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Validation of Rice Sowing Methods Under Lowland Ecosystem

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Abstract

To better understand the impact of planting techniques and rice varieties for improved yield in low land areas, a field experiment was conducted at Rajshahi University's Agronomy Field Laboratory from May 2018 to November 2018. The experiment used four rice varieties (Digha, Sadavaula, BRRI Dhan 39, and BINA Dhan-7) typically grown in the Chalan beel regions of Bangladesh. It also used two planting techniques: broadcasting and line sowing. Digha and Sadavaula are two indigenous kinds of deep water rice, and BRRI Dhan 39 and BINA Dhan-7 are two high-yielding types. The result shows that maximum plant height (152.01 cm), number of tillers (10.82), panicle length (21.16cm), fill grain (78.79), grain yield (6.708), straw yield (7.484) and biological yield (13.45) was obtained from line sowing method (M_2). Within the rice varieties, BRRI Dhan 39 shows greater performance as it contributes maximum no of tiller/m^2 (187.93), panicle length (22.02), effective tiller (144.64), grain yield (4.66), straw yield (11.16) and biological yield (15.81). Greater results for flooded rice types came from Digha, which had more tillers per square meter (87.11), panicle length (19.93), effective tillers (70.75), grain yield (2.21), straw yield (8.75), and biological yield (10.96) than Sadavaula. The findings of this study show that line sowing, as opposed to the more conventional broadcasting strategy, can significantly increase rice yield for both high-yielding (BRRI Dhan 39 and BINA Dhan-7) and locally grown flooded rice types (Digha and Sadavaula). Therefore, farmers of the area can be recommended to adopt the line sowing method rather than the broadcasting method, which can significantly boost grain production by 11.45 %.

Keywords: Broadcasting, line sowing and High Yielding Variety..

Introduction

Oryza sativa L. (Asian rice) is grown in many places around the world, but only in west African countries is *Oryza glaberrima* grown (Fuller *et al*.,2011). Due to its status as the primary staple meal for half of the world's population, rice is one of the most significant crops for food security internationally (FAOSTAT, 2014). In comparison to maize and wheat, which contribute 5 percent and 19 percent of the world's dietary energy supply, it provides 20 percent of that energy (FAO,2011). On 150 million hectares worldwide, rice is produced in 500 million metric tons annually, which is comparable to 29% of the world's grain production.

Since ancient times, rice has been a vital food staple for many communities all over the world. 49 percent of all calories ingested by people come from rice, wheat, and maize; of these, 23 percent come from rice, 17 percent from wheat, and 9 percent from maize. As a result, almost one-fourth of all calories consumed globally come from rice (Subbaiah *et al*., 2002). Furthermore, rice significantly affects the economy and food security (Timmer, 2010). Rice can be grown successfully in lowland or highland areas that have the required warmth and a lot of precipitation for its growth. Bangladesh is a well-known flood-prone nation, with more than 70% of its areas experiencing a high risk of flooding. A total of 5, 91,647 hectares of *aman* paddy fields in 32 districts have suffered flood damage, according to a floods advisory sent by Bangladesh's Department of Disaster Management on August 25, 2017. Due to severe monsoon rains, certain places in the northern parts of Bangladesh that had not previously experienced flooding have recently (2014–17) experienced flood damage.

One of the largest inland depressions with a marshy quality is called Chalanbeel. The majority of the deep water rice types that were once present have since been expanded. Even while those kinds exist, their capacity for adaptation and productivity rapidly declines. Establishing strategies for phenotypic and genotypic character development is important to safeguard these varieties and choose parents that will increase production. Farmers in flood-prone locations may cultivate flooded rice to get the desired yield. Flooded rice can withstand flooding stress through elongation ability, whereby varieties in situations of stagnant or deep water flooding (water depth 60-100 cm) avoid complete submergence by lengthening the leaf sheath, leaf lamina, and internode, allowing the plant to be submerged above the rising flood water levels, and submergence tolerance, whereby varieties survive submersion for 10 days or more, particularly in (up to 40 cm) water (Mohanty *et al*., 2000).

Table 1. Field survey for different sowing methods of rice at Chalanbeelarea of Bangladesh.

Location	Number of Farmer	Sowing method (%)		
		Broadcasting	Line sowing	Transplanting
Domdoma	27	77.6	12.3	10.1
Kantonagar	31	78.1	15.1	6.8
Sthapondighi	19	82.7	9.8	7.7
Average		79.47	12.8	8.2

In Bangladesh, plant diversity and conservation have been severely hampered by the replacement of deep water rice (DWR) with contemporary rice in wetlands. Deepwater rice varieties are in danger of going extinct since so many have been lost. Deepwater rice habitat is characterized by anaerobic conditions that prevent typical plant growth as a result of continual submersion. Deepwater rice plants are used because they can endure these harsh circumstances. A sufficient amount of easily absorbed protein with high biological value is provided by deep water rice. The extensive cultivation of deep water rice has a great deal of promise in the aquatic environment found in wetlands.

Agronomic management techniques and other biotic and abiotic elements that either directly or indirectly affect rice's growth and development also govern its production and productivity. The method used to plant rice is a key factor in determining the growth and development of the crop. Direct seeding and transplanting are the two main techniques for planting rice. Both broadcasting and line sowing can be used for direct seeding on damp land. In developing nations like Bangladesh, the choice of planting may be influenced by the availability of labor and technology. The planting techniques and the labour and cultivation costs affect the growth and yield of rice (Rani and Jayakiran, 2010). The location of Chalanbeel has historically been used for flooded rice production, but converting to the line sowing method could boost crop growth and yield with no more work (Dawe, 2003; Naklang, *et al*., 1996).

A field survey was undertaken in the Chalanbeel area as part of our study, and it was discovered that the majority of the local farmers are unaware of the enhanced seed sowing technique needed to grow flooded rice (Table 1). Farmers were persuaded to use less input and produce less than projected due to inadequate crop stands caused by unpredictable rainfall patterns and the subsequent occurrence of drought and floods conditions (around 1 t ha^{-1}). Our investigation revealed that local farmers grow both high-yielding and flooded rice varieties. The most widely grown high yielding rice types are BRRI Dhan 39 and BINA Dhan-7. In the aman season, the majority of farmar (79.47 percent) sow seeds using the broadcasting method. While 8.2% of growers employ transplanting and 12.8% utilize line sowing (for high yielding varieties only). Therefore, the purpose of the current study was to examine the interactions between growth, yield components, and yield of various flooded rice varieties grown using the broadcasting and line sowing techniques. The experiment was created with the aforementioned context in mind to examine the interactions between various flooded rice varieties of Chalanbeel under various seeding techniques. The experiment was created with the aforementioned context in mind to examine the interactions between various flooded rice varieties of Chalanbeel under various seeding techniques.

Materials and Methods

Plant materials and growth conditions

The study examined the agronomic performance of low land ecosystem cultivated rice cultivars using various planting techniques from May 17 to November 19, 2018, at the Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi, Rajshahi. The experiment included four different varieties, including V1 Digha, V2 Sadavaula, V_3 BIRRI Dhan 39, and V_4 BINA Dhan-7, as well as two seeding methods, M_1 Broadcasting and M_2 Line sowing. Three replications of the experiment were used in its Completely Random Block Design. Each unit plot measured 10 m^2 (4 m x 2.5 m). In the experiment, there were 24 total plots. The unit plots and replications were kept 1.5 and 2 meters apart.

Crop cultivation and agronomic management

A wet seedbed was prepared one day before planting the seeds. According to the experimental plan, seeds were seeded using either the broadcasting or line sowing approach. In the form of urea, triple super phosphate, muriate of potash, and gypsum, nitrogen, phosphorous, potassium, and sulphur were applied to the experimental area in the amounts of 180, 150, 70, and 60 kg ha^{-1}, respectively. At the end of the final land preparation, the full amount of fertilizers was applied as a basal dose.

Three hills from each plot (aside from the border hills) were chosen at random to gather information on growth metrics. Prior to gathering data, a few selected hills were uprooted, tagged, and thoroughly cleaned of soil elements. Up to harvest, the operation was performed at intervals of 20 days. The crop was collected when the grains were fully developed and at their peak maturity. The harvest was finished on November 19. Following harvest, the crop from each allotment was packed separately, properly identified, and carried to the threshing floor. After drying, the crops were plot-by-plot individually threshed with a paddle thresher. The grains were then cleaned and let to dry in the sun. Straws were correctly sun-dried as well. Finally, the yield of grain and straw was converted to tons per hectare and adjusted to a moisture content of 14%. Data on a few morpho-physiological, yield-component, and yield-related variables were also gathered during the final harvest. Using STATVIEW software, the data were statistically evaluated using the analysis of variance technique, and the mean differences were determined using the Duncan's New Multiple Range Test (DMRT).

Results and Discussions

During our study growth, yield contributing characters and yield were evaluated.The plant height of rice presented in table 2 differed significantly for thesowingmethod at 147 DAS. At 147 DAS, maximum plant height (152.01cm) was observed in $M_2$and the value reduced significantlyby (13.89%) in M_1.Different rice varieties in this experiment differed significantly in plant height at 147DAS (**Table 2**). At 147 DAS,the tallest plant (185.39cm) was recorded in V_2which reduced marginally(5.88%) at V_1 and significantly42.17 and 46.82%inV_4 and V_3, respectively.Plant height of rice was statistically significant due to interaction between sowing method and variety at 147 DAS. At 147 DAS, the tallest plant (201.14cm) was obtained from M_2V_2 and the shortest plant (94.61cm) was observed in M_1V_3.

From the aforementioned findings, it can be inferred that the line sowing technique in semi-submersible conditions can increase rice

Table 2. Effects of sowing method, varietal and interaction effect on plant height and crop growth rate (CGR)of rice at different day's after sowing (DAS)

Sowing method	Plant height (cm)	CGR ($g\ m^{-2}\ day^{-1}$)					
	147 DAS	**CGR 21-42**	**CGR 42-63**	**CGR 63-84**	**CGR 84-105**	**CGR 105-126**	**CGR 126-147**
M_1	130.89 b	0.40 a	1.55	15.59	8.28	7.92	4.7
M_2	152.01 a	0.32 b	1.16	13.43	12.3	9.1	4.19
LS	0.01	0.05	NS	NS	NS	NS	NS
Rice Varieties							
V_1	174.62 a	0.39 a	1.58 ab	16.68 a	7.52 c	7.45	3.77
V_2	185.39 a	0.39 a	1.85 a	17.48 ab	8.62 bc	8.08	3.51
V_3	98.58 b	0.30 b	0.90 c	10.70 c	13.62 a	7.66	4.78
V_4	107.20 b	0.35 ab	1.09 bc	13.18 bc	11.40 ab	10.86	5.7
LS	0.01	0.05	0.05	0.05	0.05	NS	NS
Interaction							
M_1V_1	164.05 c	0.46 a	1.72 ab	17.42 a	8.14 bc	6.18 b	4.15 a
M_1V_2	169.66 bc	0.42 ab	2.19 a	17.87 a	8.04 bc	9.04 ab	4.52 a
M_1V_3	94.61 e	0.32 bc	1.13 bc	12.42 ab	8.07 bc	8.02 ab	4.19 a
M_1V4	95.23 e	0.4 abc	1.17 bc	14.64 ab	8.85 cb	8.45 ab	5.91 a
M_2V_1	185.19 ab	0.32 bc	1.44 abc	15.93 ab	6.89 c	8.73 ab	3.39 a
M_2V_2	201.14 a	0.36 abc	1.52 abc	17.09 ab	9.2 bc	7.12 ab	2.51 a
M_2V_3	102.56 de	0.29 bc	0.68 c	8.99 b	19.16 a	7.3 ab	5.37 a
M_2V_4	119.17 d	0.29 c	1.01 bc	11.72 ab	13.95 ab	13.27 a	5.49 a
LS	NS	NS	NS	NS	NS	NS	NS
CV%	0.0795	0.1964	0.366	0.2927	0.2996	0.3999	0.39

Mean values in a column having the same letter (s) or without letter do not differ significantly, whereas, with a dissimilar letter (s) differ significantly as per DMRT. NS= Non significant, CV= Co-efficient of variation, LS= Level of significance ,M_1= Broadcasting method & M_2 = Line sowing methodV_1=DIGHA, V_2=Sadavaula,V_3=BRRI Dhan 39,V_4=BINA Dhan-7

plant height. Although plant height is a genetically determined trait, it is manifested in flooded rice not only for the activity of the apical meristem but also for the expansion of internodes (Nagappa *et al*., 2002). (Singh *et al*., 2003). Better light interception and nutrient availability may be the cause of the line sowing method's increasing influence (Gobi *et al*. ,2006).

Results showed that sowing method had no significant effect on crop growth rate of rice at all observations (42-63,63-84,84-105, 105-126 and 126-147 DAS) except 21-42 DAS (**Table 2**). At 21-42 DAS, the highest CGR ($0.40gm^{-2}day^{-1}$) was recorded in M_1, whilelowest CGR ($0.32gm^{-2}day^{-1}$) was observed in M_2.At 42-63 DAS,the maximum CGR ($1.55gm^{-2}day^{-1}$) and the lowest CGR ($1.16gm^{-2}day^{-1}$) was obtained from M_1 and M_2, respectively.At 63-84 DAS, maximum value of CGR ($15.59gm^{-2}day^{-1}$) was observed in $M_1$and the minimum value of CGR($13.43gm^{-2}day^{-1}$) was observed in M_2.At 84-105 DAS,the highest value of CGR ($12.30gm^{-2}day^{-1}$) was observed in M_2 and the lowest value of CGR($8.28gm^{-2}day^{-1}$) was observed in M_1. At 105-126DAS, the highest CGR ($9.10\ gm^{-2}day^{-1}$) was found in $M_2$and the lowest value($7.92gm^{-2}day^{-1}$) was observed in M_1. At 126-147 DAS, highest CGR ($4.70gm^{-2}day^{-1}$) was observed in M_1 and lowest value ($4.19gm^{-2}\ day^{-1}$) was found from M_2. Rice varieties differed significantly in crop growth rate atall observations (21-42, 42-63, 63-84, 84-105,105-126and 126-147DAS) except at 63-84 DAS (**Table 2**). At 21-42 DAS, highest CGR ($0.39gm^{-2}day^{-1}$) was obtained both in $V_1$and V_2 which reduced marginally (10.25%) in V_4 but significantly (23.08%) in V_3. At 42-63 DAS, maximum CGR ($1.85\ gm^{-2}day^{-1}$) was observed in $V_2$and minimum CGR ($0.90gm^{-2}day^{-1}$) was obtained in V_3. At 63-84 DAS, highest CGR($17.48gm^{-2}day^{-1}$) was observed in V_2 and the lowest CGR($10.70gm^{-2}day^{-1}$) was obtained in V_3. At 84-105 DAS, the highest CGR ($17.48\ gm^{-2}day^{-1}$) was recorded in $V_3$and the lowest value($10.70gm^{-2}day^{-1}$) in V_1. At 105-126 DAS, maximum CGR value ($10.86\ gm^{-2}day^{-1}$) was found in V_4 and the lowest value($7.45gm^{-2}day^{-1}$) was found in V_1.At 126-147 DAS,maximum CGR ($5.70gm^{-2}day^{-1}$) was recorded in $V_4$and the minimum value(3.51) is obtained in V_2. The interaction between sowing method and variety significantly affected CGR atall observations (21-42, 42-63, 63-84,84-105,105-126and126-147 DAS).At 21-42 DAS,the highest CGR(0.46) was found in $M_1V_1$and the lowest CGR(0.29) was found both in $M_2V_3$and M_2V_4.At 42-63 DAS, the highest CGR(2.19) was found in $M_1V_2$and the lowest CGR(0.68) was found inM_2V_3.At 63-84 DAS,the highest value (17.87) was found in $M_1V_2$and the lowest valueof CGR (8.99) was found in M_2V_3.At 84-105 DAS,the highest value of CGR (19.16) was found in $M_2V_3$and the lowest value(6.89) was found in M_2V_1.At 105-126DAS,the highest valueof CGR (13.27) was found in $M_2V_4$and the lowest value(6.18) was found in M_1V_1.At 126-147 DAS,the highest value of CGR (5.91) was found with M_1V_4 and the lowest value(2.51) was found in M_2V_2 (**Table 2**).

Due to the varied seeding technique, the panicle length was effected remarkably (**Table 3**). M_2 had the longest panicles (21.16) and M_1 had the shortest (20.03). Within different rice varieties, the maximum panicle length (22.02 cm) was measured in V_3 and drastically reduced in V_1 and V_2 by 5.23 and 2.76 percent, respectively. The sowing method and variety had a substantial interaction effect on panicle length. However, quantitatively, the M_2V3 combination had the longest panicle (22.77 cm), whereas the M_1V_2 combination had the shortest panicle (18.67 cm) (**Table 3**). Number of total tiller (m^2) wassignificantly affected due to different sowing methods. The highest number oftiller/m^2 (143.53) was observed in M_2which reduced significantly 28.63% in M_1(**Table 3**).Number of totaltiller (m^2) was affected due to different rice varieties (Digha,Sadavaula,BRRI Dhan39 and BINA Dhan7). The highest number of tillerper m^2 was recorded in V_3(187.93) which reduced marginally 24.44% in V_4andsignificantly 38.65% and 14.02 % in $V_1$and V_2, respectively (**Table 3**)**.** The interaction effectbetween sowing methodand varieties on total tiller/m^2 was significant. However, numerically the highest number of total tiller/m^2 (233.92) was found in the combination of M_2V_3 and the lowest number of totaltiller/m^2 (74.57) was found in the combination of M_2V_2 (**Table 3**).

Different seeding techniques considerably impacted the number of effective tillers/m^2. M_2 (line sowing method) produced the most effective tillers per square meter (114.56), while M_1 (84.62)

Table 3. Effects of sowing method, varietal and ineraction effect on yield components and yield of rice

Sowing method	PL(cm)	Tiller/ m^2	ET/m2	Grain/ panicle	1000gm	SY/h	GY/h	BY/h	HI
M_1	20.03	102.44b	84.62b	147.39b	28.22a	8.81b	3.04b	11.85b	25.07
M_2	21.16	143.53a	114.56a	151.35a	25.18b	9.95a	3.51a	13.45a	25.34
LS	NS	0.05	0.05	0.05	0.05	0.05	0.05	0.05	NS
Rice Varieties									
V_1	19.93b	87.11b	70.75b	139.13b	30.33a	8.75bc	2.21c	10.96c	20.30b
V_2	19.38b	74.90b	61.66b	135.20b	32.62a	7.85c	2.08c	9.93d	21.15b
V_3	22.02a	187.93a	144.64a	163.78a	21.42b	11.16a	4.66a	15.81a	29.49a
V_4	21.03ab	142.00a	121.31ab	159.27a	22.42b	9.76b	4.14b	13.90b	29.88a
LS	0.05	0.05	0.05	0.01	0.05	0.05	0.05	0.05	0.01
Interaction									
M_1V_1	19.63 ab	75.57 e	61.85 c	137 b	32.467 a	8 de	2.09 c	10.1 de	20.9 b
M_1V_2	18.67 b	75.23 e	56.4 c	133.27 b	34.9 a	7.22 e	1.98 c	9.19 c	21.69 b
M_1V_3	21.27 ab	141.93 c	95.60 bc	161.62 a	22.18 bc	10.24 b	4.19 b	14.43 b	29.14 a
M_1V4	20.53 ab	117.03 d	98.11 b	157.47 a	23.33bc	9.79 bc	3.88 b	13.67 b	28.57 a
M_2V_1	20.23 ab	98.65 de	79.65 c	141.26 b	28.2 ab	9.5 bcd	2.32 c	11.82 c	19.71 b
M_2V_2	20.1 ab	74.57 e	66.93 c	137.13 b	30.33 a	8.48 cde	2.19 c	10.67 d	20.62 b
M_2V_3	22.77 a	233.92 a	167.02 a	165.93 a	20.67 c	12.07 a	5.13 a	17.2 a	29.84 a
M_2V_4	21.53 ab	166.97 b	144.64 a	161.07 a	21.5 bc	9.73 bc	4.39 b	14.12 b	31.2 a
LS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV%	7.86%	11.03%	16.25%	5.28%	13.62%	9.55%	10.08%	4.77%	15.17%

Mean values in a column having the same letter (s) or without letter do not differ significantly, whereas, with a dissimilar letter (s) differ significantly as per DMRT. NS= Non significant, CV= Co-efficient of variation, LS= Level of significance, M_1= Broadcasting method & M_2 = Line sowing method V_1=DIGHA, V_2=Sadavaula,V_3=BRRI Dhan 39,V_4=BINA Dhan-7

produced the fewest effective tillers per square meter (broadcasting method). Effective rice tiller with M_2 was noticeably 26.13 percent higher than M_1 (**Table 3**). Within different rice cultivars, effective tillers varied greatly. Effective tillers reached their peak number (144.64) in V_3 (BRRI Dhan39), and then decreased 16.12% in V_4, 41.68% in V_1, and 12.84% in V_2 (**Table 3**). There was a substantial interaction effect was observed between planting techniques and variety. The combination M_2V_3 had the maximum number of effective tillers (167.02), whereas M_1V_2 had the lowest number of effective tillers (56.40) (**Table 3**).

Different sowing methods significantly affected the number of filled grain per panicle (**Table 3**). The highest number of filled grain/panicle (151.35) was observed inM_2which was 2.61% higher than that of M_1.Filled grains/panicle of different rice varieties differed significantly at 1% level of probability (**Table 3**). The highest number of filledgrains/panicle (163.78) was recorded from BRRI-39(V_3) which marginally reduced in V_4 but significantly reduced 12.65% & 2.82% in V_1 & V_2. The interaction effect between sowing method and varietyfor filled grain/panicle was significant. However, numerically the maximum number of filled grains/panicle (165.93) was found in the combination of M_2V_3 and the lowest number of filled grains/panicle (133.27) was found in the combination of M_1V_2 (**Table 3**).

1000 grainweight was slightly affected due to different sowing methods. The maximum weight of 1000 grains (28.22g) was observed in $M_1$and minimumweight was (25.18 g)observed in M_2 (**Table 3**).1000 grains weight was significantly affected due to different varieties of Rice. The maximum weight of 1000 grain (32.62gm) was observed in V_2 which is marginally reduced 7.02% in V_1 but significantly reduced 26.08 % & 4.46% in V_4&V_3 (**Table 3**). The interaction effect between sowing method and variety in 1000 grains weight was significant (**Table 3**). However, numerically the maximum grain weight (34.90 g) was found in the combination of$M_1V_2$and the minimum grain weight (20.67 g) was found in the combination of M_2V_3.

Different sowing methods slightly affected straw yield (**Table 3**).Themaximum straw yield (9.95 t/ha) was recorded with M_2 and the minimum straw yield (8.81 t/ha) wasfound with M_1. Straw yield in $M_2$was significantly 11.45% higher with that in M_1.Straw yield differed significantlywithin different rice varieties. The maximum straw yield (11.16 t/ha) was obtained in V_3(BRRIDhan39) and minimum yield (7.85 t/ha) was in V_2(Sadavaula).The plant height of flooded rice did not achieve its maximum height during our observation, despite the fact that flooded rice types are renowned for producing more straw. Higher tiller output, as noted in "Higher straw yield with BRRI Dhan39 and BINA Dhan-7," could potentially be the cause of (**Table 3**). The interplay of planting technique and rice type substantially impacts straw yield. Apparently,the highest straw yield (12.07 t/ha) was found in the combination of M_2V_3 and the lowest grain yield (7.22 t/ha) was found in the combination of M_1V_2 (**Table 3).**

Grain yieldof rice was significantly affected due to different sowing method (**Table 3**) and the value was remarkably higher (3.51 t/ha) at M_2.Grain yield was significantly affected due to different rice varieties,and maximum grain yield was achieved (4.66 t/ha) at V_3(BRRIDhan39).The lowest grain yield (2.08 t/ha) was found in V_2(Sadavaula, a conventional flooded rice variety).Grain yield reduced significantly 11.15% in V_4,52.58% in V_1 and 55.36% inV_2compared with V_3 (**Table 3).**Grain yield was significantly affected by the interactionbetween sowing method and variety. The highest grainyield (5.13 t/ha) was found in the combination of M_2V_3 and the lowest grainyield (1.98 t/ha) was found in the combination of M_1V_2 (**Table 3**).

Different sowing methods significantly affected biological yield (**Table 3**).The maximum biological yield (13.45 t/ha) was observed in $M_2$and minimum yield (11.85 t/ha) was in M_1(Where broadcasting method was applied). Biological yield was significantly 11.09% higherin M_2compared with M_1.Biological yield was significantly affected within different varieties of rice. The maximum biological yield (15.81 t/ha) was found inV_3(BRRI Dhan39) andminimum biological yield (9.93 t/ha) was found in V_2

(Sadavaula). Biological yield was maximumat V_3which reduced significantly 12.08, 30.68 and 37.19%in V_4, V_1 and V_2 respectively(**Table 3**). Biological yield was significantly affected by the interaction between sowing method and variety (**Table 3**). The highest biological yield (17.20 t/ha) was found in the combination of $M_2V_3$and the lowest biological yield (9.19 t/ha) was found in the combination of M_1V_2.

Harvest index showed significant variationsfor differentsowing method (**Table 3**). However, the highest harvest index of (25.34) was recorded in $M_2$and the lowest harvest index (25.07) was found in M_1.Different ricevarieties differed significantly in harvest index and the highest harvest index of (29.88) was observed in V_4 (BINA-7).The lowest harvest index (20.30) wasrecorded in V_1 (Digha). Harvest index was significantly differed due to the interaction between sowing method and variety. Numerically, the highest harvest index (31.20%) was found in the combination of $M_2V_4$and the lowest harvest index (19.71%) was found in the combination of M_2V_1(**Table 3).**

Conclusion

The experiment was consisted of two planting method(M_1= Broadcasting method and M_2= Line sowing method) and four rice varieties(V_1= Digha,V_2=Sadavaula,V_3=BRRI Dhan39,V_4=BINA Dhan-7) commonly cultivated in Chalan beel areas of Bangladesh. Among the rice varieties Digha and Sadavaula are local deep water rice varieties and BRRI Dhan39 and BINA Dhan-7 are high-yielding rice varieties

The outcome demonstrates that the line sowing method (M_2) produced the highest plant height (152.01 cm), number of tillers (10.82), panicle length (21.16 cm), fill grain (78.79 cm), grain yield (6.708 cm), straw yield (7.48 cm), and biological yield (13.45 cm).

The performance of the rice varieties is best demonstrated by BRRI Dhan 39, which contributes the most tillers per square meter (187.93), panicle length (22.02 cm), effective tillers (144.64), grains yield (4.66 t ha^{-1}), straw yield (11.16 t ha^{-1}), and biological yield (15.81t ha^{-1}). On the other hand, in terms of flooded rice types, higher values were found from Digha, which had more tillers per square meter (87.11), panicle length (19.93 cm), effective tillers (70.75), and grain, straw, and biological yields (2.21, 8.75, and 10.96t ha^{-1}, respectively).

There was little to no remarkable interaction between rice varieties and planting techniques. However, optimum grain yield was obtained by combining BRRI Dhan 39 with the line sowing method (M_2V_3), and for flooded rice varieties, maximum grain yield was obtained by combining Digha with the line sowing method (M_2V_1). The findings of this study show that line sowing, as opposed to the more common broadcasting seed sowing technique, can significantly increase rice production for both high yielding (BRRI Dhan 39 and BINA Dhan-7) and locally grown flooded rice types (Digha and Sadavaula). Therefore, it might be recommended to farmers to put in a little extra work by adopting the line sowing method rather than the broadcasting approach because it can greatly boost grain production by 11.45 percent. In addition, it would be beneficial to conduct more research on the other rice varieties as well as in various ecologies.

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