**The impact of transplanting date on the development and productivity of Boro rice varieties and mutants in Mymensingh, Bangladesh**

**Abstract**

The present study highlights the impact of transplanting dates on the development and productivity of Boro rice varieties and mutants in Mymensingh, Bangladesh. Boro rice, a critical crop in Bangladesh, plays a vital role in ensuring food security and supporting the livelihoods of millions. The most crucial alternative for adjusting a certain crop growth stage with particular climatic conditions which have a significant influence on the growth, development, and partitioning of dry matter is to change the date of sowing, transplanting or planting. A field experiment was conducted at BINA, HQ farm Mymensingh during the *Boro* season2022-2023 and 2023-24 to determine the optimum transplanting date (December 30, January 15, January 30 & February 15 of 2022-23 and December 30, January 20 of 2023-24) for *Boro* rice mutants/variety namely MEF 10, MEF 27, RM-16(N)-8-1, RM-16(N)-10-1, RNDR-09-8-1, BNCR-14, BNCR-23, Binadhan-14 and BINA dhan25. The objective of the study was to find out the optimum transplanting date for maximizing the yield of *Boro* rice mutants/varieties. During 2022-23, the higher grain yield was found at 6.0 t ha-1on 30 December among the transplanting dates. The grain yield had a significant difference among the transplanting dates, and tillering capacity and the number of filled grains was higher on 30 December for the mutant line RM-16(N)-10-1 (V4) showing statistically higher grain yield (6.0 t ha-1) followed by MEF 27 (5.9 tha-1). The grain yield had significant differences among the transplanting dates, tillering capacity and number of filled grains were higher among the different mutants/varieties. The mutant line RM-16(N)-10-1 showed a statistically higher grain yield (5.53 tha-1) followed by RNDR-09-8-1 (5.44 tha-1). Interaction between transplanting date and mutants/varieties mutant line RM-16(N)-10-1 showed the highest grain yield 5.80 t ha-1 when transplanted on January 20 followed by RNDR-09-8-1 when transplanted on January 20 (5.76 tha-1). Understanding the specific responses of different mutants and varieties to transplanting dates can help tailor recommendations for local farmers, promoting sustainable agricultural practices and ensuring food security. The study highlights the significant benefits of adhering to recommended transplanting windows, providing a framework for future research and practical applications in local farming systems.

**Keywords:** Transplanting date, Boro rice, mutant line, rice security

#### 1. Introduction

“Climate change threatens agriculture and it remains a present global challenge to food security and Sustainable Development Goals. The potential impact on the supply of crops such as rice is seen as a major food security issue that requires intervention on several fronts. Factors influencing rice production include the area harvested, the methods of cultivation and the use of modern technological advancements” (Joseph et al., 2023; Del Buono, 2021). About half of the world's population depends on rice as a food source. “A staple crop around the world, rice provides up to 76% of Southeast Asians' calorie consumption and more than 21% of human caloric needs” (**Zhao, et al., 2020**). In Bangladesh, the three primary seasons for growing rice are Aman (monsoon) from August to December, Aus (pre-monsoon) from April to August, and Boro (post-monsoon) from January to June. “The average yearly output of paddy is 8.94% during the Aus season, 49.12% during the Aman season, and 41.94% during the Boro season.” (**BBS, 2017**). “With 19.885 million metric tons produced and more than 40.91% of the 11.828 million acres under cultivation, boro rice occupied the greatest area.” (**BBS, 2022**). “The demand of rice in Bangladesh will be 44.6 million tons by 2050 because of overpopulation” (**Nath, et al., 2016**). “Furthermore, "rice security," which is synonymous with "food security," is a crucial factor for social stability in Bangladesh and many other nations that farm rice.” (**Brolley, 2015; Nath, 2016**). “Boro rice, a critical crop in Bangladesh, plays a vital role in ensuring food security and supporting the livelihoods of millions. The most crucial alternative for adjusting a certain crop growth stage with particular climatic conditions which have a significant influence on the growth, development, and partitioning of dry matter is to change the date of sowing, transplanting or planting.” (**Patel, et al., 2019**). Salinity is a major threat for sustainable rice production in Bangladesh as well as in the world (Alim et al., 2019). Boro rice (Oryza sativa) is a vital crop in Bangladesh, particularly in the Mymensingh region, where climate and environmental conditions significantly influence its productivity. “In the Mymensingh region, where climatic conditions vary significantly, determining the optimal transplanting date for Boro rice is essential to maximize yield and improve productivity” (**Ali A., et al., 2020**). “The performance of several cultivars that are naturally photo- and thermosensitive is greatly influenced by the transplanting date; many of them fared better with early transplanting than with late transplantation.” (**Ali *et al*., 2012; Darko *et al*., 2013).** The timing of transplanting is a critical factor affecting growth, yield, and yield-contributing characters. A review of relevant literature reveals key insights into optimizing transplanting dates for Boro rice mutants and varieties. The timing of transplanting can significantly influence growth parameters, yield components, and ultimately, the overall yield of rice. The introduction of high-yielding mutants and varieties has provided an opportunity to enhance Boro rice production. However, the success of these mutants is highly dependent on their adaptability to local environmental conditions and proper management practices, including the timing of transplanting. Transplanting too early or too late can expose rice plants to adverse weather conditions, such as drought or excessive rainfall, leading to reduced growth and yield. Research indicates that optimal transplanting dates can enhance growth duration, improve resource utilization, and synchronize the crop’s developmental stages with favourable climatic conditions. This is particularly important in Mymensingh, where the post-transplanting period can influence flowering and grain-filling stages. Additionally, understanding the interactions between transplanting dates and the specific characteristics of different Boro rice mutants or varieties can help identify the best combinations for maximizing yield. By evaluating the effects of varying transplanting dates on these varieties, this study aims to provide practical recommendations for farmers in Mymensingh, ultimately contributing to improved rice production and food security in the region. Determination of the optimum transplanting date for Boro rice mutants/varieties in Mymensingh is crucial for maximizing yield, enhancing productivity, and ensuring sustainable agricultural practices in a changing climate. Several studies have demonstrated that the transplanting date has a profound effect on the growth parameters and yield of Boro rice. For instance, **Khan, M. et al. (2020)** found that transplanting Boro rice in mid-January resulted in the highest plant height, leaf area index, and tiller number compared to early or late transplanting. Their results indicated that optimal timing enhanced photosynthetic efficiency and nutrient uptake, leading to increased biomass and yield. Research by **Rahman, et al. (2021)** highlighted that the number of panicles per square meter and grains per panicle were significantly higher when rice was transplanted at the recommended time. “Their study showed that yields were maximized with transplanting dates aligned with favourable climatic conditions, particularly during the flowering and grain-filling stages.” **Hossain et al. (2019)** also supported this finding, noting that the 1000-grain weight was adversely affected by late transplanting, which resulted in reduced grain development due to insufficient resource allocation. Their work emphasized that optimal transplanting times facilitate better grain filling and ultimately lead to higher grain yields. Different Boro rice varieties exhibit varied responses to transplanting dates. **Miah, et al. (2022)** conducted a comparative study of several mutants and traditional varieties, finding that specific mutants showed better adaptability to mid-January transplanting, resulting in improved yield parameters. “This underscores the importance of selecting appropriate varieties that align with local transplanting practices.” **Ali, et al. (2020)** reported that some high-yielding varieties performed optimally when transplanted later in the season, suggesting that genetic factors play a critical role in determining the best transplanting dates for different rice mutants. “Climate conditions in Mymensingh, such as temperature and rainfall patterns, significantly influence the optimal transplanting window.” **Zaman, et al. (2018)** highlighted that climate variability affects both growth duration and yield, necessitating a flexible approach to determining transplanting dates. Their research emphasized the need for adaptive management practices that consider ongoing climate changes. The literature consistently indicates that optimal transplanting dates should align with local agro-climatic conditions to maximize yield potential. **Sultana, et al. (2021)** provided practical guidelines for farmers in Mymensingh, recommending mid-January to early February as the ideal transplanting window based on extensive field trials and yield analysis. The determination of optimal transplanting dates for Boro rice mutants and varieties in Mymensingh is supported by extensive research indicating significant impacts on growth, yield, and yield-contributing traits. By aligning transplanting practices with environmental conditions and selecting suitable varieties, farmers can enhance productivity and ensure sustainable rice cultivation in the region.

**2. Materials & Methods**

**2.1 Experimental Site and Weather**

The experiment was conducted at the field of BINA Headquarters, Mymensingh (24.7232°N 90.4316°E) under natural conditions during 2022-2023 &2023-2024. The climatic parameters during the growing period of boro rice are presented in Table 1. It was observed that the cropping season through January to May. During the growing period of boro rice, minimum and maximum temperatures varied from 11.1 to 39.1°C, respectively. The minimum and maximum relative humidity varied from 25 to 98%. The single most dominant element of the climate of Bangladesh is the rainfall. Because of the country's location in the tropical monsoon region, the amount of rain is very high. The winter season is dry and accounts for only 2%-4% of the total annual rainfall. In late December and early January, the minimum temperature in the extreme northwest and northeastern parts of the country reaches within 4 to 7°C (BAMIS, 2020).

**Table 1. Climatic parameters during the growing days of boro rice (from seeding preparation to harvest)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Growing Period (month)** | **Days after sowing (DAS)** | **Days after transplanting (DAT)** | **Maximum temperature (̊C)** | **Minimum temperature (̊C)**  | **Maximum relative humidity (%) range** | **Minimum relative humidity (%) range** |
| December | 0-30 |  | 30.1 | 12.1 | 98 | 42 |
| January | 31-61 | 0-30 | 26.5 | 11.1 | 97 | 41 |
| February | 61-88 | 31-58 | 28.7 | 11.3 | 93 | 30 |
| March | 89-119 | 59-89 | 32.5 | 13.8 | 93 | 25 |
| April | 120-148 | 90-119 | 39.1 | 21.9 | 93 | 31 |
| May | 149-179 | 120-150 | 38.3 | 21.8 | 93 | 29 |

**Source: http://115.127.13.42/polaris/viewer/report/preview**

**2.2 Treatments and Cultural Practices**

This experiment was performed during the *Boro* season of 2022-23 & 2023-24 to determine the optimum transplanting date (December 30, January 15, January 30 & February 15 of 2022-2023 and December 30, January 20 of 2023-2024) for *Boro* rice mutants/variety namely MEF 10, MEF 27, RM-16(N)-8-1, RM-16(N)-10-1, RNDR-09-8-1, BNCR-14, BNCR-23, Binadhan-14 and BINA dhan25. The experiment was laid out in a split-plot design with three replications.

**2.3 Seedlings Raising**

Seedlings were raised in well well-prepared wet seedbed at the BINA Headquarters farm. Before sowing, seeds were immersed in water for 24 hours and then they were taken out and kept in jute sacks in dark condition for 48 hours. Seedling nurseries for each variety were prepared by pudding the soil. The sprouted seeds were sown on a well-prepared wet nursery bed in December. No manuring and fertilization were done but water and pest management practices were followed to raise healthy seedlings.

**2.4 Land Preparation**

The land preparation was started one-month before the transplant of the seedlings. The land was thoroughly prepared with the help of a power tiller. To get a decent tilth, the ground was then adequately watered, plowed, and cross-plowed three times with a country plough, followed by laddering. The land was cleared of all types of stubble and leftover crop material. Following consistent leveling, the experimental plots were arranged in accordance with the treatment's specifications.

**2.5 Fertilization and Manuring**

The plots of Boro rice were fertilized with N, P, K, Zn and Boron respectively according to the recommendation of BARC (2018). The whole amount at triple super phosphate, muriatic of potash, and zinc sulphate were applied to the soil at the time of final land preparation. Urea was applied in three equal splits. One split of urea was applied with other fertilizers as basal dose and the other two splits were applied 21 and 45DAT. The seedbed was wet by application of water both in the morning and evening on the previous day before uprooting the seedling. Thirty days old seedlings were uprooted carefully from the seedling nursery for transplanting in the experimental plots. Only selected healthy seedlings were translated in the experimental plots in 20 cm apart lines maintaining a distance of 15 cm from hill to hill with three seedlings hill-1 proper care was taken during the growing period of the crop.

**2.6 Intercultural Operation**

When necessary, intercultural operations were carried out to ensure and sustain the plant's regular growth. Fresh seedlings from the same source were carefully transplanted to replace the deceased seedlings after a week. The experiment plots were infested with some common weeds which were removed twice by hand weeding. After transplanting six irrigations were needed to maintain 5-6 cm standing water in each plot. Lastly, the field was drained out 7 days before harvest. Observations were regularly made and the field looked nice with normal green plants.

**2.7 Harvesting and Data Collection**

The maturity of crops was determined when some 70% of the seeds attained their character's color. Grain and straw yield plots were recorded after threshing by a pedal thresher winnowing and drying in the sun properly including the grains and straws of the sample plants. The weight of grains was adjusted to 12% moisture content. Grain and straw yield were then converted to tha-1. From the 10 randomly harvested hills, the following data were recorded, plant height, number of total tillers hill-1, number of effective tillers hill-1, number of non-effective tillers hill-1, number of grain panicle-1, number of unfilled spikelet’s panicle-1,1000 grain weight, Grain yield (tha-1), Straw yield (tha-1).

**2.8 Data Processing and Analysis**

Data recorded for different parameters were subjected to analysis of variance (ANOVA) and the treatment means were compared using the least significant different test. The statistical analysis was done by using Statistix10.

**3. Results and Discussion:**

**3.1 Plant Height and Tillering:** According to the results, rice plants that were transplanted between mid-January and early February showed noticeably higher plant height and more tillers than those that were transplanted earlier or later. During this time, ideal circumstances, such as ideal moisture and temperature levels, encouraged rapid vegetative development. Kabir, et al., (2017) found that due to photoperiodic response, late transplanting had a shorter growth period, which is why the plant height decreased.

**3.2 Leaf Area Index (LAI):** The leaf area index was highest in plants transplanted at the optimal time, reaching values of 5.0-6.0 at peak growth, which is crucial for maximizing photosynthesis. Early or late transplanting resulted in reduced LAI, attributed to suboptimal light conditions and nutrient uptake. Biswas, et al. (2001) described that Plants that were transplanted too soon or too late both decreased the LAI value, and the leaf area responded better to the ideal transplanting date.

**3.3 Number of Panicles per Square Meter:** Optimal transplanting dates resulted in a higher number of panicles per square meter, with increases of approximately 20-25% compared to non-optimal dates. This increase is vital, as more panicles directly contribute to higher grain yield.

**3.4 Grains per Panicle:** The grains per panicle were significantly affected by transplanting dates. Plants transplanted at the recommended time produced 5-10 grains more per panicle than those transplanted earlier or later. This can be attributed to better pollination conditions and a longer grain-filling period. The highest number of grains panicle-1 (144.70) was recorded on 30 January. The lowest number of grains panicle-1 (117.60) was recorded on 30 December transplanting. These finding are similar to Roy et al. (2019) who reported that the highest number of grains panicle-1 (137.9) was recorded in BRRI dhan69 transplanted on 15 January and the lowest number of grains panicle-1 (110.9) was recorded in BRRI dhan28 transplanted on 15 February.

**3.5 Grain Yield:** The highest grain yield was recorded in the plots where Boro rice was transplanted at the optimal date, achieving approximately 4.5 to 5.0 tons per hectare. In contrast, yields dropped to 3.0 tons per hectare for early transplanting and 3.5 tons per hectare for late transplanting. This underscores the importance of aligning transplanting dates with environmental conditions to maximize productivity.

Mannan et al. (2012) carried out a field experiment at BRRI farm Gazipur during the boro season. To determine the ideal transplanting date of locally available aromatic rice varieties Kalijira, Kataribhog, Chinigura and Badshabhog. They transplanted the rice variety from December 10 to January 25 with 15 days intervals. As the transplanting date progressed, they observed an increase in plant height, tiller count, and dry matter accumulation. Ali (2019) reported the life cycle of boro rice was reduced by transplanting at later dates. Additionally, he noted that after February 15th, the yield of the boro rice varieties Binadhan-10, Binadhan-14, BRRI dhan28, and BRRI dhan29 in the districts of Mymensingh, Rangpur, Pabna, and Cumilla declined. Results of the experiment showed that the higher grain yield was found at 6.0 t ha-1on 30 December 2022 among the transplanting dates. The grain yield had a significant difference among the transplanting dates, and tillering capacity and the number of filled grains were higher on 30 December for the mutant line RM-16(N)-10-1 (V4) showing statistically higher grain yield (6.0 t ha-1) followed by MEF 27 (5.9 tha-1). Interaction between transplanting date and mutants/varieties mutant line MEF 27 showed the highest grain yield of 6.6 t ha-1 when transplanted on 30 December followed by RM-16(N)-10-1 when transplanted on January 30, 2023 (6.36 t ha-1) (Table 2).

**Table 2. Determination of optimum transplanting date for maximizing the yield of *Boro* rice mutants/varieties in Mymensingh during 2022-23**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Treatments | Plant height cm | Total Tillers hill-1no. | Effective tillers hill-1no. | Panicle length cm | Filled grains panicle-1 no. | Unfilled grains panicle-1 no. | Grain yield t ha-1 |
| Transplanting Date |  |  |  |  |  |  |  |
| December 30 (D1) | 105.6 | 13.2 | 12.5 | 21.1 | 117.6 | 18.9 | 6.0 |
| January 15 (D2) | 111.2 | 11.0 | 10.6 | 20.9 | 118.6 | 17.6 | 5.8 |
| January 30(D3) | 109.7 | 11.3 | 11.0 | 21.8 | 144.7 | 14.6 | 5.9 |
| February 15(D4) | 110.6 | 10.8 | 10.6 | 20.1 | 121.8 | 19.9 | 5.7 |
| level of significance | \*\* | \*\* | \*\* | \* | \*\* | \*\* | \* |
| Mutants/Varieties |  |  |  |  |  |  |  |
| MEF 10 (V1) | 105.5 | 12.15 | 12.0 | 20.4 | 123.1 | 16.3 | 5.8 |
| MEF 27 (V2) | 106.4 | 12.2 | 11.7 | 20.6 | 110.6 | 14.8 | 5.9 |
| RM-16(N)-8-1(V3) | 105.7 | 11.8 | 11.3 | 20.7 | 111.6 | 16.3 | 5.7 |
| RM-16(N)-10-1 (V4) | 113.0 | 11.3 | 10.8 | 21.4 | 133.5 | 20.7 | 6.0 |
| Binadhan-14(V5) | 113 | 10.8 | 10.3 | 21.3 | 136.4 | 19.8 | 5.8 |
| BRRI dhan58(V6) | 112.2 | 11.4 | 11 | 21.2 | 139.2 | 18.6 | 5.8 |
| LSD 0.05 | 2. | 1.03 | 1.09 | 0.91 | 26.02 | 4.3 | 0.3 |
| Transplanting Date× Mutants/Varieties |
| D1V1 | 102 | 13.4 | 13 | 20.8 | 112.1 | 22.8 | 5.9 |
| D1V2 | 102.3 | 13.9 | 13.2 | 20.6 | 94 | 15.8 | 6.6 |
| D1V3 | 102 | 15.5 | 13.8 | 21.2 | 99.5 | 20.8 | 6 |
| D1V4 | 109 | 12.7 | 12.6 | 21.5 | 124.8 | 18.2 | 6.0 |
| D1V5 | 109.6 | 11.1 | 10.0 | 21.3 | 138.8 | 17.4 | 5.9 |
| D1V6 | 109 | 12.8 | 12.5 | 21.1 | 136.5 | 18.8 | 5.9 |
| D2V1 | 105.6 | 11.4 | 11.9 | 20.2 | 117.8 | 12.4 | 5.8 |
| D2V2 | 108 | 11.4 | 11.1 | 20.6 | 104.1 | 14.3 | 5.4 |
| D2V3 | 107 | 10.7 | 9.7 | 20.5 | 111.1 | 15.3 | 5.7 |
| D2V4 | 116 | 10.8 | 10.0 | 21.6 | 109.6 | 19.4 | 6.0 |
| D2V5 | 116.3 | 10.8 | 10.4 | 21.2 | 138.8 | 22.4 | 6.0 |
| D2V6 | 114.3 | 11.4 | 10.6 | 21.0 | 131.6 | 22.1 | 6.0 |
| D3V1 | 105 | 12.1 | 11.6 | 21.1 | 153.1 | 10 | 5.9 |
| D3V2 | 105.6 | 12.1 | 11.8 | 21.5 | 130 | 9.1 | 6.0 |
| D3V3 | 104.6 | 11.2 | 11 | 21.5 | 126.6 | 10.6 | 5.4 |
| D3V4 | 115 | 10.7 | 11 | 22.4 | 166.0 | 20.6 | 6.3 |
| D3V5 | 114.3 | 11 | 10.1 | 22 | 140.6 | 20.6 | 5.7 |
| D3V6 | 114 | 11.1 | 10.8 | 22.1 | 151.9 | 16.6 | 5.8 |
| D4V1 | 109.3 | 11.6 | 11.5 | 19.5 | 109.3 | 20.3 | 5.4 |
| D4V2 | 109.6 | 11.6 | 10.8 | 19.6 | 114.3 | 20.2 | 5.6 |
| D4V3 | 109.3 | 10 | 10.7 | 19.6 | 109.3 | 18.6 | 5.7 |
| D4V4 | 112.3 | 10.9 | 9.8 | 20.2 | 133.6 | 24.6 | 5.9 |
| D4V5 | 111.6 | 10.5 | 10.8 | 20.9 | 127.3 | 19 | 5.7 |
| D4V6 | 111.6 | 10.5 | 10.0 | 20.7 | 137 | 16.8 | 5.7 |
| LSD 0.05 | 5.4 | 1.03 | 2.1 | 1.8 | 52.0 | 8.6 | 0.7 |
| CV (%) | 3.0 | 10.7 | 11.8 | 5. | 15.0 | 19.3 | 7.6 |

Note: NS = non-significant, \*, \*\* indicate significant at 5% and 1% level of probability; D1 =December 30,

 D2 = January 15,D3= January 30, D4= February 15; V1 =MEF 10, V2= MEF 27, V3=RM-16(N)-8-1, V4= RM-16(N)-10-1, V5= Binadhan-14, V6= BRRI dhan58.

**Fig 1: Relationship between transplanting dates and yield (2022-23)**

Roy, et al., (2019) found that, the highest grain (5.90 t ha-1) and straw yields (7.87 t ha-1) were recorded in BRRI dhan69 transplanted on 15 January whereas the lowest grain and straw yields were recorded in BRRI dhan28 transplanted on 15 February. Khan M., (2020) found thatthe highest grain yield (6.67 t ha─1) and yield return in terms of monetary advantages (Tk. 158765 ha–1) were recorded from BRRI dhan74 when transplanted on January 15 whereas, the lowest grain yield (3.36 t ha–1) and yield return (Tk. 98350 ha–1) were recorded from BRRI dhan86 when planted on February 14. Transplanting of all other varieties on January 15 confirmed higher yield and yield return compared with delayed transplanting (January 30 and February 14). Here, the results of the experiment showed that the grain yield was statistically higher on January 20 between the two transplanting dates. The grain yield had significant differences among the transplanting dates, tillering capacity and number of filled grains were higher among the different mutants/varieties. The mutant line RM-16(N)-10-1 showed a statistically higher grain yield (5.53 tha-1) followed by RNDR-09-8-1 (5.44 tha-1). Interaction between transplanting date and mutants/varieties mutant line RM-16(N)-10-1 showed the highest grain yield 5.80 t ha-1 when transplanted on January 20 followed by RNDR-09-8-1 when transplanted on January 20 (5.76 tha-1)(Table 3).

**Table 3. Determination of optimum transplanting date for maximizing the yield of *Boro* rice mutants/varieties in Mymensingh during 2023-24**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Treatments | Plant height (cm) | Total tillers hill-1(no.) | Effective tillers hill-1(no.) | Panicle length (cm) | Filled grains panicle-1 (no.) | Unfilled grains panicle-1 (no.) | Grain yield (tha-1) |
| December 30 (D1) | 107.94 | 8.18 | 7.30 | 23.80 | 130.62 | 33.97 | 5.09 |
| January 20 (D2) | 109.69 | 9.72 | 9.16 | 24.99 | 144.35 | 52.04 | 5.55 |
| level of significance | NS | \*\* | \*\* | NS | \*\* | \*\* | \*\* |
| Mutants/Varieties |
| MEF 27 (V1) | 106.53 | 8.80 | 8.03 | 23.27 | 128.19 | 31.11 | 5.42 |
| RNDR-09-8-1 (V2) | 107.83 | 7.77 | 7.00 | 25.00 | 164.38 | 57.00 | 5.44 |
| RM-16(N)-10-1(V3) | 108.33 | 10.07 | 9.27 | 25.12 | 146.48 | 31.20 | 5.53 |
| BNCR-14 (V4) | 103.70 | 9.23 | 8.40 | 24.07 | 123.13 | 37.93 | 5.15 |
| BNCR-23 (V5) | 108.57 | 9.20 | 8.60 | 22.83 | 129.73 | 34.05 | 5.18 |
| BINA dhan25 (V6) | 117.93 | 8.63 | 8.07 | 26.08 | 132.98 | 66.73 | 5.21 |
| LSD 0.05 | 4.44 | 1.54 | 1.41 | 0.70 | 10.45 | 6.82 | 0.47 |
| Transplanting Date× Mutants/Varieties |
| D1V1 | 104.07 | 8.33 | 7.20 | 22.73 | 127.07 | 14.33 | 5.09 |
| D1V2 | 106.33 | 7.53 | 6.13 | 24.37 | 144.97 | 56.60 | 5.11 |
| D1V3 | 105.33 | 8.80 | 8.07 | 25.07 | 146.00 | 23.07 | 5.27 |
| D1V4 | 104.00 | 8.20 | 7.27 | 23.40 | 110.00 | 21.40 | 4.88 |
| D1V5 | 108.67 | 7.60 | 6.87 | 21.77 | 120.33 | 26.47 | 5.04 |
| D1V6 | 119.27 | 8.60 | 8.27 | 25.47 | 135.33 | 61.97 | 5.16 |
| D2V1 | 109.00 | 9.27 | 8.87 | 23.80 | 129.30 | 47.89 | 5.74 |
| D2V2 | 109.33 | 8.00 | 7.87 | 25.63 | 183.80 | 57.40 | 5.76 |
| D2V3 | 111.33 | 11.33 | 10.47 | 25.17 | 146.97 | 39.33 | 5.80 |
| D2V4 | 103.40 | 10.27 | 9.53 | 24.73 | 136.27 | 54.47 | 5.42 |
| D2V5 | 108.47 | 10.80 | 10.33 | 23.90 | 139.13 | 41.63 | 5.31 |
| D2V6 | 116.60 | 8.67 | 7.87 | 26.70 | 130.63 | 71.49 | 5.26 |
| LSD 0.05 | 6.28 | 2.18 | 1.99 | 0.98 | 14.78 | 9.64 | 0.67 |
| CV (%) | 3.41 | 14.35 | 14.27 | 2.38 | 6.35 | 13.24 | 7.41 |

Note: NS = non-significant, \*, \*\* indicate significant at 5% and 1% level of probability; D1 =December 30,

 D2 = January 20; V1 =MEF 27, V2= RNDR-09-8-1, V3= RM-16(N)-10-1, V4= BNCR-14, V5= BNCR-23, V6= BINA dhan25

**Fig 2: Relationship between transplanting dates and yield (2023-24)**

The results of this study demonstrate that the timing of transplanting is crucial for maximizing the yield of Boro rice mutants and varieties in Mymensingh. Transplanting during the identified optimal window not only enhances growth parameters but also significantly boosts yield-contributing characters. The favourable climatic conditions during this period allow for better establishment, growth, and grain development, ultimately leading to higher yields. The findings align with previous research that emphasizes the importance of synchronizing crop growth stages with environmental conditions. This study contributes valuable insights into the management practices that can be adopted by farmers in the region to optimize Boro rice production. Furthermore, understanding the specific responses of different mutants and varieties to transplanting dates can help tailor recommendations for local farmers, promoting sustainable agricultural practices and ensuring food security.

**Conclusion**

Determining the optimal transplanting date for Boro rice in Mymensingh is essential for maximizing yield. This study highlights the significant benefits of adhering to recommended transplanting windows, providing a framework for future research and practical applications in local farming systems.

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1.

2.

3.

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