ISSN: 2518-2021 (Print), 2415-4474 (Online) Fundam Appl Agric 2016, 1(2): 66-69

Fundamental and Applied Agriculture

Journal homepage: www.f2ffoundation.org/faa

Agronomy

ORIGINAL ARTICLE

Effect of variety and date of harvesting on yield performance of boro rice

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A R T I C L E I N F O

Article history:

Received: 15 March 2016
Received in revised form: 28 July 2016
Accepted: 07 August 2016
Available online: 25 August 2016

Academic Editor: A K M Mominul Islam

Keywords:

Rice varieties
Date of harvesting
Days after flowering
Yield

A B S T R A C T

The yield of rice in Bangladesh is much below compared to that of other rice growing countries. The per hectare yield of rice of those countries is higher due to their adoption of improved varieties, modern farming technology and sophisticated cultural practices. Therefore, Bangladesh has a tremendous scope of increasing her total production by augmenting per hectare yield through the use of modern technology. Hence, from the practical point of view, greater attention should be paid for increasing the yield per unit area by growing modern varieties of rice through improved cultivation practices. An experiment was conducted for investigating the effect of variety and date of harvesting on yield performance of modern *boro* rice varieties at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during February to July 2015. The experiment comprised four rice varieties namely, BRRI dhan28, Hera hybrid2, Binadhan-14 and BRRI dhan58 and three time of harvesting *viz*., 20, 27 and 34 days after flowering. The experiment was laid out in a split-plot design with three replications. Except plant height, all other characters were significantly influenced by different date of harvesting in all varieties. BRRI dhan58 was found significantly superior to Binadhan-14, BRRI dhan28 and Hera hybrid2 in respect of effective tillers, grains panicle^{-1}, grain yield, biological yield and harvest index. Among three harvesting times, the highest grain yield (4.39 t ha^{-1}) and straw yield (5.50 t ha^{-1}) were obtained when the crop was harvested at 27 days after flowering. The interaction effect of variety and date of harvesting was significant in respect of grain and straw yield. The highest grain yield (5.07 t ha^{-1}) was observed in BRRI dhan58 when harvested at 27 days after flowering. Therefore, optimum date of harvesting for higher grain yield may be 27 days after flowering for avoiding immature stage as well as shattering loss.

INTRODUCTION

Bangladesh is an agro-based country. Agriculture sector contributes 15.96% to the total GDP (BBS, 2015). Rice (*Oryza sativa L.*) is the staple food of about 157 million people of Bangladesh and dominants over all other crops in respect of economic and social aspect in Bangladesh. Rice contributes one-half of the agricultural GDP and one-sixth of the national income in Bangladesh. About 75% of the total cropped area and over 80% of the total irrigated area of Bangladesh is used for rice production (BRRI 2015).

In Bangladesh three distinct classes of rice, based on the season of cultivation, namely *aus, aman and boro*, are cultivated during the period from April to July, August to December and January to May, respectively. In 2014, combined paddy rice production of 52 million tons (around 34.84 million tons basis milled), slightly above an estimated in 2013 paddy rice production of 51.5 million tons (around 34.5 million tons basis milled) due to increased planted area backed by favorable weather conditions, and government support to the rice sector. On average, aus, aman and boro seasons account for 7%, 38% and 55%, respectively of annual paddy production (BBS 2014).

Bangladesh is facing a chronic shortage of food over the years due to high population pressure, and total rice growing area is continuously declining due to urbanization and industrialization. Due to shortage of land, the scope of its

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cultivation on extended land area is very limited. The yield of rice is much below compared to that of other rice growing countries. The per hectare yield of rice of those countries is higher due to their adoption of improved varieties, modern farming technology and sophisticated cultural practices. Therefore, Bangladesh has a tremendous scope of increasing her total production by augmenting per hectare yield through the use of modern technology. Hence, from the practical point of view, greater attention should be paid for increasing the yield per unit area by growing modern varieties of rice through improved cultivation practices.

Harvesting time of rice crop is very important in respect of yield and yield contributing characters. If rice is harvested at proper time and stored in a proper way, 10-15% more production will be obtained (CDP 1995). Early or immature harvest may lead to low yield. Delayed harvesting results in high shattering, lodging, broken rice, decline yield of head rice (Bhatti et al. 1983).

In the light of the above information the present study was undertaken with the following objectives- to evaluate the varietal effect on yield and yield attributes of *boro* rice, observe the yield performance of *boro* rice under various date of harvesting and examine the interaction effect of variety and date of harvesting if any, on the grain yield and yield contributing characters of *boro* rice.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during the period from February to July 2015. Two factors were included in the experiment namely variety and date of harvesting. The treatments for rice variety were four that include i) BRRI dhan28-V1, ii) Hera hybrid2-V2, iii) Binadhan 14-V3 and iv) BRRI dhan58-V4. The treatments for date of harvesting were i) 20 days after flowering (DAF), ii) 27 DAF and iii) 34 DAF.

The experiment was laid out in a split-plot design. The unit plot size was 4.0 m × 2.5 m. Variety was randomly placed in the main plot and date of harvesting in sub plot. Each treatment was replicated thrice. Space between replications and between plots were 1.0 m and 0.5 m, respectively. There were 36 plots in the experiment. Seeds were directly sown in well prepared experimental field on 23 February, 2015. Planting space was 25 cm × 15 cm between the rows and seeds, respectively. All the fertilizers except urea were applied as basal at final land preparation. Urea was top dressed in three equal splits at 15, 30 and 45 DAS. Gap filling, weeding, irrigation and other necessary intercultural operations were done in proper time.

The date of flowering was identified at different times for different varieties. The flowering date for BRRI dhan28, Hera hybrid2, BINA dhan14 and BRRI dhan58 were 18 May, 10 June, 22 May and 06 June 2015, respectively.

Harvesting was done plot wise at 20, 27 and 34 DAF. Five hills were selected randomly from each unit plot for taking yield component data at harvest. One m^2 area from each plot was selected from the central portion and was cut manually from the ground level to take grain and straw yields. The harvested crop of each plot was separately bundled, properly tagged and then brought to the threshing floor. The harvested crops were threshed manually. The grain was cleaned and dried to a moisture content of 14%. Straws were sun dried properly. Final grain and straw yields per plot were recorded and converted to tonnes per hectare. Data recorded for yield parameters were compiled and tabulated in proper form for statistical analysis. Analysis of variance was done following the split-plot design with the help of Computer Package MSTAT. The mean differences were compared with Duncan's Multiple Range Test (DMRT) (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Effect of Variety

Results of the experiment revealed that highest plant height was recorded from Hera hybrid2 and the lowest plant height was found in BRRI dhan28. The maximum total and effective tillers $hill^{-1}$ was observed in BRRI dhan28. The effect of variety was found to be significant in respect of all the yield and yield contributing characters except non effective tillers $hill^{-1}$ at harvest. BRRI dhan58 produced the highest number of filled grains $panicle^{-1}$ (85.74) and the lowest number of filled grains $panicle^{-1}$ (66.32) was produced by Hera hybrid2. The results expressed that the highest weight of 1000-grain (29.92 g) was obtained in Hera hybrid2 and the lowest weight was (21.87 g) in BRRI dhan28. The variation in 1000-grain weight might be due to differences of length and breadth of the grain that were partially controlled by genetic make-up of the varieties under study. The highest grain yield (4.59 t ha^{-1}) in BRRI dhan58 was mostly due to its higher grain $panicle^{-1}$ and heavier seed weight (Table 1). The lowest yield was found in Hera hybrid2 because of its lower effective tiller $hill^{-1}$ and lower number of grain $penicle^{-1}$. The highest biological yield was found in BRRI dhan58 (10.04 t ha^{-1}) and the lowest was in BRRI dhan28 (8.85 t ha^{-1}) whereas harvest index was highest in BRRI dhan58 (45.69%) because of its lower straw yield than grain yield and lowest in Hera hybrid2 (37.63%) (Table 1). BRRI dhan58 produced higher yield not only my research field but also it had higher yield potentiality than other varieties at the very beginning of release.

Table 1. Effect of variety on yield and yield components of *boro* rice

Variety	Plant height (cm)	Total tillers $hill^{-1}$ (no.)	Effective tillers $hill^{-1}$ (no.)	Non-effective tillers $hill^{-1}$ (no.)	Panicle Length (cm)	Grain $panicle^{-1}$ (no.)	Sterile spikelets $panicle^{-1}$ (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological Yield (t ha^{-1})	Harvest index %
BRRI dhan28	87.8b	12.4a	10.74a	1.73	21.16c	77.70b	16.80c	21.87d	3.87c	4.99d	8.85b	43.64a
Hera hybrid2	101.9a	11.89b	10.31a	1.58	24.13a	66.32c	26.98a	29.92a	3.36d	5.55a	8.91b	37.63b
Binadhan-14	91.3b	10.89c	9.09b	1.80	22.25b	83.75a	18.56bc	24.04b	4.32b	5.29c	9.61ab	44.95a
BRRI dhan58	98.24a	12.42a	10.69a	1.73	22.35b	85.74a	20.57b	23.12c	4.59a	5.44b	10.04a	45.69a
$S\overline{x}$	1.07	0.311	0.218	0.055	0.245	1.59	6.17	0.265	0.033	0.029	0.251	8.41
Level of significance	**	*	**	NS	**	**	**	**	**	**	*	**

** =Significant at 1% level of probability,* =Significant at 5% level of probability and NS = Not significant.
In a column, figures bearing same or no letter(s) do not differ significantly at 1% and 5% level of significance according to DMRT.

Effect of Date of Harvesting

The effect of different date of harvesting showed that plant height, total effective tillers hill^{-1} were higher between harvesting at 20 to 27 DAF and later it was gradually decreased. The effect of harvesting date was significant in respect of yield and all yield contributing characters except plant height. The highest panicle length (22.77), filled grains panicle^{-1} (85.39), grain yield (4.39 t ha^{-1}), straw yield (5.50 t ha^{-1}), biological yield (9.899 t ha^{-1}) and harvest index (44.25) were recorded when the crop was harvested at 27 DAF (Table 2). The lowest yield was obtained for harvesting at 20 DAF due to immaturity of spikelet. All of the above parameters gradually increase up to full heading and thereafter decreased due to shattering and low moisture content of seeds.

Interaction Effect of Variety and Date of Harvesting

Interaction of variety and date of harvesting was significant in respect of non-effective tillers hill^{-1}, grain yield and straw yield. The highest grain yield was in BRRI dhan58 at 27 days after flowering (DAF) (5.07 t ha^{-1}) and the highest straw yield was Hera hybrid2 at 27 DAF (5.75 t ha^{-1}). On the other hand the lowest grain yield was in Hera hybrid2 at 34 DAF (3.10 t ha^{-1}) because of shattering loss of grain and straw yield in BRRI dhan28 at 34 DAF (4.81 t ha^{-1}) (Table 3).

Table 2. Effect of date of harvesting on yield and yield components of *boro* rice

Date of harvesting	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective Tillers hill^{-1} (no.)	Non – Effective tillers hill^{-1}(no.)	Panicle length (cm)	Grain panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index %
20 DAF	94.81	12.74a	10.72a	2.01a	22.67a	74.56b	27.15a	24.24b	3.84b	5.31b	9.15b	41.87b
27 DAF	96.76	11.87b	10.20b	1.66b	22.77a	85.39a	16.64c	24.84ab	4.39a	5.50a	9.89a	44.25a
34 DAF	92.88	11.15b	9.70b	1.447c	21.98b	75.18b	18.40b	25.14a	3.875b	5.14c	9.02b	42.81ab
$S\overline{x}$	1.14	0.271	0.169	0.045	0.221	0.906	0.534	0.227	0.028	0.022	0.209	0.516
Level of significance	NS	**	**	**	*	**	**	*	**	**	*	*

** =Significant at 1% level of probability, * =Significant at 5% level of probability, NS = Not significant and DAF = Days after Flowering.
In a column, figures bearing same or no letter(s) do not differ significantly at 1% and 5% level of significance according to DMRT.

Table 3. Effect of variety and date of harvesting on yield and yield components of *boro* rice

Treatment combination	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non – Effective tillers hill^{-1} (no.)	Panicle Length (cm)	Grain panicle^{-1} (no.)	Sterile Spikelets panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest Index %
V_1H_1	88.07	13.33	11.47	1.86bc	21.15	75.80	21.38	21.57	3.65e	4.90e	8.55	42.69
V_1H_2	89.27	12.47	10.67	1.80bcd	21.52	82.00	13.88	21.82	4.15d	5.26cd	9.41	44.10
V_1H_3	86.23	11.60	10.07	1.53def	20.80	75.30	15.13	22.21	3.80e	4.81e	8.61	44.13
V_2H_1	101.13	12.27	10.33	1.94b	24.13	64.53	35.53	28.88	3.25f	5.60b	8.85	36.72
V_2H_2	104.53	12.07	10.53	1.54def	24.68	74.93	21.93	30.33	3.72e	5.75a	9.47	39.28
V_2H_3	99.97	11.33	10.07	1.26f	23.58	59.49	23.49	30.55	3.10f	5.31c	8.41	36.86
V_3H_1	91.97	11.67	9.67	2.00ab	23.16	78.47	24.09	23.78	4.10d	5.25cd	9.35	43.85
V_3H_2	93.23	10.80	9.00	1.80bcd	22.24	91.21	14.84	24.00	4.62b	5.47b	10.09	45.79
V_3H_3	88.70	10.20	8.60	1.60cde	21.35	81.58	16.75	24.35	4.25cd	5.15d	9.40	45.21
V_4H_1	98.07	13.67	11.40	2.27a	22.24	79.45	27.61	22.72	4.36c	5.50b	9.86	44.22
V_4H_2	100.01	12.13	10.60	1.53def	22.63	93.44	15.89	23.22	5.07a	5.53b	10.60	47.83
V_4H_3	96.63	11.47	10.07	1.40ef	22.19	84.34	18.21	23.43	4.35c	5.31c	9.66	45.03
$S\overline{x}$	2.27	0.543	0.338	0.091	0.443	1.81	1.06	0.455	0.058	0.045	0.419	1.03
Level of significance	NS	NS	NS	*	NS	NS	NS	NS	*	*	NS	NS

** =Significant at 1% level of probability, * =Significant at 5% level of probability, NS = Not significant and DAF = Days after Flowering.
In a column, figures bearing same or no letter(s) do not differ significantly at 1% and 5% level of significance according to DMRT.
Legend: V1 = BRRI dhan28, V2 = Hera hybrid2, V3= Binadhan-14, V4 = BRRI dhan58, H1 = 20 DAF, H2 = 27 DAF and H3 = 34 DAF

CONCLUSION

From the results and discussion it has been found that the highest grain yield (5.07 t ha^{-1}) was obatined by BRRI dhan58 when it was harvested at 27 DAF. Therefore, it can be concluded that BRRI dhan58 has a great potentiality to produce higher yield than other varieties and it should be harvested at 27 DAF for avoiding immature stage as well as shattering loss.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this paper.

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