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Effect of different transplanting methods on yield of Binadhan-14 (*Oryza sativa* L.) at late *boro* season under climate change

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ABSTRACT

To find out the suitable planting method under climate change on the yield and yield attributes of late *boro* rice in Bangladesh, an experiment was conducted at Bangladesh Institute of Nuclear Agriculture (BINA) farms at *boro* season of 2014-15. Three different sowing methods viz., direct seeding with sprouting seed & without sprouting seed and transplanting were practised to evaluate Binadhan-14 along with one check BRRI dhan 28. Due to climate change, water level goes downwards, government wants to replace *boro* areas as late *boro* to minimize irrigation water and keep the water level constant. In this study, Binadhan-14 showed higher grain yield than BRRI dhan 28. Comparative effect of transplanting method, the highest grain yield was produced in transplanting method. Direct seeding was seven days earlier than transplanted rice. However, considering crop duration direct seeding with sprouting seed will be effective by sacrificing grain yield.

Key words : Climate change, late *boro*, rice, transplanting, yield

INTRODUCTION

Rice is a staple food of about 557 million people of the world (Manzanilla *et al.,* 2010) and it feeds almost half of humanity. At 749.1 million tonnes, global paddy production in 2015 is forecast to stage a 0.9% recovery from 2014 (FAO, 2015). Meteorologists have identified four seasons on the basis of rainfall patterns viz., monsoons (June to September) 80%, during post-monsoon (October-November) and winter (December-February) 10% (World Bank, 2000). Ground water levels decline (> 1 to 0.1-0.5 m/ year) across the country due to intensive abstraction of ground water during dry season rice cultivation (Hossain and Siddique, 2015).

Irrigation is a pre-requisite for agricultural cultivation during the dry season. In dry season, rice covers almost 50% of the production in Bangladesh. Drought intensity plays a crucial role for agricultural productivity in physiographic areas such as level and high Barind Tracts areas and Madhupur Tract areas during winter season. In **kharif**-I (March-June) and **rabi** (October-February) season of Bangladesh is widespread over the country. Ground water table is declining due to over extraction of water for irrigation. It is essential to transplant the rice in late *boro* season to ensure the maximum use of rainfall. It is also important to develop transplanting method in late *boro* season (2nd week of February to March).

Binadhan-14 was late transplanting high yield potential short duration rice released in 2013. At present, rice cultivation is done in different ways in the world. The most important cultivation ways are direct seeding and transplanting methods. Direct seeding of rice is the water and labour saving technique of cultivation (Mahajan *et al.,* 2006; Won *et al.,* 2015). It is a potential alternate and a successful method in various rice growing countries of the world (Adair *et al.,* 1942).

The objective of the study was to evaluate the effect of planting methods on the

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yield and yield contributing characters of late *boro* rice varieties and develop a suitable method of transplanting under climate change in Bangladesh.

MATERIALS AND METHODS

An experiment was laid to find out the yield potentiality of Binadhan-14 in direct seeding and transplanting method. The experiment was conducted at BINA head quarter (HQ), Mymensingh and Sub-station, Rangpur. Binadhan-14 was evaluated along with one check variety : BRRI dhan 28 during late *boro* season of 2014-15. Three different sowing methods viz., transplanting, direct seeding without sprouting & direct seeding with sprouting seed were applied at the experimental sites. The unit plot size was 3 × 2 m. Thirty-days old seedlings were transplanted at 2-3 seedlings/hill with a planting spacing of 20 × 15 cm. The plots were fertilized with 105, 15, 60, 15 and 1.5 kg/ha of N, P, K, S and Zn as urea, triple super phosphate (TSP), murate of potash (MoP), gypsum and zinc oxide, respectively. All the fertilizers except urea were applied at final land preparation in full amount. Urea was applied in three splits 30% at 7-10 days after transplanting (DAT), 30% at 20-30 DAT and the last 40% at panicle initiation stage. The crop was harvested at different dates at maturity. The experiment was laid out in a RCB design with three replications. Data on yield and yield components were recorded at harvest and were statistically analyzed following the design used for the experiment and the means were compared with LSD.

RESULTS AND DISCUSSION

Mymensingh

Analysis of data showed that the number of effective tillers/hill was significant in different cultivars but not significant in different cultivation methods. Similar results were also shown by panicles/hill and panicle length. In case of filled grains/panicle, variety and cultivation methods both were not significant. The maximum number of effective tillers/hill (7.34) BRRI dhan 28, panicles/hill (6.61) BRRI dhan 28, filled grains/panicle (69.42) Binadhan-14 and panicle length (67.16 cm) BRRI dhan 28 were obtained from varieties study at Mymensingh. The results showed that the highest grain yield (4.94 t/ha) was obtained by Binadhan-14 (Table 1) followed by BRRI dhan 28 which produced 4.86 t/ha.

The study reported from methods analysis that the maximum number of effective tillers/hill (7.76), number of panicles/hill (8.05), filled grains/panicle (76.50) and panicle length (20.83 cm) were shown by transplanting method at Mymensingh. Methods of sowing showed that highest grain yield (5.54 t/ha) was produced in transplanting method and the

Table 1. Effect of direct seeding and transplanting of Binadhan-14 on the yield and yield contributing characters in late *boro* season during 2014-15 at HQ, Mymensingh

Treatment	Plant height (cm)	Tillers/ hill	Panicles/ hill	Panicle length (cm)	Filled grains/ panicle	Unfilled grains/ panicle	1000-seed weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Crop duration (days)	Cost : benefit ratio
Varieties											
Binadhan-14 (V_1)	81.10	6.11	5.50	19.53	69.42	17.51	22.99	**4.94**	5.98	-	
BRRI dhan-28 (V_2)	92.13	7.34	6.61	20.47	67.16	14.00	22.62	4.86	5.87		
LSD (P=0.05)	**	**	**	**	NS	**	NS	NS	NS	-	
Methods											
Transplanting (D_1)	86.23	7.76	8.05	20.83	76.50	15.53	22.41	**5.54**	6.04	-	1.67
Direct seeding (S–D_2)	86.41	6.68	6.20	20.10	68.57	16.00	23.11	4.95	5.87		1.93
Direct seeding (WS–D_3)	87.11	6.73	5.91	20.07	67.80	15.73	22.90	4.90	5.87		1.65
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-
Varieties x Methods											
V_1D_1	80.63	6.06	6.57	19.47	79.33	17.27	22.40	**6.00**	6.17	129	
V_2D_1	92.01	7.47	5.53	20.20	67.67	13.80	22.42	4.90	5.91	136	
V_1D_2	81.07	6.13	5.63	19.47	69.87	17.80	23.31	4.90	6.00	120	
V_2D_2	91.76	7.23	6.76	20.73	67.27	14.20	22.90	4.78	5.73	128	
V_1D_3	81.60	6.13	5.30	19.67	69.07	17.47	23.26	4.93	5.77	125	
V_2D_3	92.63	7.33	5.53	20.47	66.53	14.00	22.55	4.88	5.97	131	
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	
C.V (%)	0.92	6.80	8.63	2.37	9.27	18.19	2.93	6.99	3.49	-	

S : Sprouting and WS : Without sprouting. NS : Not Significant.

second highest yield (4.95 t/ha) in direct seeding (sprouting) method.

Interaction between varieties and methods showed the highest grain yield in transplanting method by Binadhan-14 (6.00 t/ha) and second highest (4.93 t/ha) in direct seeding (without sprouting) by the same variety. Similar results were also obtained by Xiang *et al.* (1999) and Nourbakhshian (2000).

Growth Duration

Interaction of varieties and cultivation methods significantly affected crop duration (Table 1). Establishment of rice with transplanting method needed the longest duration for maturity. Binadhan-14 required 129, 120 and 125 days for maturity by the methods of transplanting, direct seeding with sprouting and direct seeding without sprouting, respectively. On the other hand, BRRI dhan 28 required 136, 128 and 131 days for maturity by the methods of transplanting, direct seeding with sprouting and direct seeding without sprouting, respectively. The direct seeding with sprouting method was one week earlier than transplanting method. Rani and Jayakiran (2010) also agreed with that depending on a cultivar, direct seeded rice matured seven to ten days earlier than transplanted rice. Growth duration of the crop was considerably reduced in direct seeded rice might be due to the absence of transplanting shock. The longer days to flowering and maturity in seedling transplanting could be due to longer period required for crop establishments in the main field. Direct seeding with sprouted seed method was second highest in grain yield also saved labour cost. Rana *et al.* (2014) reported the highest cost : benefit ratio in direct seeding method. Rani and Jayakiran (2010) found higher net returns in their experiment due to saving of labour cost and irrigation water in direct seeded rice. The association of grain yield and crop duration indicated that the direct seeding system would applicable.

Cost : Benefit Ratio

The highest cost : benefit ratio (1.93) was noted in direct seeding of sprouted seed followed by transplanting method (1.67) and direct seeding without sprouting (1.65).

Rangpur

Analysis of data showed that the number of effective tillers/hill was significant in different cultivars but not significant in different cultivation methods. Panicles/hill, filled grains/panicle and grain yield were significant in both the different cultivars and cultivation methods. From varieties study at Rangpur, the maximum number of effective tiller/hill (11.57) Binadhan-14, panicles/hill (12.05) BRRI dhan 28, filled grains/panicle (95.91) Binadhan-14 and panicle length (22.78 cm) BRRI dhan 28 were obtained. The results showed that the highest grain yield (5.32 t/ha) was obtained by Binadhan-14 (Table 2) followed

Table 2. Effect of direct seeding and transplanting of Binadhan-14 on the yield and yield contributing characters in late *boro* season during 2014-15 at BINA Sub-station, Rangpur

Treatment	Plant height (cm)	Tillers/ hill	Panicles/ hill	Panicle length (cm)	Filled grains/ panicle	Unfilled grains/ panicle	1000-seed weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Crop duration (days)	Cost : benefit ratio
Varieties											
Binadhan-14 (V_1)	92.47	11.57	10.23	20.98	95.91	24.03	22.13	5.32	7.56		
BRRI dhan-28 (V_2)	101.95	13.78	12.05	22.78	80.28	32.33	22.62	4.89	8.00		
LSD (P=0.05)	**	**	**	**	**	**	NS	**	**		-
Methods											
Transplanting (D_1)	98.73	12.21	11.58	22.11	99.06	31.80	23.53	5.92	7.75		1.79
Direct seeding (WS–D_2)	95.68	10.13	10.70	21.65	77.13	24.57	21.40	4.29	8.81		1.71
LSD (P=0.05)	**	NS	**	NS	**	**	**	**	**		-
Varieties x Methods											
$V_1 D_1$	92.17	11.80	9.93	20.90	108.33	23.53	22.94	6.29	6.95	128	
V_1D_2	92.76	11.33	10.53	21.06	83.50	24.53	21.32	4.35	8.17	133	
$V_2 D_1$	105.398	12.63	11.46	23.33	89.80	40.07	23.76	5.56	8.56	121	
$V_2 D_2$		14.93	12.63	22.23	70.76	24.60	21.47	4.23	8.45	129	
LSD (P=0.05)	1.82	1.34	NS	NS	NS	4.74	NS	0.08	0.09		
C.V. (%)	0.94	5.29	3.60	2.53	4.07	8.41	2.30	0.89	0.55		

S : Sprouting and WS : Without sprouting. NS : Not Significant.

by BRRI dhan 28 which produced 4.89 t/ha.

The results from different methods showed the maximum number of effective tillers/hill (12.21), number of panicles/hill (11.58), filled grains/panicle (99.06) and panicle length (22.11 cm) in transplanting method at Rangpur. Methods of sowing showed that highest grain yield (5.92 t/ha) was produced in transplanting method and the second highest yield (4.29 t/ha) in direct seeding method.

Interaction between varieties and methods showed that the highest grain yield (6.29 t/ha) was produced in transplanting method by Binadhan-14. Similar results were also obtained by Yang *et al.* (1998) and Rana *et al.* (2014).

Growth Duration

Interaction of varieties and cultivation methods significantly affected crop duration (Table 2). Establishment of rice with transplanting method needed the longest duration for maturity. Binadhan-14 required 128 and 121 days for maturity by the methods of transplanting and direct seeding with sprouting, respectively. On the other hand, BRRI dhan 28 required 133 and 129 days for maturity by the methods of transplanting and direct seeding with sprouting, respectively. Here also direct seeding with sprouting method was one week earlier than transplanting method. Masuduzzaman (2011) reported that BRRI dhan 28 required 138 days for direct seeding and 143 days for transplanting method. He also supported that direct seeding was seven days earlier than transplanted rice. Considering crop duration, the direct seeding with sprouting seed was beneficial method.

Cost : Benefit Ratio

The highest cost : benefit ratio (1.79) was noted in transplanting method followed by direct seeding without sprouting (1.71).

CONCLUSION

Water resources have become vulnerable and inadequate for agriculture under climate change. To escape dry season crops and irrigation based rice farming, *boro* rice shall be shifted as late *boro*. Comparative effect of transplanting method in late *boro* season of 2014-15 was studied in BINA farm. Binadhan-14 showed the maximum grain yield. Transplanting methods showed maximum grain yield in most cases except crop duration. Further study is required to conclude the most effective method of cultivation for Binadhan-14 with other agronomical management practices.

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