.16d	47.22c
W_1	101.0a	8.49a	6.44a	2.31cd	23.57ab	103.2b	16.43cd	22.47	5.05a	5.02b	50.31ab
W_2	101.5a	8.16a	5.73bc	2.40bcd	24.36a	100.7b	19.80b	23.08	4.72b	4.33cd	52.12a
W_3	100.5a	7.80a	5.62c	2.22d	22.85b	103.0b	17.62c	23.46	4.33c	4.11d	51.70a
W_4	103.3a	8.64a	5.96abc	2.58bc	23.30b	109.0a	18.06c	22.75	4.50c	4.72bc	49.15abc
W_5	100.7a	8.42a	6.35ab	2.64b	22.87b	101.0b	17.78c	22.65	4.83b	4.64bc	51.62a
W_6	101.7a	8.58a	6.02abc	2.27cd	22.64b	110.4a	15.16d	22.79	5.18a	5.56a	48.20bc
CV (%)	3.25	10.86	10.31	12.14	4.40	5.87	9.44	6.69	4.01	9.12	5.65
Level of significance	**	**	**	**	**	**	**	NS	**	**	**

In a column figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT.
** = Significant at 1% level of probability; NS = Non significant

Interaction effect of variety and weeding regimes on yield and yield components of transplanted *aman* rice

The interaction of variety and weeding regime had significant effect on all the yield and yield components except 1000-grain weight (Table 3). The tallest plant (111.9 cm) was found in BR11 under Manage + one hand weeding at 35 DAT ($V_1 \times W_4$) treatment and the shortest one from Binadhan7 under no weeding ($V_3 \times W_0$) treatment among the interactions. The highest number of total tillers hill^{-1} (11.13) was observed in Binadhan-7 under weed free ($V_3 \times W_6$) treatment and the lowest one (5.13) in BR11 under no weeding ($V_1 \times W_0$) treatment. The highest number of effective tillers hill^{-1} (7.33) was found in Binadhan-7 under weed free ($V_3 \times W_6$) treatment. The lowest number of effective tillers hill^{-1} (4.33) was found in variety BR11 under no weeding ($V_1 \times W_0$) treatment which was followed by BRRI dhan39 in no weeding ($V_2 \times W_0$) treatment. The highest number of non-effective tillers hill^{-1} (3.63) was produced by variety BR11 and Binadhan-7 in W_0 (No weeding) treatment and the lowest one (1.93) was observed in the variety BR11 with W_6 (Weed free) and variety BRRI dhan39 with W_3 (Pre-emergence herbicide Rifit). The longest panicle (25.50 cm) was found in BRRI dhan39 under Rifit + one hand weeding at 35 DAT ($V_2 \times W_5$) treatment and the shortest panicle (18.84 cm) was found in Binadhan7 under no weeding ($V_3 \times W_0$) treatment. The highest number of grains panicle^{-1} (128.0) was produced in BRRI dhan39 under Manage + one hand weeding at 35 DAT ($V_2 \times W_4$) treatment and the lowest one (72.16) was produced by Binadhan-7 under no weeding ($V_3 \times W_0$) treatment which was statistically identical with $V_3 \times W_2$ treatments. The highest number (29.23) of sterile spikelet's panicle^{-1} was found in Binadhan-7 under no weeding ($V_3 \times W_0$) treatment and the lowest one (12.65) was found from BRRI dhan39 with weed free ($V_2 \times W_6$) which was statistically identical with ($V_2 \times W_3$) treatment. The highest grain yield was recorded from variety BRRI dhan39 × weed free treatment ($V_2 \times W_6$) treatment which was statistically similar (5.50 t ha^{-1}) with variety BR11 × two hand weedings at 15 and 35 DATs ($V_1 \times W_1$) treatment, BRRI dhan39 × two hand weedings at 15 and 35 DATs and BR11 × weed free treatment. The lowest grain yield was obtained from BR11under no weeding treatment which was statistically similar with BRRI dhan39 × no weeding and Binadhan-7 × no weeding treatments. The highest straw yield (6.17 t ha^{-1}) was found in BR 11 under weed free treatment ($V_1 \times W_6$) which was statistically identical with $V_1 \times W_5$ treatment. The lowest straw yield (3.83 t ha^{-1}) was produced by BRRI dhan39 under no weeding ($V_2 \times W_0$) and $V_3 \times W_3$, $V_3 \times W_4$ and $V_3 \times W_5$ treatments. The highest harvest index (56.19%) was observed in BRRI dhan39 × application of pre-emergence herbicide Rifit + one hand weeding at 35 DAT ($V_2 \times W_5$) treatment which was statistically identical with ($V_3 \times W_4$) treatment. The lowest harvest index (42.86%) was observed in BR11 under Rifit + one hand weeding at 35 DAT ($V_1 \times W_5$) treatments. From the results of the study it may be concluded that BR11 rice could be cultivated using two hand weedings at 15 and 35 DATs for obtaining higher yield.

Table 3. Interaction effect of variety and weeding regime on the yield and yield components of transplanted *aman* rice

Variety × Weeding	Plant height (cm)	Total tillers hill^{-1}	Effective tillers hill^{-1}	Non-effective tillers hill^{-1}	Panicle length (cm)	Grains panicle^{-1}	Sterile spikelet panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1W_0	103.2bcd	5.130j	4.330i	3.63 a	21.96d-f	87.38ij	18.31c-fg	25.17	3.67i	4.33def	45.83g-i
V_1W_1	109.3ab	9.00b-d	6.93a-c	2.00fg	24.09a-c	103.0e-g	12.65i	27.61	5.50ab	6.00a	47.83d-i
V_1W_2	109.1ab	7.67d-g	6.07b-f	2.07fg	23.62a-d	112.6de	21.28bc	27.50	4.50e-h	4.42c-f	50.43b-g
V_1W_3	107.0abc	7.60d-g	5.67d-h	2.07fg	23.17bcd	101.0f-h	17.71d-g	27.64	4.33gh	4.67cde	48.15d-i
V_1W_4	111.9a	9.33bc	6.67a-d	2.67cde	22.12de	105.0ef	19.45b-ef	27.69	4.50e-h	5.17bc	46.55e-i
V_1W_5	106.5abc	8.00c-g	6.33b-e	3.40ab	22.79cd	103.9e-g	19.11b-ef	26.82	4.50e-h	6.00a	42.86i
V_1W_6	108.3ab	6.93f-i	4.93f-i	1.93g	23.86a-d	125.0a-c	18.07c-g	27.51	5.33a-c	6.17a	46.38f-i
V_2W_0	85.21i	5.47ij	4.50i	2.87b-d	20.85ef	81.70jk	20.10b-e	19.15	3.67i	3.83f	48.89c-h
V_2W_1	99.11def	7.20f-h	5.33e-i	2.07fg	23.12cd	115.6cd	15.78gh	19.46	5.33a-c	5.00bcd	51.61a-f
V_2W_2	98.27def	6.73ghi	4.66hi	2.07fg	24.38abc	117.3a-d	17.84d-g	20.83	4.68d-f	4.33d-f	51.89a-e
V_2W_3	107.6a-c	7.27e-h	5.33e-i	1.93g	24.61abc	126.9ab	12.78i	22.13	4.50e-h	3.83f	54.54ab
V_2W_4	104.0bcd	8.40cd-g	5.73d-h	2.67c-e	25.11ab	128.0a	17.67d-g	19.96	4.17h	5.17bc	44.84hi
V_2W_5	103.8b-d	8.93b-e	6.93a-c	2.00fg	25.50a	116.8b-d	13.63hi	19.80	5.17bc	4.08ef	56.19a
V_2W_6	101.9cde	7.67c-g	5.40e-i	2.13e-g	23.82a-d	119.4a-d	10.74i	19.87	5.53a	5.00bcd	52.52a-d
V_3W_0	82.20i	5.87hij	4.80ghi	3.63a	18.84g	72.16k	29.23a	18.98	3.83i	4.33def	46.94e-i
V_3W_1	94.77fg	9.27b-d	7.06ab	2.87b-d	23.49bcd	90.68hij	20.8bcd	20.35	4.33fgh	4.08ef	51.49a-f
V_3W_2	97.23efg	10.07ab	6.47b-e	3.07bc	25.09ab	72.34k	20.27b-e	20.91	5.00cd	4.25def	54.05a-c
V_3W_3	86.90hi	8.53b-f	5.87c-g	2.67c-e	20.77ef	81.04jk	22.38b	20.62	4.17h	3.83f	52.41a-d
V_3W_4	93.94fg	8.20c-g	5.47e-i	2.40d-g	22.66cd	93.90ghi	17.06efg	20.60	4.83de	3.83f	56.07a
V_3W_5	91.90gh	8.33c-g	5.80c-h	2.53c-f	20.32efg	82.18jk	20.60bcd	21.32	4.83de	3.83f	55.81ab
V_3W_6	94.96fg	11.13a	7.73a	2.73cd	20.24fg	86.75ij	16.6fg	21.00	4.67defg	5.50ab	45.70ghi
CV%	3.25	10.86	10.31	12.14	4.40	5.87	9.44	4.49	4.01	9.12	5.65
Level of significance	**	**	**	**	**	**	**	NS	**	**	**

In a column figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT.
** = Significant at 1% level of probability; NS = Non significant

V_1 = BR11, V_2 = BRRI dhan 39, V_3 = Binadhan7

W_0 = Weedy check, W_1 = Hand weeding at 15 and 35 DATs, W_2 = Early post-emergence herbicide (Manage), W_3 = Pre-emergence herbicide (Refit), W_4 =Manage + one hand weeding at 35 DAT, W_5 =Refit + one hand weeding at 35 DAT, W_6 = Weed frees

Conclusion

From the results of the study it may be concluded that among the different treatment combinations, BR11 rice with two hand weedings at 15 and 35 DATs might be done for controlling weed effetely and for obtaining higher yield of transplanted aman rice.

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