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Effect of plant establishment method and weeding on the yield and yield components of Boro rice

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Abstract

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, Bangladesh during December 2013 to May 2014 to observe the effect of plant establishment method and weeding on the yield and yieldcomponents of boro rice cv. BRRI dhan29. The treatments included two plant establishment methods viz. direct seeding and transplantingusing the seedling of direct seeded plots; four weedings viz. no weeding, one weeding at 15 days after transplanting (DAT), two weedings at 15 and 30 DAT, three weedings at 15, 30 and 45 DAT.The experiment was laid out in a randomized complete block design with four replications. Yield contributing characters and yield of boro rice were influenced by plant establishment method and weeding. The highest plant height (79.24 cm), grains panicle^{-1} (121.90), grain yield (2.86 t ha^{-1}), straw yield (3.56 t ha^{-1}), biological yield (6.42 t ha^{-1}) and harvest index (44.81%) were recorded by transplanting method. The highest number of total tillers hill^{-1} (17.48), effective tillers hill^{-1} (13.39), grain yield (3.38 t ha^{-1}), straw yield (4.22 t ha^{-1}), biological yield (7.61 t ha^{-1}) and harvest index (47.01%) were obtained with three weeding at 15, 30 and 45 DAT. The lowest grain yield (1.69 t ha^{-1}) and straw yield (2.42 t ha^{-1}) were recorded from no weeding. The highest grain yield (3.65 t ha^{-1}) was recorded from transplanting method with three weeding, which was statistically similar to transplanting method with two weeding. Again direct seeding method with three weeding resulted in similar yield with that of transplanting method with two weeding. The lowest grain yield (1.46 t ha^{-1}) was recorded from direct seeding method with no weeding. From the present experiment it may be concluded that transplanting method with two weeding or direct seeding method with three weeding may be recommended for cultivation of modern bororice.

Key words: Plant establishment method, weeding, boro rice, yield

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Introduction

Boro rice cultivation in Bangladesh is predominantly practiced in transplanting method that involves raising, uprooting and transplanting of seedlings. This is rather a resource and cost intensive method since preparation of seedbed, raising of seedling and transplanting are labor and time intensive operations. Different plant establishment methods like direct seeding and transplanting seedlings from the same source (direct seeded crop field) may reduce the risk of seedlings failure and cost of raising seedlings and labour cost in the nursery bed. Irrespective of the method of rice establishment, weeds are a major impediment to rice production through their ability

to compete for resources and their impact on product quality (Ganajaxi *et al.*, 2000). A large portion of rice seedlings in Boro season is severely injured due to heavy dense fog and cold. Because of this complexity and the harshness of the environment, sometime the availability of Boro rice seedlings become shortage. Even the seedling crisis is so higher that it is needed to transplant some tillers from the same source as direct seeded plots. That is, separated tillers obtained from direct seeded crop as seedlings for transplant Boro rice. This technique of transplanting of separated tillers may be a promising alternative for growing rice in boro season (Mridha *et al.*, 1991). Vegetative propagation with clonal tillers is an alternative technology to re-transplant the damaged fields. Sharma (1995) conducted a series of experiments with direct seeded rice and experienced better performance of clonal tillers over nursery seedlings. It was possible to uproot some plants from the main field without hampering the mother transplanted crop. Weeds are considered as the major constraints among the various factors of lowering the rice yield. Weeds compete with rice plant severely for space, nutrients, air, water and light and adversely affect plant height, architecture, tillering habit, growth pattern and crop duration (Miah*et al.*, 1990). The climate as well as the edaphic condition of Bangladesh is favorable for the growth of numerous noxious weed species. Competition between rice and weeds is generally influenced by the season at which the crop is grown, the plant establishment method, the weed species present and their habit, the growth rate, density of both crops and weeds. Singh and Ghosh (2007) reported that weed control treatments increased grain yield as well as gross income. Yield loss depends upon some variables like magnitude of weed infestation, type of weed species and type of associated crop (Moody, 2003). On the other hand, weeding keeps the land clean and the soil becomes well aerated. Number and time of weeding is also necessary for having higher grain yield and better economic return (Gaffer, 1998). So, the best weeding regime needs to be resorted to reduce weed infestations that can also play an important role in reducing the early infestation of weeds in the crop field. Therefore, the present study was undertaken to evaluate the yield performance of Boro rice cv. BRRI dhan29 under different plant establishment methods and weeding practices.

Materials and Methods

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from December 2013 to May 2014. The experiment consisted of the following treatments. i) plant establishment method viz. direct seeding (M_1) and transplanting using the tillers from direct seeded plot (M_2) ii) weeding viz. no weeding (W_0), one weeding (W_1) at 15 DAT, two weeding (W_2) at 15 and 30 DAT and three weeding (W_3) at 15, 30 and 45 DAT. The experimental field was medium high land belonging to the Sonatola Soil Series of Grey Floodplain soil under the agro-ecological zone of Old Brahmaputra Floodplain (AEZ-9). The experiment was laid out in a randomized complete block design with four replications. Thus total number of plots was32. The space between blocks and between unit plots was 1.0 m and 0.75 m, respectively. The unit plot size was 4.0 m x 2.5 m. The plots were fertilized with Urea, Triple Super Phosphate (TSP), Muriate of Potash (MOP) and Gypsum @ 200, 120, 60 and 60 kg ha^{-1}, respectively. The whole amount of TSP, MOP and Gypsum and one-third of urea were applied at the time of final land preparation. The rest amount of urea was applied in equal installments at 40 and 70 DAT. The tillers of 45 days old were separated from direct seeded plots and transplanted on the well puddled experimental plots on 27 January 2014. All management practices were done as and when necessary. Five hills were selected randomly from each unit plot and uprooted before harvesting for recording necessary data. The crop was harvested at full maturity on 28 May 2014. The crop of individual plot was threshed by pedal thresher. Grains were cleaned and sun dried to moisture content of 14%. Straws were sun dried properly. Finally grain 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-C. Collected data were

analyzed using "Analysis of variance" technique and the significance of the mean differences was adjudged by the Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Effect of plant establishment method on yield and yield components of BRRI dhan29

Results showed that plant establishment method had significant effect on plant height, effective tillers, grains panicle^{-1}, grain yield and biological yield (Table 1). Taller plant (79.24 cm), higher number of effective tillers hill^{-1} (9.55), grains panicle^{-1} (121.90), grain yield (2.86 tha^{-1}), straw yield (3.56 tha^{-1}) and biological yield (6.42 tha^{-1}) were recorded in transplanting method. Similar results found by Anwar *et al.* (1998), who reported that plant establishment method effect on yield and yield contributing characters of rice. The higher number of effective tillers hill^{-1} and the higher number of grains panicle^{-1} were mainly responsible for the highest grain yield. Transplanting method resulted higher grain and straw yield because healthy and fresh tillers are separated from same source direct seeded plots. Lower grain, straw and biological yield are obtained from direct seeding plots because some tillers were injured and some seeds were not germinated properly due to dense fog and cold. This confirms the reports of Biswas and Salokhe (2005).

Effect of weeding on yield and yield components of BRRI dhan29

The effect of weeding on yield and yield contributing characters was significant (Table 2). The tallest plant (79.80 cm), highest number of total tillers hill^{-1} (17.48), effective tillers hill^{-1} (13.38), longest length of panicle (24.28 cm), highest grains panicle^{-1} (131.4), grain yield (3.39t ha^{-1}), straw yield (4.22 t ha^{-1}) and biological yield (7.61 t ha^{-1}) were obtained from three weeding which were also similar to two weeding. Weed free condition produced the highest grain yield as reported by Bari *et al.* (2009) and Chowdhury *et al.* (1995). Competition between rice plants and weeds for essential nutrients and water was lower in case of two and three weeding compared to no weeding. Three weeding which was statistically similar with two weeding produced highest grain yield as well as biological yield while lowest grain yield was found in no weeding.

Interaction effects of plant establishment method and weeding on yield and yield components of BRRI dhan29

The interaction of plant establishment method and weeding had significant effects on all plant characters except plant height, number of grains panicle^{-1} and total spikelets panicle^{-1} (Table 3). Apparently the tallest plant (80.57 cm) was obtained from transplanting method with three weeding ($M_2 \times W_3$) and the shortest plant (73.25 cm) was obtained from direct seeding method with no weeding ($M_1 \times W_0$). The highest number of total tillers hill^{-1} (19.50) was obtained from transplanting method with three weeding ($M_2 \times W_3$) and the lowest number of total tillers hill^{-1} (5.55) was obtained from direct seeding method with no weeding ($M_1 \times W_0$). It was observed that the highest number of effective tillers hill^{-1} (15.25) was found from transplanting method with three weeding ($M_2 \times W_3$). The lowest number of effective tillers hill^{-1} (4.55) was found from direct seeding method with no weeding ($M_1 \times W_0$). The highest non-effective tillers hill^{-1} (4.25) was obtained from direct seeding method with no weeding ($M_1 \times W_0$) and the lowest number of non effective tillers hill^{-1} (1.00) was obtained from transplanting method with three weeding ($M_2 \times W_3$). The longest panicle (24.60 cm) was obtained from transplanting method with three weeding ($M_2 \times W_3$). The shortest panicle (21.79 cm) was obtained from direct seeding method with no weeding ($M_1 \times W_0$). Numerically the highest number of grains panicle^{-1} (135.3) was obtained from transplanting method with three weeding ($M_2 \times W_3$) and the lowest number of grains panicle^{-1} (89.10) was obtained from direct seeding method with no weeding ($M_1 \times W_0$). It was observed that the highest number of sterile spikelets panicle^{-1} (18.77) was obtained from direct seeding method with no weeding ($M_1 \times W_0$) and the lowest number of sterile spikelets panicle^{-1} (13.39) was obtained from transplanting method with three weeding ($M_2 \times W_3$). The maximum weight of 1000-grain was observed (20.91 g) in transplanting method with three

weeding ($M_2 \times W_3$) and the minimum 1000-grain weight (19.88 g) was obtained from direct seeding method with no weeding ($M_1 \times W_0$).

Table 1. Effect of plant establishment method on yield contributing characters and yield of Boro rice (cv. BRRI dhan29)

Plant establishment method	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	Panicle length (cm)	No. of filled grains panicle^{-1}	No. of unfilled grains panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
M_1	77.36b	12.02	8.93b	3.12a	23.34	111.80b	16.16	20.23b	2.37b	3.07b	5.45b	42.94b
M_2	79.24a	12.05	9.55a	2.50b	23.63	121.90a	16.13	20.49a	2.86a	3.56a	6.42a	44.81a
LSD (0.05)	0.46	0.18	0.11	0.09	0.29	1.15	0.13	0.18	0.02	0.16	0.12	0.77
Level of Significance	**	NS	**	**	NS	**	NS	**	**	**	**	**
CV (%)	0.81	2.11	1.63	4.44	1.70	1.35	1.10	1.24	2.72	6.75	2.69	2.41

Here, M_1 = Direct seeding method, M_2 = Transplanting method, In a column, figures with the same letters do not differ significantly as per DMRT, ** = Significant at 1% level of probability, NS = Not significant, LSD = Least Significant Difference

Table 2. Effect of weeding on yield and yield contributing characters of Boro rice (cv. BRRI dhan29)

Number of weeding	Plant height (cm)	No.of total tillers hill^{-1}	No.of effective tillers hill^{-1}	No.of non-effective tillers hill^{-1}	Panicle length (cm)	No.of filled grains panicle^{-1}	No.of unfilled grains panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
W_0	74.50b	5.67d	4.55d	4.10a	21.86c	93.82d	18.46a	19.99c	1.69d	2.42d	4.11d	41.13d
W_1	79.39a	9.93c	7.63c	3.65b	23.65b	112.70c	17.65b	20.36b	2.07c	2.81c	4.88c	42.54c
W_2	79.51a	15.07b	11.43b	2.38c	24.14a	129.30b	15.00c	20.20bc	3.31b	3.83b	7.14b	44.82b
W_3	79.80a	17.48a	13.38a	1.13d	24.28a	131.40a	13.47d	20.88a	3.38a	4.22a	7.61a	47.01a
LSD (0.05)	0.66	0.27	0.16	0.13	0.42	1.64	0.19	0.26	0.03	0.23	0.16	1.09
Level of Significance	**	**	**	**	**	**	**	**	**	**	**	**
CV (%)	0.81	2.11	1.63	4.44	1.70	1.35	1.10	1.24	2.72	6.75	2.69	2.41

Here, W_0= No weeding, W_1= One weeding at 15 days after transplanting (DAT), W_2= Two weeding at 15 DAT and 30 DAT, W_3= Three weeding at 15 DAT, 30 DAT and 45 DAT, In a column, figures with the same letters do not differ significantly as per DMRT, ** = Significant at 1% level of probability. LSD = Least Significant Difference

Table 3. Interaction between plant establishment method and weeding on yield contributing characters and yield of Boro rice (cv. BRRI dhan29)

Interaction (plant establishment method × weeding)	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	Length of panicle (cm)	No. of filled grains panicle^{-1}	No. of unfilled grains panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%
$M_1 \times W_0$	73.25	5.55f	4.55e	4.25a	21.79d	89.10	18.77a	19.88b	1.46f	2.50d	3.96g	36.76e
$M_1 \times W_1$	78.45	8.25e	6.90d	3.90b	23.75c	106.8	18.15a	19.99b	1.90e	2.59d	4.49e	42.36d
$M_1 \times W_2$	78.57	15.45b	11.50b	3.40c	23.86c	123.6	14.95d	20.15b	2.99c	3.11c	6.10c	43.57cd
$M_1 \times W_3$	79.18	14.90c	11.50b	1.25d	23.97bc	127.6	13.56e	20.85a	3.62ab	4.11b	7.23b	46.07b
$M_2 \times W_0$	75.75	5.80f	4.55e	3.40c	21.94d	98.54	17.88b	19.99b	1.92e	2.33d	4.25f	42.72d
$M_2 \times W_1$	80.20	11.60d	8.35c	3.95b	23.44c	118.5	17.42b	20.52a	2.24d	3.02c	5.26d	44.97bc
$M_2 \times W_2$	80.43	15.25bc	11.35b	1.35d	24.53ab	135.1	15.05c	20.57a	3.12b	4.33ab	7.98a	45.50b
$M_2 \times W_3$	80.57	19.50a	15.25a	1.00e	24.60a	135.3	13.39e	20.91a	3.65a	4.56a	8.18a	49.05a
LSD (0.05)	0.93	0.38	0.22	0.19	0.59	2.32	0.26	0.37	0.05	0.33	0.23	1.55
Level of Significance	NS	**	**	**	*	NS	**	*	**	**	**	**

Here, M_1= Direct seeding method,M_2= Transplanting method, W_0= No weeding , W_1= One weeding at 15 days after transplanting (DAT), W_2= Two weeding at 15 DAT and 30 DAT,W_3= Three weeding at 15 DAT, 30 DAT and 45 DAT, In a column, figures with the same letters do not differ significantly as per DMRT, NS= Not significant, LSD = Least Significant Difference, * = Significant at 5% level of probability, ** = Significant at 1% level of probability

Again direct seeding method with three weeding resulted in identical yield with that of transplanting method with two weeding. Thus the results revealed that transplanting method with two weeding was found as good as direct seeding method with three weeding. The lowest grain yield (1.46 t ha^{-1}) was obtained from direct seeding method with no weeding ($M_1 \times W_0$). The highest straw yield (4.56 t ha^{-1}) was obtained from transplanting method with three weeding ($M_2 \times W_3$) and the lowest (2.50 t ha^{-1}) was obtained from direct seeding method with no weeding ($M_1 \times W_0$). The highest biological yield (8.18 t ha^{-1}) was obtained from transplanting method with three weeding ($M_2 \times W_3$) and the lowest biological yield (3.96 t ha^{-1}) was obtained from direct seeding method with no weeding ($M_1 \times W_0$). The highest harvest index (49.05 %) was obtained from transplanting method with three weeding ($M_2 \times W_3$) and the lowest harvest index (36.76 %) was obtained from direct seeding method with no weeding ($M_1 \times W_0$).

Conclusion

From this study, it can be concluded that both the methods may be practiced for Boro rice cultivation. Transplanting method with three weeding resulted in higher grain yield, which was statistically identical to two weeding with the same method of transplanting. Again results revealed that direct seeding method with three weeding produced similar yield with that of transplanting method with two weeding. Therefore, from the results of the experiment it may be concluded that transplanting method with two weeding or direct seeding method with three weeding may be recommended for cultivation of modern Boro rice cv. BRRI dhan29. However, to reach a valid conclusion more experiments should be conducted at different AEZs of Bangladesh where cost involvement needs to be studied.

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