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Evaluation of Aus Rice (*Oryza sativa* L.) Production in Less Irrigated Situation in Northern Region of Bangladesh

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Abstract

Twenty one demonstrations and two validation trials were carried out at the farmers' field in the northern region of Bangladesh during 2014 using Aus rice: variety BRRI dhan48 to enhance Aus (pre-monsoon) rice cultivation. Grain yields of 3.5 to 6.5 t ha^{-1} were obtained from demonstrations plots conducted in different farmers' field. The validation trial was conducted in the farmers' field at Mithapukur and Nilphamari Sadar Upazillas using BRRI dhan28 and BRRI dhan48 as Braus (rice grown between Boro and Aus season) after harvesting potato. Grain yield of about 5.0 t ha^{-1} was obtained from the rice variety BRRI dhan28, while 6.6 t ha^{-1} was obtained from BRRI dhan48. BRRI dhan48, due to its shorter growth duration (100-105 days) required 2-3 less irrigations. About 28-36% less irrigation water was required during dry season when BRRI dhan48 was used as Braus instead of BRRI dhan28 as a Boro crop. About 20 to 60% higher grain yield was observed in different farmers' field with BRRI dhan48 over BRRI dhan28, which indicated that BRRI dhan48 is a potential rice variety during Aus or Braus season. BRRI dhan48 can be cultivated after Boro harvest or as Braus after potato harvest. The variety could also decrease the pressure on ground water utilization for rice cultivation during dry season.

Keywords: BRRI dhan48, Braus, Climate change.

1. Introduction

Boro (dry season) rice (*Oryza sativa* L.) -Fallow-T. aman (monsoon rice) cropping pattern is dominant in Rangpur region of northern Bangladesh, where about 40% of cultivable land is comprised of this pattern. Farmers are growing boro rice in medium high land by irrigating more than 20 times in a season. Thus, boro cultivation is costly due to high water consumption (Nargis *et al.*, 2009). In Bangladesh, ground water is decreasing day by day due to climate change, less rainfall, less recharge of ground water (Hodgson *et al.*, 2014). Nevertheless with the rising water stress and erratic rainfall, Bangladesh Government has been trying to reduce the Boro rice cultivation in the country for last few years. Aus (pre-monsoon season) rice production between Rabi (dry season) and Kharif II (Braus) might be an alternate to save underground water. Production of short duration rain-fed Aus rice is a good step to conserve ground water (Roy *et al*., 2013).

Farming of Aus crop area using unused seasonal rain water must be increased during the Kharif-1

season as an additional and substitute cereal crop to gradually replace cultivation of more irrigation water consuming and costly Boro farming (Rahman *et al.*, 2016). Hence groundwater utilization will be reduced in Rangpur region under climate change situation and food security will be stable with the up-scaling of Aus instead of Boro rice. At present, the Aus area in Rangpur region is about 9% (Personal communication with DD and AD of DAE, Rangpur). The government has given a thrust on Aus rice cultivation by distributing seeds, fertilizers etc. among the farmers of Bangladesh. The present study was undertaken to evaluate the yield performance of Aus rice, variety BRRI dhan48 and estimate the irrigation water requirement of the Aus rice compared to Boro rice at the farmers' field of Rangpur.

2. Materials and Methods

Thirty five farmers of seven villages namely Bagerbazar of Pirgonj, Rangpur Batason Durgapur of Mithpukur, Rangpur, Fulgas of Lalmonirhat Sadar, Surpukur of Aditmari, Lalmonirhat, Sundra Hobi of Kaligonj, Lalmonirhat Amtoli of Rajarhat, Kurigram and Ponchapukuri of Nilphamari Sadar were selected in Rangpur region to introduce BRRIdhan48 as against local varieties like Parija, Vhadi etc. Selected lands were medium-high and the type of soil was light textured.

2.1 Cultivation methods

Rice seeds of BRRI dhan48 was collected from BRRI Rangpur. Land was prepared by the respective farmers and basal fertilizers was applied @ of 60, 75, and 45 kg per ha, TSP, MoP and gypsum, respectively and urea was applied @ 180 kg per ha at 12 & 25 DAT following BRRI recommendation. Adaptive trial of Braus was conducted in potato growing area (Mithapukur and Nilphamari Sadar Upazilla) after harvesting potato. The most popular Boro variety BRRI dhan28 and Aus variety BRRI dhan48 were used in the adaptive trial in Braus. The seeding date was 1st week of February and transplanting date was 2nd week of March, 2014. Thirty five days old seedlings were transplanted for both the varieties. BRRI recommended cultural practices like weed management, irrigation, pest management were done as and when necessary.

2.2 Data collection and analysis

The data on plant height, panicle m^{-2}, grain $panicle^{-1}$, growth duration and grain yield were collected from rice plants of 5m × 2m area from each plot with 3 replications. The grain moisture was measured just after threshing and grain yield was adjusted at 14% moisture content. Combined analysis (Programing R) was done to find out the interaction effect of genotype × environment for 21 demonstrations on BRRI dhan48 in different locations of Rangpur.

3. Results and Discussion

The average plant height was 103 cm, average panicle m^{-2} was 275, average grain $panicle^{-1}$ was 88 and average grain yield was 4.50 t ha^{-1} (Table 1). Grain yield performance was higher (5.97 t ha^{-1}) after potato harvest (Table 2).

3.1 Genotype × Environment effect

Based on combined analysis of variance the individual effect of genotypes and locations were highly significant (1% level) and the interaction effect of genotype and location was significant (5% level). BRRI dhan48 showed different performance in different locations. The yield performance was not stable over the locations. The CV value was 9.4% which indicated that the experiment was perfectly designed and the precision levels was satisfactory (Table 3). The reliability of the data were acceptable.

3.2 Validation trial on BRRI dhan28 and BRRI dhan48 in Rangpur and Nilphamari

Table 4 shows that the highest grain yield (6.71 t ha^{-1}) was observed in BRRI dhan48 at

Mithapukur and the lowest yield (4.22 t ha^{-1}) was observed in BRRI dhan28 at Nilphamari Sadar. Yield performance of BRRI dhan28 at Mithapukur and BRRI dhan28 and 48 in Nilphamari Sadar was statistically similar. So, in Rangpur region after potato harvest BRRI dhan48 could be cultivated as Barus season for higher yield in respective of cropping pattern.

Table 1. Plant height, panicle no. m^{-2}, grains no. $panicle^{-1}$ and grain yield of BRRI dhan48 as influenced by different locations during Aus 2014 at Rangpur region

Location	Demo no.	Plant ht. (cm)	Panicle no. m^{-2}	Grain no.$panicle^{-1}$	1000 GW (g)	Yield (t ha^{-1})
Bagerbazar	2	106**	310a*	92ab	24.7**	6.04a
Lalmonirhat Sadar	3	102	273bc	77bc	24.1	3.73b
Aditmari	3	103	265cd	71c	23.8	3.37b
Kaligonj	1	102	254cd	68c	23.7	3.10b
Rajarhat, Kurigram	8	103	293ab	99a	24.5	5.58a
Nilphamari Sadar	4	102	238d	90ab	23.7	3.35b

* In column, mean with same letter (s) are not differed significantly at 5% level of significance, ** NS

Table 2. Plant height, panicle m^{-2}, grains $panicle^{-1}$ and grain yield of BRRI dhan48 as influenced by different cropping pattern during Aus 2014, Rangpur region

Cropping Pattern	Demo no.	Plant ht. (cm)	Panicle no. m^{-2}	Grain no.$panicle^{-1}$	Yield (t ha^{-1})
After Boro harvest	4	102**	256b*	87abc	3.96bc
After damaged Boro	1	102	296a	92ab	4.60b
After potato harvest	8	104	302a	100a	5.97a
After sunflower harvest	1	101	252b	68c	3.10c
After tobacco harvest	7	102	257b	78bc	3.31c
CV%		1.54	9.65	15.21	29.24

* In column, means with same letter (s) are not differed significantly at 5% level of significance, **NS

Table 3. Combined analysis for grain yield of BRRI dhan48, Aus 2014, Rangpur

S.V	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Genotype (G)	1	5.7241	5.7241	24.8793	0.002482 **
Location (L)	1	6.5921	6.5921	28.652	0.001740 **
L:R	6	1.9597	0.3266	1.4196	0.340637
G:L	1	2.1536	2.1536	9.3603	0.022240 *
Residuals	6	1.3804	0.2301		

R= Replication, CV%= 9.4, Mean= 5.098, LSD= 0.587

Table 4. Grain yield of two varieties in Mithapukur and Nilphamari Sadar during Braus season 2014, Rangpur

Location	Yield (t ha^{-1})	
	BRRI dhan48	BRRI dhan28
Mithapukur	6.71a*	4.78b
Nilphamari Sadar	4.69b	4.23b

* In column, means with same letter (s) are not differed significantly at 5% level of significance.

Table 5. Irrigation number required for BRRI dhan28 and BRRI dhan48 during Braus 2014 season

Demo no.	No of irrigation		Applied water (mm)		Rainfall (mm)	Total water (mm)		Yield (t ha^{-1})		% increase over BRRI dhan28
	BRRI dhan28	BRRI dhan48	BRRI dhan28	BRRI dhan48		BRRI dhan28	BRRI dhan48	BRRI dhan28	BRRI dhan48	
Mithapukur, Rangpur										
1	15	13	543	471	390	933	861	5770	6940	20.15
2	15	13	573	496	390	963	886	5450	6560	20.49
3	15	13	573	496	390	963	886	4180	6670	59.57
4	15	12	591	473	390	981	863	3700	6650	79.76
5	13	13	546	546	390	936	936	5590	6180	10.57
6	13	13	512	512	390	902	902	4160	6730	61.70
7	15	13	588	510	390	978	900	5740	6650	15.91
8	15	13	525	455	390	915	845	5510	6660	20.97
9	15	14	591	551	390	981	941	4280	6650	55.10
10	15	14	591	551	390	981	941	5130	6700	30.60
Average						953	896	4951	6639	37.48
Nilphamari Sadar										
1	15	13	633	548	360	993	908	4250	5050	18.80
2	15	13	578	501	360	938	861	4050	4350	7.40
3	15	13	584	506	360	944	866	4350	4750	9.20
4	15	12	574	459	360	934	819	4250	4600	8.20
Average						952	864	4225	4688	10.90

Table 5 also showed that about 12 to 15 number of irrigation was required for Braus cultivation as there was rainfall of 360-390 mm during March-May. BRRI dhan48 received 2-3 number of less irrigation in most cases due to shorter growth duration as compared to BRRI dhan28. In this region, average 864-896 mm of water required (Mainuddin *et al.*, 2014) for cultivating BRRI dhan48, whereas BRRI dhan28 required about 953 mm of water (Table 5). Over aged seedlings need more irrigations to overcome transplanting shock for BRRI dhan28 at vegetative stage. So, BRRI dhan28 required more irrigation water than BRRI dhan48.

Figure 1 and 2 showed the comparative water requirement for both the varieties in Rangpur region. BRRI dhan28 and BRRI dhan48 were

transplanted under irrigated condition due to lack of rainfall during March in Rangpur region (Fig. 1 & 2). Irrigation requirement depends on rainfall and reference crop evapo-transpiration. No irrigation water was applied during the month of June due to sufficient rainfall. So, evaporative demand of crops minimized through rainwater. In the month of May, irrigation requirement was much lower than the month of April due to much lower evaporation demand that could be provided from rainfall for both the varieties (Figs. 1 & 2).

If BRRI dhan28 was cultivated as a Boro variety in proper time, considering conventional irrigation practice then 20-25 number of irrigation water was required in this region which was about 1630-1744 mm of water (BRRI 2012-13) and also yield of BRRI dhan48 as Braus obtained more or less similar to BRRI dhan28 as Boro. Boro rice, an irrigated crop, consumed 73 percent of the total crop irrigation and contributed to a greater extent in total rice production in Bangladesh (Rahman *et al.*, 2009).

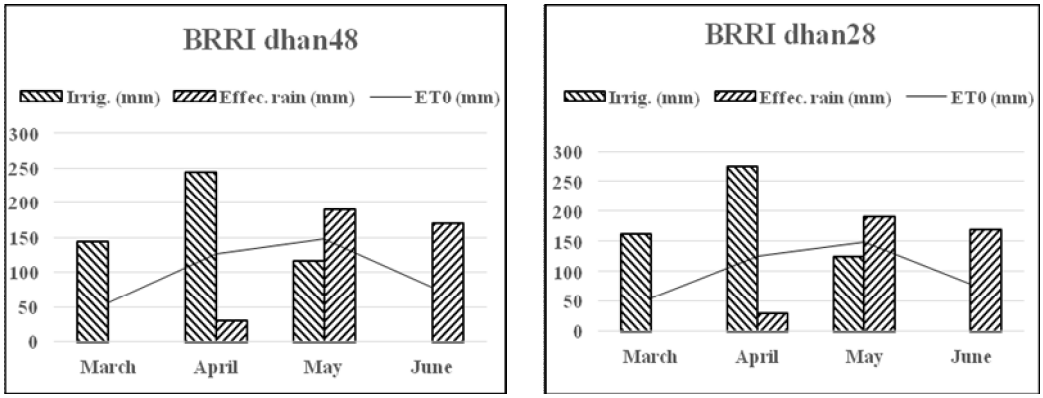

Figure 1. Monthly effective rainfall, reference crop evapotranspiration (ET_0) and irrigation water for BRRI dhan48 and BRRI dhan28 at Mithapukur, Rangpur district

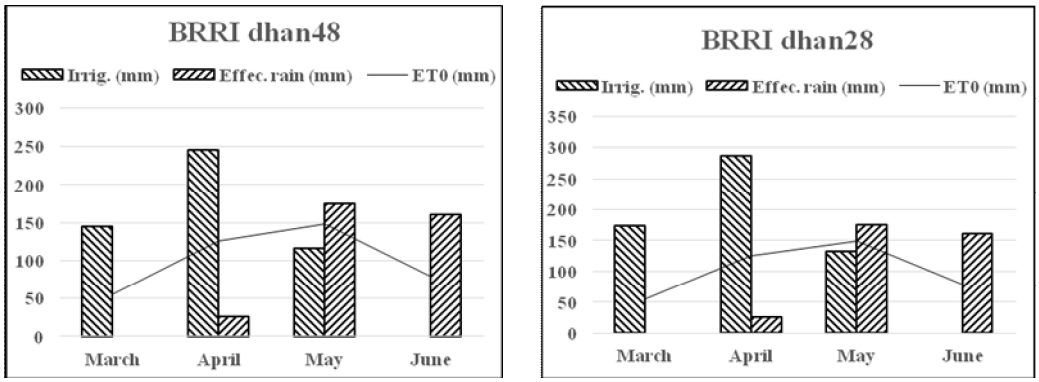

Figure 2. Monthly effective rainfall, reference crop evapotranspiration (ET_0) and irrigation water for BRRI dhan48 and BRRI dhan28 at Sadar, Nilphamari district

So, if BRRI dhan48 was cultivated as late Boro or Braus instead of BRRI dhan28 as Boro then it can save about 28-36 percent of irrigation water. Thus, it was clear from the results that in late Boro or as Braus, BRRI dhan48 is the best variety compared to BRRI dhan28. Badshah *et al*. (2013) also reported that BRRI dhan28 gave lower grain yield when it was planted 15 February and 15 March compared to hybrid varieties. Therefore, groundwater utilization can be reduced during Boro season in this region by cultivating BRRI dhan48 as Braus rice. This is a good alternative to save ground water in the climate change situation and also to ensure food security. It was also observed that the grain yield of BRRI dhan48 was higher when cultivated after potato compared to tobacco, which was mainly due to aggressive nutrient uptake by tobacco.

4. Conclusions

Potato-BRRI dhan48 - T.Aman might be the potential and profitable cropping pattern in medium lowland to medium highland area (about 80%) of Rangpur region. BRRI dhan48 is the best variety as late Boro compared to BRRI dhan28.

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