Comparative study of BRRI dhan41 and local variety Rajasail under direct wet seeded method at coastal char land of Bangladesh

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Abstract

The experimental study was conducted at coastal char land of BRRI Farm, Sonagzi, Feni during T. Aman season, 2005 to compare the yield performance and profitability of BRRI dhan41 and local variety Rajasail under direct wet seeded condition using Drum Seeder technology. Sprouted seeds of BRRI dhan41 and Rajasail were sown as direct wet seeded method using the drum seeder. Factorial RCBD was followed with three replications. The results showed that BRRI dhan41 produced relatively higher grain yield of 2.2 t ha^{-1} under weeded condition compared to un-weeded (1.69 t ha^{-1}) plots. The local variety Rajasail gave about 28% lowers grain yield than that of BRRI dhan41 under weeded condition. However, BRRI dhan41 gave higher grain yield compared to Rajasail under both weeded and un-weeded conditions. Moreover, harvest index was higher in BRRIdhan41 (0.41) under weeded condition but its growth duration was about 20 days longer than that of Rajasail. Regarding the Drum Seeder technology, it appeared as cost saving technology. Higher benefit-cost ratio was obtained for BRRI dhan41 (1.43) under weeded condition because of higher grain yield whereas lower was obtained for local variety (1.02) under weeded condition because of more input cost. Farmer of coastal char land preferred to cultivate Rajasail because of about 20 days early harvest that leads to grow another rabi crops such as lady's finger, black gram and other winter vegetables in the residual soil moisture. Farmer can cultivate modern variety like BRRI dhan41 using drum seeder technology for harvesting higher benefit.

Key words: Direct wet-seeded rice, BRRI dhan41, Local rice variety Rajasail and Drum Seeder technology

Introduction

More than half of the world's population use rice as a stable food and it is generally grown under wetland condition (Islam and Ahmad, 1999; Farouq *et al*. 2011). Among different rice establishment methods, direct seeding and transplanting are the most popular. Direct seeding of rice refers to the process of establishing rice from seeds sown in the field rather than transplanting of seedlings from the nursery. In Bangladesh, manual transplanting of seedling under puddled condition is generally practiced for rice establishment which requires more irrigation and labors for land preparation, seedling raising and uprooting and transplanting. Now-a-days, more agricultural laborers are migrating to urban areas for non-farm employment causes labor scarcity during peak transplanting period and encourage farmers delay transplanting with older seedlings resultant lower grain yield. In the Southeast Asian countries, rice production practices are changing with the advancement of technologies and changing socio-economic conditions. Direct wet seeding is a good alternative for HYV rice establishment where pre-germinated seeds are broadcasted into puddled soil (Can and Xuan, 2002) and requires less water and labor (Coxhead, 1984). This method reduces the growth duration by about 8 days compared to conventional transplanted rice (Hussain *et al*., 2003) because direct seeded rice may escape transplanting shock and injury (Satter *et al.*, 1996). Presently, 23% of rice is cultivated under direct-seeding method globally (Rao *et al*., 2007). It is reported that direct seeded rice produced about 15% of higher grain yield in China (Ding *et al.*, 1999) and 2-12% in Bangladesh (Huassin *et al.*, 2003) over the transplanted rice. In Philippines, under continuous standing water, direct wet-seeded rice yielded higher than transplanted by 3-17% and increased water productivity (yield per unit water use) 25-48% (Tabbal *et al*., 2002). Satter and khan (1994) reported that direct wet-seeded rice required about 20% less water but gave 10% higher yield during boro season compared with transplanted rice. As of Isvilanoda (2002), direct seeded rice reduced 2-6% production cost and increased 37% net return in dry season. Rice growing under direct wet seeding method is swiftly increasing in many Southeast Asian countries because of it less cost and more benefits (Pandey, *et. al*., 2002). Direct wet seeding (DWS) of rice by drum seeder (a manually operated technology to sow the pre-germinated seeds in the wet land) is a new idea in Bangladesh and may be a good alternative of rice establishment in the irrigated conditions. BRRI dhan29 produced the highest grain yield of 5.76 and 6.47 tha^{-1} in Boro season, 2004-05 and 2005-06, respectively

under direct wet seeded rice using drum seeder with single thick row (Islam *et al*., 2008). In the char areas (Char a tract of land surrounded by waters of an ocean, sea lake or stream; it usually means, any accretion in a river course or estuary) of greater Noakhali district of Bangladesh, many farmers used to practice direct wet seeded rice by hand broadcasting. Traditional varieties like Rajasail are mostly adopted in this area as direct wet seeded method. The yield potentials of this variety are poor and hence, the farmers get marginal net return. If the farmers would cultivate the modern rice instead of traditional variety of Rajasail, they might get more net return even from the same practice of direct wet seeding. It was essential to know the causes of growing local varieties under hand broadcasting method instead of modern rice varieties using drum seeder technology by the farmers. If it could be shown the beneficial aspects HYV and Drum Seeder to the farmers, they will adopt it. Contrary, transplanting shock of the transplanted rice prolongs the growth duration that limits the cultivation of long duration HYV rice and land productivity. With these view, a study was conducted at BRRI Sonagazi Research farm to compare the yield performance of one modern variety of BRRI dhan41 and one local variety of Rajasail under direct wet seeded method using Drum Seeder during T. Aman season, 2005.

Methodology

This study was conducted at BRRI Farm, Sonagzi, Feni of Bangladesh during T. Aman season, 2005 to compare the yield performance and economics of modern rice variety BRRI dhan41 and local variety Rajasail under direct wet seeded method using Drum Seeder technology. Sprouted seeds of the two selected varieties were sown in the well-prepared puddled land as direct wet seeded rice using drum seeder with double thin row (row to row distance: 200 mm) on 29 July 2005. The drum seeder is a manually operated direct seeding farm implement and consists of six drum and two driving wheels. Drum of the drum seeder rotate as the driving wheels rotate. As a result, the seeds from the drum dispensed to the field through the holes. The seed rate was 45 and 50 kg ha^{-1} for BRRI dhan41 and Rajasail, respectively because of different grain size and 1000 grains weight. BRRI recommended fertilizers, such as Triple Super Phosphate, Muriate of Potash, Gypsum and Zinc-sulphate were applied as basal @ 100, 70, 60 and 10 kg ha^{-1}, respectively at the time of final land preparation. Urea was applied @ 160 kg ha^{-1} into three equal splits at 15, 45 and 55 days after transplanting (DAT) for each variety. Two times hand weeding were also done at 15 DAT and 35 DAT to keep the field weed free of the weeded plots. Gap filling was done in some spots of the drum seeded and broadcasted plots because of seedling mortality due to heavy rain, bird damage of seeds etc. Plots were kept saturated till the tillering stage and minimum standing water was maintained up to boating stage. However, plots were kept with standing water of 30-40 mm at 35-40 days after sowing. Other intercultural operations were done as and when necessary. Crops and yield attributes data of panicle m^{-2}, filled grains/panicle, sterility %, duration of maturity, grain and straw yield were recorded. Grain yield and yield contributing parameters were recorded following the procedure of Gomez and Gomez (1984).

Results and discussion

Two-way interaction of the variety and weeding condition was not significant whereas single effect of variety and weeding condition influenced the plant height significantly (Table 1). Averaged across the weeding condition, HYV (BRRI dhan41) demonstrated significantly higher plant height (114.3 cm) whereas plant height under weeded condition was higher (110.7 cm) compared to un-weeded condition. However, 2-way interaction of variety and weeding condition was not influenced significantly on growth duration whereas single effect of variety showed significant effect. Averaged across the weeding condition, BRRI dhan41 (129 days) gave higher duration compared to Rajasail (107 days).

Table 1. Plant height and crop duration as affected by variety and weeding condition

Treatments	Plant height (cm)		Mean	Growth duration (days)		Mean
	HYV	LV		HYV	LV	
Weeded	117.7	103.7	110.7	129.3	107.7	118.5
Un-weeded	111.0	101.0	106.0	128.7	106.7	117.7
Mean	114.3	102.3	-	129.0	107.2	
LoS	V=*, W=* and V × W=NS			V=*, W=NS and V × W=NS		
$LSD_{0.05}$	V=9.4 and W=4.3			V=5.9		
% of CV	2.5			1.2		

Note: *= significant at 5% level of probability, **= significant at 1% level of probability, V= variety, W= weeding condition, NS= Not significant, LoS=Level of significance, HYV= High yielding variety (BBRI dhan41), LV= Local variety (Rajasail)

Combine effect of variety and weeding condition on panicles was not significant whereas single effect was demonstrated significantly. Rajasail (LV) showed significantly higher number of panicles m^{-2} compared to BRRI dhan41 (HYV) at 1% level of probability. Averaged across the weeding condition, LV produced 198 number of panicles m^{-2} whereas HYV produced only 100 panicles m^{-2} (Table 2.a). However, panicle m^{-2} in weeded condition (157.8) was also significantly higher compared to un-weeded condition (141). Table 2(a) also reveals that single effect of variety and weeding condition on filled grains per panicle was highly significant (1% level of probability). Two-way interaction of variety and weeding condition on filled grains also significant at 5% level of probability as were single effect of variety and weeding condition at 1% level of probability (Table 2.a). The highest number of filled grains per panicle was obtained in HYV (101) under weeded condition whereas the lowest was obtained in LV (39) under un-weeded condition. Averaged across the weeding condition, filled grains per panicle were observed 93 in HYV whereas it was only 39 in LV.

On the other hand, two-way interaction effect on percent of sterility was significant at 5% level of probability as were single effect of weeding condition whereas effect of variety was insignificant (Table 2.b). Averaged across the varieties, un-weeded plots produced higher percentage of sterility compared to weeded condition. On the contrary, the highest percentage of sterility was observed in LV (29) and HYV (29) under weeded and un-weeded conditions, respectively. In case of 1000 grain weight, only variety influenced significantly whereas LV gave higher weight (25.7 g 1000 $grain^{-1}$).

Table 3 shows that HYV gave significantly higher harvest index (0.39) compared to LV (0.30). Contrary to, weeding condition did not show significant effect on harvest index. Interaction effect of variety and weed management found statistically significant as were single effect of variety. Yield of paddy also varied significantly with the 2-way interaction of variety and weeding condition as were single effect of variety and weeding condition (Table 3). HYV gave significantly higher grain yield (2.2 t ha^{-1}) under weeded condition whereas lower was observed in LV (1.43 t ha^{-1}) under un-weeded condition. Averaged across the weeding condition, HYV (1.9 t ha^{-1}) gave higher grain yield over LV. Weeded plot gave 27 and 10 percent of higher grain yield over un-weeded plot under HYV and LV, respectively. Average production of HYV and LV were 1.9 t ha^{-1} and 1.5 t ha^{-1} under weeded and un-weeded conditions, respectively. These results were agreed with Bautista and Gagelonia (1994) as they reported that direct wet seeding (DWS) using drum seeder gave increased yield of 425 and 750 kg ha^{-1} compared with broadcasting and transplanting method, respectively. Hussain *et al.* (2004) also found that DWS by drum seeder in single thick row gave about 22% higher yield than transplanting method with weeded plots.

Table 2(a). Yield contributing parameters as affected by variety and weeding condition

Treatments	Panicles m^{-2}		Mean	Filled grains $panicle^{-1}$		Mean
	HYV	LV		HYV	LV	
Weeded	106.0	209.7	157.8	101.33	39.33	70.3
Un-weeded	95.0	187.0	141.0	84.33	38.67	61.5
Mean	100.5	198.3	-	92.8	39.0	-
LoS	V=**, W=* and V × W=NS			V=**, W=** and V×W=*		
$LSD_{0.05}$	V=23.25 and W=8.23			V=9.49, W=4.49, V×W=6.36		
% of CV	3.43			4.25		

Note: *= significant at 5% level of probability, **= significant at 1% level of probability, V= variety, W= weeding condition, NS= Not significant, LoS=Level of significance, HYV= High yielding variety (BBRI dhan41), LV= Local variety (Rajasail).

Table 2(b). Yield contributing parameters as affected by variety and weeding condition

Treatments	Sterility (%)		Mean	1000 grain wt.(g)		Mean
	HYV	LV		HYV	LV	
Weeded	21.33	28.67	25.0	22.75	25.5	24.1
Un-weeded	29	28	28.5	22.65	25.85	24.3
Mean	25.2	28.3	-	22.7	25.7	-
LoS	V=NS, W=* and V × W=*			V=*,W=NS and V × W=NS		
$LSD_{0.05}$	W=3.07 and V×W=4.34			V=0.32		
% of CV	7.16			1.34		

Note: *= significant at 5% level of probability, **= significant at 1% level of probability, V= variety, W= weeding condition, NS= Not significant, LoS=Level of significance, HYV= High yielding variety (BBRI dhan41), LV= Local variety (Rajasail)

Table 3. Yield (t/ha @ 14% moisture content) as affected by variety and weeding condition

Treatments	Harvest index(HI)		Mean	Grain yield (tha^{-1})		Mean
	HYV	LV		HYV	LV	
Weeded	0.41	0.30	0.36	2.2	1.59	1.9
Un-weeded	0.36	0.30	0.33	1.61	1.43	1.5
Mean	0.39	0.30	-	1.9	1.5	
LoS	V=*, W=NS and V × W=*			V=*, W=** and V × W=**		
$LSD_{0.05}$	V=0.01 and V × W=0.03			V=0.37, W=0.11 and V ×W=0.15		
% of CV	3.76			3.85		

Note: *= significant at 5% level of probability, **= significant at 1% level of probability, V= variety, W= weeding condition, NS= Not significant, LoS=Level of significance, HYV= High yielding variety (BBRI dhan41), LV= Local variety (Rajasail)

Table 4: Cost and benefit includes in different treatments

Variety	Weeding condition	Total input cost (Tk ha^{-1})	Gross return (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
HYV	Weeded	14965	21351	6386	1.43
	Un-weeded	13215	15584	2369	1.18
LV	Weeded	15040	15343	303	1.02
	Un-weeded	13290	13799	509	1.04

Note: Local market price of paddy: 9Tk/kg and Straw: 1.0 Tk/kg

This result again confirms with the findings of Ding *et al*., 1999 and Satter and Khan, 1994, where they reported that up to 15% of grain yield increased in direct seeded rice compared with transplanted rice both under weeded condition.

Economic analysis

Total input cost included all variable cost (fuel, labour, fertilizer, machine hiring cost, pesticide and other expenses) and fixed cost (land opportunity cost) from land preparation to harvesting operation. Same amount of seed, fertilizer and pesticide were applied in all the plots. Weeding treatment showed significant effect on input cost, gross return, gross margin and benefit cost ratio (BCR). The highest gross margin was observed in HYV and the lowest in LV under weeded condition (Table 4). Higher grain yield in HYV under weeded condition led to increase gross return. The highest BCR was for HYV under both weeded (1.43) and un-weeded (1.18) condition. The lowest BCR was found 1.02 in LV weeded condition because of more input cost and less grain yield.

Conclusion

BRRI dhan41 gave higher grain yield than Rajasail under both weeded and un-weeded conditions. The low gain yield of Rajasail was attributed for its lower grains per panicle, higher sterility, lodging susceptibility especially at the ripening phase. Cultivation of BRRI dhan41 with proper weed management along with direct wet seeded method using drum seeder technology showed higher BCR (1.43). Farmers of coastal char land can cultivate modern variety like BRRI dhan41 using drum seeder technology for harvesting higher yield and getting more benefit.

References

Bautista EU and Gagelonia EC. 1994. Rice drum seeder. Technology! *Los-Banos*.16 (1):24.

Coxhead IA. 1984. The economics of wet seeding: Inducements to and consequences of some recent changes in Philippines rice cultivation. M. S. thesis. Agricultural Development Economic in the Australian National University, Australia.

Dingkhun M, Schnier HF, De Datta SK, Dorffing K and Javellana C. 1991. Relationship between ripening phase productivity and crop duration, canopy photosynthesis and senescence in transplant and direct seeded low land rice. *Field Crop Research*. 26(3-4): 327-345.

Ding XH, Fu RY and Fang L. 1999. A study on tiller ear bearing of direct seeded rice for yield up to 8.25 t/ha m^2. *China Rice* No. 2: 18-19.

Farooq M, Kadambot Siddique HM, Rehman H, Aziz T, Dong-JinLee and Wahid A. 2011. "Rice direct seeding: Experiences, challenges and opportunities." Soil & Tillage Research 111 pp 87–98.

Gomez KA and Gomez AA, (1984). Statistical procedures for agricultural research (2 ed.). John wiley and sons, NewYork, 680p.

Hussain MM, Haque MA, Islam MA and Islam MR. 2000. Performance of direct wet seeded rice under on farm irrigated conditions in Bangladesh. Bangladesh Journal of Environmental Science. 6(2): 329-333.

Hussain MM, Haque MA, Khan MAI, Rashid MM and Islam MF. 2003. Direct wet-seeded method of establishment of rice under irrigated condition. *The Agriculturists.* 1(1): 106-113.

Hussain MM, Islam MF, Abedin MZ, Rashid MM and Alam MZ. 2004. Direct wet seeding using drum seeder: a new dimension of rice (*Oryza sativa* L.) cultivation in Bangladesh. *The Agriculturists.* 2(1): 146-150.

Islam MS, Halder KP and Chowdhury MJUC. 2008. Effect of Crop Establishment Methods and Variety on the Yield of Rice in the Irrigated Ecosystem. Intl. J. BioRes. 4(3): 31-35.

Isvilanoda S. 2002. Development trends and farmers' benefits in the adoption of wet-seeded rice in Thailand. Direct Seeding: Research Strategies and Opportunities. International Rice Research Institute. pp. 115-124.

Kim HunHo and Kim HH. 1998. Analysis of lodging-related traits of direct seeded rice. *Korean Journal of crop Science*. 43(1): 32-37.

Pandey, Mortimer SM, Wade L, Tuong TP, Lopez K, Hardy B. editors. 2002. Direct Seeding: Research Issues and Opportunities. *In:* Proceedings of the Int. Workshop on Direct Seeding in Asian Rice Systems: Strategic Research Issues and Opportunities, 25-28 January 2000, Bangkok, Thailand. Los Banos (Philippines): IRRI, 383 p.

AN Rao, Johnson DE, Sivaprasad B, Ladha JK and Mortimer AM. 2007. Weed management in direct-seeded rice. Adv. Agron. 93:153–255.

Satter MA and Khan MAK. 1994. An assessment of the wet seeded rice cultivation technique in Bangladesh. Paper presented in the international workshop on constraints, opportunities and innovations for wet seeded rice. 31 May- 3 June, 1994 at Maruay Garden Hotel, Bangkok, Thailand.

Satter MA, Bhuiyan SI, and Undan RC. 1996. Water management of direct seeded rice vs. transplanted rice in an irrigated system. *Journal of the Institution of Engineers*, Bangladesh. Agricultural Engineering Division. Vol. 24/AE. No. 1: 62-68.

Islam Syedul M and Ahmad Desa. 1999. Modification, Test and Evaluation of Manually Operated Drum Type Seeder for Lowland Paddy. Pertanika J. Sci. &Technology.7(2): 85-98.

Tabbal DF, Bauman BAM, Bhuiyan SI, Sibayan EB and Satter MA. 2002. On-farm strategies for reducing water input in irrigated rice; Case studies in the Philippines. Agricultural Water Management. 56: 93-112.