

EVALUATION OF POPULAR SHORT DURATION *T. AMAN* RICE VARIETY IN RANGPUR AND DINAJPUR REGION

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ABSTRACT

An experiment was conducted to evaluate the overall performance of popular short duration inbred *T. aman* rice varieties (Binadhan-16, Binadhan-17, BRRI dhan71, BRRI dhan75, BRRI dhan103, BRRI dhan87, Binadhan-7 and Binadhan-22) at three different locations (Research farm of Bangladesh Institute of Nuclear Agriculture (BINA) and Bangladesh Rice Research Institute (BRRI), Rangpur and Bangladesh Wheat and Maize Research Institute (BWMRI), Dinajpur) during *T. aman* season 2022-23. Results revealed that the variety BRRI dhan103 had the best significant performance regarding all traits evaluated (plant height, days to maturity, culm length, effective tillers hill⁻¹, panicle length, filled grains panicle⁻¹, and grain yield) (125.90 cm, 119.70 days, 116.40 cm, 17.87, 29.13 cm, 165.0, and 6.69 t ha⁻¹, respectively) as compared to that of other varieties. Locations revealed that the research field of BINA and BRRI, Rangpur required numerically similar highest days for maturity (113.3 and 113.80 cm). Interaction effect also showed that the BRRI dhan103 grown at research field of BRRI Rangpur required the highest days for maturity (122.0 days) which also recorded the longest culm (117.20 cm) and panicle (29.80 cm), more effective tillers hill⁻¹ (18.20) and filled grains panicle⁻¹ (167.60) which confirm the highest grain yield (6.74 t ha⁻¹). However, BRRI dhan103 grown at research field of BINA, Rangpur and BWMRI, Dinajpur also obtained the identical longest culm (115.80 and 116.20 cm, respectively) and grain yield (6.67 and 6.67 t ha⁻¹, respectively) in this study. Among the tested varieties, BRRI dhan103 had the higher yield potential short durable inbred Aman variety along with wider adaptation in respect to location capacity for northern part of Bangladesh.

Key words: Short duration, inbred *T. aman*, location, growth and yield

Introduction

Rice (*Oryza sativa* L.) is the most significant staple food for 650 million hungry and 80% of world undernourished people worldwide which supplying more than half of the daily calories and proteins for the half of world's population (Saha *et al.*, 2021). Among the rice growing countries of the world, Bangladesh positioned 3rd (Anonymous, 2023) on rice cultivation and 5th on area under production (BBS, 2024). The country's GDP is 14.23% (FY 2022-23) with 40.60% labour force in agricultural sector of Bangladesh while the annual production of rice is 39.10 million metric tons from 28.75 million acres of land (BBS, 2024). But, this production didn't meet our food demand due to the rapid increasing rate of population and also lose roughly 225 ha of land due to urban sprawl (Timsina *et al.*, 2018). So, we have to think how to solve the food problem of the country. In Bangladesh, BINA, BRRI, IRRI and diverse seed organizations has been presented high yielding rice varieties and it acquires positive monumentation in rice production for the particular three distinct growing seasons (Haque and Biswas, 2011). But still a wide gap between the potential yield and the actual yield exists in our country. Various efforts are being made in the country to narrow down this gap, of which the variety selection, regional adaptability, cultural methods, management practices etc are gaining importance (Islam, 2021a). Now-a-day's different high yielding rice varieties are available in Bangladesh which have more yield potential than different conventional varieties (Islam, 2021a). Rice varieties grown in different locations vary significantly in composition due to the variation in genetic, climatic factor, cultivation method, and soil conditions (Mapiemfu *et al.*, 2017). Islam (2021b) also reported that the geographical and agronomic conditions of Bangladesh are favorable for rice cultivation which contributes about 92% of the total food grains produced in the country. Due to its very fertile land and favorable weather, varieties of crop grow abundantly in this country (Islam, 2021b). At the present situation it is necessary to increase per hectare yield of rice within short time while double or triple cropping may possible. On the above

facts, BRRI has developed some short duration rice cultivars like BRRI dhan56, BRRI dhan66 and BRRI dhan71 (Rahman *et al.*, 2021). From the recent research conducted by Aktar *et al.* (2022) also was found that the cultivation of short duration *Aman* rice can create an opportunity to intensify the cropping intensity from double cropping to triple cropping. Moreover, cropping intensity should be increased by adopting short duration *Aman* rice cultivars. These also include less risk of typhoon-driven lodging and of pest damage (rodents, birds, and insects), combined with the higher sale price for providing the first harvests during a given cultivation season (Xu *et al.*, 2018). Ngawang *et al.* (2016) also reported that the traditional rice varieties take about 160-200 days to mature and are highly susceptible to climatic events while improved short duration varieties could be harvested in about 110 to 130 days. Adaptable of inbred short-duration varieties will improve our options for responding to climate change and the need for intensified cultivation. Therefore, the present study was to identify the morphological characteristics associated with high yield of short duration rice varieties suitable to cultivate at regional condition of Rangpur and Dinajpur, Bangladesh. So, the study was undertaken to investigate the performance of inbred short duration *T. aman* rice varieties under different locations of Bangladesh.

Materials and methods

The experiment was conducted to evaluate the performance of popular short duration inbred *T. aman* rice at different locations of Rangpur and Dinajpur during the *Aman* season in 2023. Eight released rice variety viz. Binadhan-16, Binadhan-17, BRRI dhan71, BRRI dhan75, BRRI dhan103, BRRI dhan87, Binadhan-7 and Binadhan-22 and three research farm of Bangladesh Institute of Nuclear Agriculture (BINA) and Bangladesh Rice Research Institute (BRRI), Rangpur and Bangladesh Wheat and Maize Research Institute (BWMRI), Dinajpur were considered for the present study. All the selected genotypes were collected from the BINA, Mymensingh and BRRI, Joydebpur, Gazipur. The experiment was laid out in two factors with five replications. The size of unit plot was 4.0×2.5 m (10 m^2) where block to block and plot to plot distance was 0.75 m and 0.5 m, respectively. The land was prepared thoroughly by tilling single time with a power tiller and subsequently ploughing four times with country plough followed by laddering on 22 June, 2023. All weeds, stubbles and crop residues were removed from the fields to obtain desirable puddling condition. After that the land was prepared plot and block wise as per layout of the experiment. The plots were fertilized with 200-50-70-5-5 kg ha⁻¹ of urea, TSP, MoP, Zinc Sulphate and Boron, respectively as per recommended guide BARC, 2012. After making the plots the entire amounts of TSP, MoP, ZnSO₄, and Boron were applied at the time of final land preparation. Urea was applied in three installments at 10, 22 and 40 days after transplanting (DAT). The seedlings were uprooted from the seedling nursery without causing much mechanical injury to the roots and they were immediately transplanted in the well prepared puddled field on 10 July 2023 at the rate of two seedlings hill⁻¹ maintaining row-row and hill-hill distance of 20 cm and 15cm, respectively. Other intercultural operations such as weeding, gap filling, irrigation, plant protection measures etc. were done properly as and when necessary. At maturity (when 90% of the seeds became golden yellow in color), all plots were harvested manually from the ground level to take grain yield. Data on plant height, days to maturity, culm length, number of effective tillers, panicle length, number of filled grains and grain yield were recorded. The harvested crops were threshed manually. The grains were cleaned and dried to a moisture content of 14%. Final grain yield was recorded in g m⁻² and then converted into tha⁻¹. Recorded data were compiled and tabulated in proper form for statistical analysis. Analysis of variance was done with the help of MSTATC computer package programme. The mean differences among the treatments were evaluated with Duncan's Multiple Range Test (DMRT).

Results and Discussions

Plant height: Significant variations due to the effect of short duration rice varieties were observed for the plant height where BRRI dhan103 and BRRI dhan87 showed the statistically identical tallest plant (125.50 and 125.90 cm, respectively) while Binadhan-22 had the shortest (89.53 cm) as compared to that of other varieties (Table 1). However, effect of location did not showed any significant response on plant height but the effect of interactions between variety and location showed significant different on plant height at

harvest (Table 2 and Table 3). The variety BRRI dhan87 grown under the research field of BINA, Rangpur recorded the significantly taller plant (129.80 cm) and the variety Binadhan-22 at research field of BWMRI, Dinajpur observed the shortest plant (89.20 cm) while Binadhan-22 grown under other locations and both Binadhan-7 at three locations showed statistically identical shortest plant height (89.80, 89.60, 92.60, 92.80 and 93.20 cm, respectively) in this study (Table 3). These results revealed that the variety BRRI dhan103 at BINA, Rangpur showed higher elongation in plant height as compared to that of other varieties and other two locations. Among the selected genotypes, shortest plant height (89.53 cm) obtained by Binadhan-22 (Table-1). Similar findings were also reported by Islam *et al.* (2017) and more other researchers who also found significant variation on plant growth of *T. aman* rice which might be due to the variation in genetic makeup of the cultivars and also the variation in adaptability with the studied area.

Days to maturity: The variety had significant impact on days to maturity where BRRI dhan103 required the longest days (119.70 days, respectively) while the least days for these trait (105.60 days, respectively) were needed for the variety BRRI dhan71. However, BRRI dhan75 required the identically similar lowest days for maturity (107.60 days) (Table 1). However, the research field of BINA and BRRI, Rangpur required statistically identical highest days (113.3 days) for maturity compared to that of the research field of BWMRI, Dinajpur (110.90 days) (Table 2). On the other hand, the variety BRRI dhan103 at BRRI research farm, Rangpur needed the highest days for maturity (122.0 days) followed by the same variety grown at the research field of BWMRI, Dinajpur (120.0 days, respectively). The variety BRRI dhan75 grown at BWMRI, Dinajpur required the lowest days for maturity (102.40 days) (Table 3). The longest days for maturity were also required for the genotype BRRI dhan103 while in BRRI, Rangpur delayed the maturity.

Table 1. Effect of variety on growth and yield of rice

Variety	Plant height (cm)	Days to maturity	Culm length (cm)	Effective tillers plant ⁻¹ (no.)	Panicle length (cm)	Filled grains panicle ⁻¹ (no.)	Grain yield (t ha ⁻¹)
Binadhan-16	105.6 c	114.9 b	84.27 d	12.87 d	27.00 b	129.3 e	4.848 f
Binadhan-17	102.0 d	115.3 b	109.9 b	17.33 a	28.60 a	153.3 b	6.193 b
BRRI dhan71	110.8 b	105.6 d	60.93 f	11.20 e	23.67 d	117.8 g	4.609 g
BRRI dhan75	109.4 b	107.6 d	100.8 c	14.60 c	25.87 c	125.8 f	5.081 e
BRRI dhan103	124.5 a	119.7 a	116.4 a	17.87 a	29.13 a	165.0 a	6.693 a
BRRI dhan87	125.9 a	111.5 c	76.00 e	14.73 bc	27.60 b	126.2 ef	5.613 d
Binadhan-7	92.87 e	111.2 c	84.93 d	12.73 d	25.13 c	137.2 d	5.124 e
Binadhan-22	89.53 f	115.7 b	83.20 d	15.53 b	27.00 b	146.4 c	5.873 c
Level of sig.	**	**	**	**	**	**	**
LSD _(0.05)	2.12	2.35	3.26	0.85	0.86	3.19	0.16
CV (%)	2.72	2.88	5.01	8.04	4.45	3.20	4.07

Table 2. Effect of location/ regional condition on growth and yield of aromatic rice

Location	Plant height (cm)	Days to maturity	Culm length (cm)	Effective tillers plant ⁻¹ (no.)	Panicle length (cm)	Filled grains panicle ⁻¹ (no.)	Grain yield (t ha ⁻¹)
BINA, Rangpur (L ₁)	108.20	113.3 a	89.10	14.57	26.80	137.30	5.493 ab
BRRI, Rangpur (L ₂)	107.70	113.8 a	89.65	14.73	26.77	138.60	5.582 a
BWMRI, Dinajpur (L ₃)	106.80	110.9 b	89.93	14.52	26.67	137.00	5.437 b
Level of sig.	ns	**	ns	ns	ns	ns	**
LSD _(0.05)	1.30	1.44	1.99	0.52	0.53	1.95	0.10
CV (%)	2.72	2.88	5.01	8.04	4.45	3.20	4.07

In a column, figures having similar and no letter(s) do not differed significantly at $p \leq 0.05$, whereas figures with dissimilar letter(s) differed significantly as per DMRT; ** $p \leq 0.01$ and ns= not significant

Table 3. Interaction effect of variety and location on growth and yield of rice

Variety	Location	Plant height (cm)	Days to maturity	Culm length (cm)	Effective tillers plant ⁻¹ (no.)	Panicle length (cm)	Filled grains panicle ⁻¹ (no.)	Grain yield (t ha ⁻¹)
Binadhan-16	L ₁	107.4 def	115.0 cde	84.6 f	12.4 ijklm	26.8 defg	126.2 klmno	4.87 efg
	L ₂	104.4 fg	116.6 bcd	84.0 f	13.2 ghijk	27.2 cdef	131.6 ijk	4.95 ef
	L ₃	105.0 efg	113.2 cdefg	84.2 f	13.0 ghijk	27.0 cdefg	130.2 jklm	4.73 efg
Binadhan-17	L ₁	101.4 g	113.2 cdefg	107.4 b	16.8 abc	27.8 bcde	151.6 de	5.67 cd
	L ₁	102.6 g	117.8 abc	112.8 ab	17.8 ab	29.40 ab	156.0 cd	6.55 ab
	L ₂	102.0 g	115.0 cde	109.6 b	17.4 ab	28.6 abc	152.2 de	6.36 b
BRRI dhan71	L ₃	109.6 cd	108.8 ghi	61.4 h	11.6 klm	24.2 hij	120.6 op	4.63 fg
	L ₁	112.0 c	104.8 ij	60.0 h	10.8 m	23.0 j	115.8 p	4.59 g
	L ₂	110.8 cd	103.2 j	61.4 h	11.2 lm	23.8 ij	117.0 p	4.61 g
BRRI dhan75	L ₃	108.8 cde	109.8 fgh	95.6 cd	14.0 efghi	25.4 ghi	123.0 no	4.89 efg
	L ₁	112.2 c	110.6 efgh	108.2 b	15.2 cdef	26.4 efg	129.2 klmn	5.64 cd
	L ₂	107.2 def	102.4 j	98.6 c	14.6 defg	25.8 fgh	125.2 lmno	4.71 efg
BRRI dhan103	L ₃	125.8 b	117.0 bcd	115.8 a	17.6 ab	28.4 abcd	161.4 bc	6.67 a
	L ₁	124.0 b	122.0 a	117.2 a	18.2 a	29.8 a	167.6 a	6.74 a
	L ₂	123.6 b	120.0 ab	116.2 a	17.8 ab	29.2 ab	166.0 ab	6.67 a
BRRI dhan87	L ₃	129.8 a	115.0 cde	75.8 g	15.6 cde	28.4 abcd	130.8 ijkl	5.91 c
	L ₁	124.2 b	112.8 defg	76.6 g	14.4 efg	26.6 efg	123.6 no	5.41 d
	L ₂	123.6 b	106.8 hij	75.6 g	14.2 efgh	27.8 bcde	124.2 mno	5.52 d
Binadhan-7	L ₃	92.60 h	113.8 cdef	88.4 ef	13.6 fghij	26.4 efg	139.6 gh	5.45 d
	L ₁	92.80 h	109.0 ghi	75.2 g	12.0 jklm	24.4 hij	135.6 hij	4.89 efg
	L ₂	93.20 h	110.8 efgh	91.2 de	12.6 hijkl	24.6 hij	136.4 hi	5.03 e
Binadhan-22	L ₃	89.80 h	113.8 cdef	83.8 f	15.0 def	27.0 cdefg	145.4 fg	5.86 c
	L ₁	89.60 h	117.2 bcd	83.2 f	16.2 bcd	27.4 cdef	149.0 ef	5.89 c
	L ₂	89.20 h	116.0 bcd	82.6 f	15.4 cde	26.6 efg	144.8 fg	5.87 c
Level of sig.		*	**	**	*	*	**	**
LSD _(0.05)		3.67	4.08	5.64	1.48	1.49	5.53	0.28
CV (%)		2.72	2.88	5.01	8.04	4.45	3.20	4.07

In a column, figures having similar and no letter(s) do not differed significantly at $p \leq 0.05$, whereas figures with dissimilar letter(s) differed significantly as per DMRT; ** $p \leq 0.01$ and * $p \leq 0.05$

The above variation due to the variety under different locations were found might be due to the variation in adaptability with different locations and also the variation in varietal performance among the tested genotypes. The variation in days to flowering and maturity were also reported by Rakib *et al.* (2019) who reported that the rice varieties had significant variation on duration of flowering and harvest compared to other varieties due to the variation in their genetic characteristics and also the variation in adaptability with the varied the locations and different environments as well.

Culm length (cm): The effect of variety had significant response on culm length with different locations had no significant effect (Table 1 and 2). Result revealed that the variety BRRI dhan103 showed significantly the longest culm (116.40 cm) and the variety BRRI dhan71 recorded the shortest culm (60.93 cm) (Table 1). In contrast, the variety BRRI dhan103 grown at the research field lab of BRRI, Rangpur had the longest culm (117.20 cm) while similar variety grown at BINA, Rangpur and BWMRI, Dinajpur had the numerically similar longest culm (115.80 and 116.20 cm, respectively). Similarly, BRRI dhan71 grown at three locations (BINA and BRRI at Rangpur and BWMRI, Dinajpur) also recorded the numerically identical shortest culm length (61.40, 60.00 and 61.40 cm, respectively, Table 3). The variation in culm length due to the different variety was obtained due to the variation in their characteristics and also the variation in range of wider adaptability of the selected varieties.

Number of effective tillers hill⁻¹: The effect of variety and interaction effect between variety and location showed significant variation on number of effective tillers hill⁻¹ while location had non significant response (Table 1, Table 2 and Table 3). From the Table 1, it was found that the variety BRRI dhan103 produced the highest number of effective tillers hill⁻¹ (17.87) whereas the variety Binadhan-17 had also statistically at similar rank (17.33). In contrast, the variety BRRI dhan71 observed the lowest number of effective tillers hill⁻¹ (11.20). In case of interactions, the variety BRRI dhan103 grown at the research field of BRRI, Rangpur produced the higher number of effective tillers hill⁻¹ (18.20) followed by the same variety and Binadhan-17 grown at BWMRI, Dinajpur (17.80 and 17.80) and Binadhan-71 grown at BWMRI, Dinajpur and BINA, Rangpur (17.40 and 16.80, respectively) while BRRI dhan71 grown at BRRI, Rangpur produced the lowest number of effective tillers hill⁻¹ (10.80) (Table 3). In the present study, BRRI dhan103 indicates the highest significant impact on the production of effective tillers hill⁻¹ than other *T. aman* inbred rice varieties which might be due to inherent genotypic make up or the well adaptability of this variety. The differences were also obtained might be due to the variation in photosynthetic activity, variation in utilizing capability of macro and micro nutrients from the soil and other physiological functions. Similarly, Rakib *et al.* (2019); Islam *et al.* (2017) also found similar observation with the present study who also found variation in tiller production might be due to the similar reason behind the present study.

Panicle length: Results obtained from the present study also revealed that the variety BRRI dhan103 and Binadhan-17 showed statistically identical longest panicle (29.13 and 28.60 cm, respectively) while it was recorded shortest (23.67 cm) from the variety BRRI dhan71 (Table 1). The effect of location did not showed any significant response among them (Table 2). In case of interaction, the variety BRRI dhan103 grown at BRRI, Rangpur recorded the longest panicle (29.80 cm) followed by the same variety grown at BWMRI, Dinajpur (29.20 cm) and the variety Binadhan-17 grown at BRRI, Rangpur (29.40 cm) and BWMRI, Dinajpur (28.60 cm) while BRRI dhan71 grown at BRRI, Rangpur observed the shortest panicle (23.0 cm) (Table 3). The variety BRRI dhan03 further showed highest significant impact on panicle length might be due to the variety had highly adaptable under the studied locations while the location BRRI, Rangpur was more favourable for enhancing the plant growth of rice might be due to the good quality of soil and highest capability to utilize the macro and micro nutrient to the root zone of plant.

Number of filled grains panicle⁻¹: A significant variation for the number of filled grains panicle⁻¹ was recorded due to the effect of variety and interactions effects while location had non significant different for filled grains panicle⁻¹. Among the varieties, the highest number of filled grains panicle⁻¹ (165.0) was recorded from the variety BRRI dhan103 and lowest (125.80) from the variety BRRI dhan7. In case of interactions, BRRI dhan103 grown at BRRI, Rangpur gave the highest number of filled grains panicle⁻¹ (167.60) followed by the same variety grown at BWMRI, Dinajpur (166.0) while it was produced lowest (115.80) from the variety BRRI dhan71 grown at BRRI, Rangpur and it was statistically identical to the same variety grown at BWMRI, Dinajpur (117.0) (Table 3). The above variation in filled grains panicle⁻¹ among the varieties were also found might be due to the variation in genetic characters of the variety and variation in adaptability whereas the genetic characters of BRRI dhan103 had better adaptable capability with the studied locations which ultimately influence the filled grain by reducing the unfilled grain resulting in highest grain yield. The above finding of the present research was also agreed to the findings of Rakib *et al.* (2019).

Grain yield: Grain yield also found significant variation among the variety where BRRI dhan87 produced significantly the highest grain yield (6.69 t ha⁻¹) while the variety BRRI dhan71 observed the lowest grain yield (4.61 t ha⁻¹) (Table 1). However, the research field lab of BRRI, Rangpur produced significantly the highest grain yield (5.58 t ha⁻¹) and BWMRI, Dinajpur observed the lowest grain yield (5.44 t ha⁻¹) but BINA, Rangpur showed average medium grain yield (5.49 t ha⁻¹) (Table 2). Finally, the grain yield was recorded highest (6.74 t ha⁻¹) from the variety BRRI dhan103 grown at BRRI, Rangpur but the same variety also produced numerically same highest grain yield with other two locations (6.67 t ha⁻¹) while BRRI dhan71 also produced numerically identical lowest grain yield grown at both BRRI, Rangpur (4.59 t ha⁻¹) and BWMRI, Dinajpur (4.61 t ha⁻¹) (Table 3). The greater production of grain was obtained in BRRI dhan103 might be due to the variety had superiority regarding effective tillers hill⁻¹, panicle length, filled

grains panicle⁻¹ and total 1000-seeds which contributed to the greater grain production compared to other genotypes in this study. These findings was the most probably similar to the findings Islam *et al.* (2021) who also found that the BRRI dhan34 significantly superior for effective tillers number hill⁻¹, panicles length, grains number panicle⁻¹ which influenced the grain yield as compared to that of other varieties.

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