

RESEARCH ARTICLE

EFFECT OF NITROGENOUS FERTILIZER ON THE YIELD PERFORMANCE OF *BORO* RICE CULTIVARS

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ABSTRACT

The investigation was conducted from November 2021 to May 2022 at the Agronomy Field Laboratory of the Bangladesh Agricultural University (BAU), Mymensingh, to determine the impact of nitrogenous fertilizer on the yield performance of *boro* rice varieties. Three replications of the experiment were set up using a randomized full block design. According to the data, variety had a substantial impact on *boro* rice's yield and yield components. From BRRI Hybrid dhan5, the most harvest index (47.26%), highest grain yield (7.50 t ha⁻¹), highest straw yield (8.32 t ha⁻¹), and maximum 1000-grain weight (30.22 g) were obtained. Varying nitrogen concentrations also had a big impact on *boro* rice yield. The maximum RD of N from USG (N4) produced the highest grain yield (5.95 t ha⁻¹), highest straw yield (6.85 t ha⁻¹), and highest 1000-grain weight (23.71 g). The BRRI Hybrid dhan5 with 100% of RD of N from urea yielded a 1000-grain weight (30.65 g) and harvest index (48.02%) in the event of an interaction. With the application of 100% of RD of N from USG, BRRI Hybrid dhan5 yielded the best number of effective tillers hill⁻¹ (11.47), grains panicle⁻¹ (161), straw yield (9.67 t ha⁻¹), and highest grain yield (8.88 t ha⁻¹). A conclusion that can be drawn from the study's findings is that BRRI Hybrid dhan5 combined with USG application may be suggested in order to maximize grain production and improve weed control during *boro* season.

KEYWORDS

Boro rice, BRRI Hybrid dhan5, Poultry manure, Prilled Urea, USG, Yield

1. INTRODUCTION

Growing in a variety of climate zones, rice (*Oryza sativa* L.) is one of the most significant cereal crops in the world, providing food for human use. Over 3 billion people, or more than half of the global population, eat it as a staple diet. According to a researcher, the world's greatest annual per capita consumption of rice is still observed here (Salam et al., 2019). Most of the world's population is fed by rice (*Oryza sativa* L.), the most significant grain crop in the world. Forty-nine percent of the calories consumed by humans come from rice, seventeen percent from wheat, and nine percent from maize (Halder et al., 2024; Khatun et al., 2024; Asaduzzaman et al., 2024). Rice therefore makes up around one-fourth of the calories consumed worldwide (Farhat et al., 2023). One of the leading producers and consumers of rice worldwide is Bangladesh, one of the rice-producing nations. The production of rice is a major contributor to Bangladesh's GDP, creation of jobs, and food supply. Bangladesh's rice-based agricultural system, which contributes 13.47% of GDP (gross domestic product), has a major effect on the country's agrarian economy (BBS, 2021). Security of food and nutrition in Bangladesh depends on an adequate rice system (Timsina et al., 2018). In the last few years, the nation has not only achieved rice production self-sufficiency but has also progressively reached the export market (BER, 2015). Currently, 11.70 million hectares of land in Bangladesh are used to produce around 37.61 MT of rice (BBS, 2021). Three separate growing seasons are observed in Bangladesh for rice cultivation: "aman" (July to December), "aus" (March to July), and "boro" (December to May). Approximately 11.15%, 47.93%, and 40.91% of the total planted area is made up of Aus, Aman, and Boro rice, respectively (BBS, 2021). When it comes to production value, boro is the most significant and biggest crop in Bangladesh. 19.89 million metric tons of boro rice are produced on 4.79 million hectares of land (BBS, 2021). A significant step toward Bangladesh's resilient rice system is the production of 19.89 million tons of boro rice in 2021 (MOA, 2021).

Nitrogen is the most essential nutrient and a key building block for rice (Hasan, 2008). It has an impact on rice's development, yield, and

vegetative growth. Yield of improved rice varieties may reduce due to improper use of fertilizer, which also causes high cost of production. Inadequate amount of N fertilizer management might be the reason of low response of many high yielding improved varieties (Salam et al., 2022). A higher yield is the consequence of good plant growth and grain formation, which is ensured by an optimal quantity of nitrogen (Wang, 2005). When sprayed as urea, nitrogen usage efficiency for rice crops typically falls between 25 and 35% and seldom rises above 50% (Singh and Yadav, 1985). Wet land soil's particular characteristics encourage nitrogen loss by surface runoff, leaching, denitrification, and ammonia volatilization. In Bangladesh, rice agriculture during the boro season faces challenges related to nitrogen losses. Thus, it is essential to create practical plans for more efficient use of nitrogenous fertilizer. The presence of weeds is one of the primary causes of the low rice production (Hossain et al., 2024). Without a question, keeping the crop free of weed infestation allows rice farmers to reap the full benefits of expensive inputs like fertilizer and herbicides. It is estimated that weed infestation in Bangladesh decreases grain by 70–80% in aus rice, 30–40% in transplanted aman rice, and 22–36% in boro rice varieties (Mamun, 1990). Rice plants and weeds compete with one another for nitrogen, and in a field where weeds are abundant, weeds absorb nitrogen more quickly than rice plants, especially when nitrogen levels are high (Mia et al., 2024; Siddika et al., 2024). It was discovered that as the nitrogen rate increased, *E. crus-galli* growth and seed production increased as well, resulting in reduced nitrogen available to the rice plants (Islam et al., 2024; Chauhan and Abugho, 2013). Thus, an important consideration when assessing the impact of nitrogen on the behavior of weed infestations as well as the growth and productivity of transplant boro rice is effective nitrogen management. Till now very few remarkable research work is held on this and also there is not enough information for the right sources, combinations and level of nitrogenous fertilizers for boro rice-based cropping systems to increase yield. So, efforts and clarification are required to formulate suitable nitrogen management for particular varieties in order to successfully control weeds and maximize productivity. This study was therefore carried out to assess

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how nitrogen management affects transplant boro rice varieties' yield performance.

2. MATERIALS AND METHODS

2.1 Experimental Site and Design

The experimental site is situated around 18 meters above sea level and is located geographically at 24°25'N latitude and 90°50'E longitude. The dark gray, noncalcareous flood plain soil beneath the Sonatola Series of Old Brahmaputra alluvial soil is classified as belonging to Agro-ecological zone 9 by the researcher (UNDP and FAO, 1988). Utilizing three replications, the experiment was set up using a randomized complete block design (RCBD). A total of 25 therapy combinations were available. The unit plot count was seventy-five in total. Five meters by two and a half meters made up the unit plot. On January 10, 2022, the experiment was laid out, with plot to plot and replication to replication intervals of 0.5 and 1.0 meters, correspondingly.

2.2 Experimental Treatments

The following two sets of treatments were included in the experiment: Factor A: Variety (5): BRRi dhan28 (V₁), BRRi dhan29 (V₂), BRRi dhan71 (V₃), BRRi dhan100 (V₄), BRRi Hybrid dhan5 (V₅). Factor B: Level of Nitrogen (5): No nitrogen (N₀), 100% of RD of nitrogen from urea (N₁) (300 kg ha⁻¹), 100% of RD of nitrogen from poultry manure (N₂) (14.5 t ha⁻¹), 50% of RD of nitrogen from urea and 50% of RD of nitrogen from poultry manure (N₃) (150 kg ha⁻¹ and 7.25 t ha⁻¹), 100% of RD of nitrogen from USG (N₄) (2.7g per four hills)

2.3 Fertilizer Application

As per the guidelines provided by the Bangladesh Rice Research Institute (BRRi) for *boro* rice, the field was fertilized with urea, triple superphosphate, gypsum, muriate of potash, and zinc sulphate at a rate of 300-100-160-110-10 kg ha⁻¹. In accordance with the treatment specifications, none of the fifteen plots received any nitrogenous fertilizer application. The whole dosages of TSP, MoP, gypsum, and zinc sulphate were given as the base dose at the last stage of land preparation in every plot. According to treatment guidelines, urea was top dressed in 15 plots in three equal splits at 15 DAT, 30 DAT, and 45 DAT, respectively. Application of urea at 300 kg ha⁻¹ was necessary to obtain 100% of the needed amount of N. The remaining 15 plots received 100% of the recommended dose of nitrogen from urea super granule (USG). Ten days after transplanting, USG pellets (2.7 g) were manually placed in the root zone at a depth of eight cm in the middle of four hills that divided two adjacent rows.

2.4 Transplanting, Harvesting, And Post-Harvest Processing

In the well-puddled experimental plots, seedlings were transplanted on January 13, 2022. All the kinds were given a 25 cm by 15 cm spacing. During the transplantation process, the plots' soil was kept moist but not allowed to stand water. 90% of the grains had to become a golden yellow hue to indicate that the crop was mature. Various dates were used for the harvesting of various kinds. BRRi dhan28 and BRRi dhan71 were harvested on 23 April 2022, BRRi dhan100 was harvested on 05 May 2022 and BRRi dhan29, BRRi Hybrid dhan5 were harvested on 09 May 2022. To provide statistics on crop yield, hills from each plot's central 1 m² area were picked. Each plot's gathered crop was carefully packaged, labeled, and transported to the spotless threshing floor. Grain was cleaned after the crops were threshed using a pedal thresher. Following appropriate sun drying, the weights of the grain and straw for each plot were noted and

translated to tons per hectare.

2.5 Collection of Data After Harvesting

Plant height (PH), Total tillers hill⁻¹ (TT), Effective tillers hill⁻¹ (ET), Panicle length (PL), Grains panicle⁻¹ (GPP), Sterile spikelets panicle⁻¹ (SPP), 1000-grain weight (TGW), Grain yield (GY), Straw yield (SY), Biological yield (BY), Harvest index (HI)

2.6 HI (%)

It was computed using the following formula and represents the ratio of economic yield:

$$HI (\%) = \frac{GY}{BY} \times 100$$

Here, BY = GY+ SY

2.7 Statistical Analysis

In the format needed for statistical analysis, character data pertaining to yield and yield contributing were gathered and tallied. The obtained data were statistically analyzed using the "Analysis of Variance" approach and the MSTAT computer application. When required, the significance of the mean difference between the treatments was assessed using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

3. RESULTS AND DISCUSSIONS

3.1 Crop Characters, Yield, And Yield Contributing Characters

3.1.1 Effect of Variety

The effect of variety on PH of *boro* rice at maturity was significant at 1% level of probability. PH ranged from 91.29 cm to 100.6 cm. BRRi dhan71 had the tallest plant (100.6 cm) compared to BRRi dhan28 (97.47 cm), BRRi Hybrid dhan5 (98 cm), BRRi dhan100 (95.20 cm) and BRRi dhan29 (91.29 cm) (Figure 1A). This outcome agrees with the research done by Alam et al. (2012), who also found that the cultivars had varying PH. At the 5% probability level, the effect of variety on the TT was significant. BRRi Dhan29 had the highest TT number (10.53), while BRRi Hybrid Dhan5 had the lowest (8.95) (Figure 1B). This outcome concurs with the research conducted by Uddin and colleagues (2013). Additionally, (Salem et al., 2011) found that nitrogen control increased the TT. The significance level for the ET was 5%. Regarding the cultivars that were studied, the ET varied from 8.18 to 9.59. As per the results, BRRi Dhan100 had the most ET (9.59), whereas BRRi Dhan71 had the least ET (8.18). According to Figure 1C, the ET in BRRi Dhan28, BRRi Dhan29, and BRRi Hybrid Dhan5 were 8.51, 8.94, and 8.82, respectively. Additionally, they discovered differences in the ET among the types. Variety has an extremely substantial impact on PL (Tyeb et al., 2013; 2015). Panicles varied in length from 22.23 to 23.81. As shown in Figure 1D, BRRi Hybrid dhan5 yielded the largest panicle measuring 23.81 cm, whereas BRRi dhan28 generated the shortest panicle measuring 22.23 cm. Consent is given to the conclusions of the study by this outcome (Beutler et al., 2014; Bashir et al., 2012). The amount of GPP was significantly impacted by variety. There were between 90.72 and 138.00 grains in panicle⁻¹. The numbers of GPP that BRRi Hybrid dhan5 and BRRi Dhan28 generated were, respectively, 138.00 and 90.72 (Figure 1E). The genetic variations among the types may be the cause of this. As variety is largely determined by heredity, BRRi (1995) revealed that variety had a considerable impact on the GPP. It also documented comparable results in other rice types, according to the researchers (Mia et al., 2023; Pooniya et al., 2012).

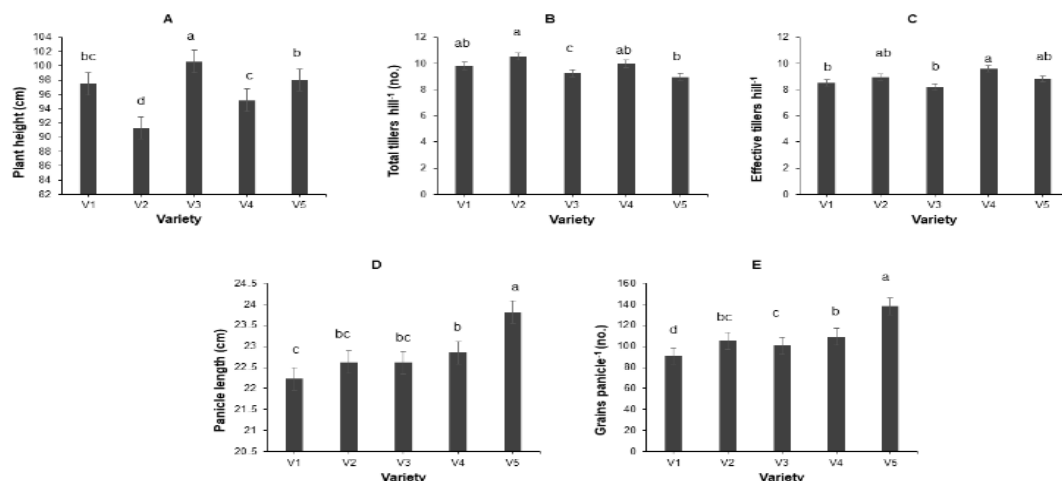


Figure 1: Effect of variety on different parameters.

V₁= BRRi dhan28, V₂= BRRi dhan29, V₃= BRRi dhan71, V₄= BRRi dhan100, V₅= BRRi Hybrid dhan5.

At 1% probability, the effect of variety on the quantity of SPP was substantial. In comparison to BRRi dhan29 (12.08), BRRi dhan28 (12.83), and BRRi dhan71 (13.27), BRRi Hybrid dhan5 generated the most SPP (14.41), whereas BRRi dhan100 produced the fewest (9.41) (Figure 2A). According to Alam (2013), there was a strong correlation between the quantity of SPP and variety. The TGW was significantly impacted by variety. Out of all the 1000 grains, BRRi Hybrid Dhan5 yielded the maximum weight (30.22 g). In contrast, BRRi Dhan100 generated the lowest weight (18.84 g), while BRRi Dhan28 (22.36 g), BRRi Dhan29 (21.38 g), and BRRi Dhan71 (24.29 g) provided the lowest weight (Figure 2B). The study found variations in TGW due to morphological and varietal variety (Roy et al., 2014). The weight of 1000 grains vary throughout the types, according to experiments conducted by researcher (Islam et al., 2023). The yield of grains was significantly impacted by variety. The variety BRRi Hybrid dhan5 yielded the most grain (7.50 t ha⁻¹). Because

the variety BRRi Hybrid Dhan5 had the highest GPP and the highest TGW, these factors combined to provide the maximum GY. In comparison to BRRi dhan28 (4.43 t ha⁻¹), BRRi dhan29 (5.47 t ha⁻¹), and BRRi dhan100 (5.64 t ha⁻¹), BRRi dhan71 had the lowest GY (4.35 t ha⁻¹) (Figure 2C). These fluctuations supported the hypothesis put forth, which suggested that variations in grain production could be caused by changes in the genetic composition of the cultivars (Impa et al., 2013). In comparison to BRRi dhan100 (6.61 t ha⁻¹), BRRi dhan29 (6.47 t ha⁻¹), and BRRi dhan28 (5.40 t ha⁻¹), the variety BRRi Hybrid dhan5 had the highest SY (8.32 t ha⁻¹). BRRi dhan71 had the lowest straw production (5.37 t ha⁻¹) (Figure 2D).

The outcomes corroborated those of Misra and Abidi (2006), who noted notable varietal variations in straw production between cultivars. Varieties had a major impact on the harvest index. For BRRi hybrid dhan5, the greatest harvest index (47.26%) was recorded. In Figure 2E, the harvest index for BRRi dhan71 was 44.63%, the lowest for BRRi dhan29 (45.73%), BRRi dhan28 (45.04%), and BRRi dhan100 (45.92%).

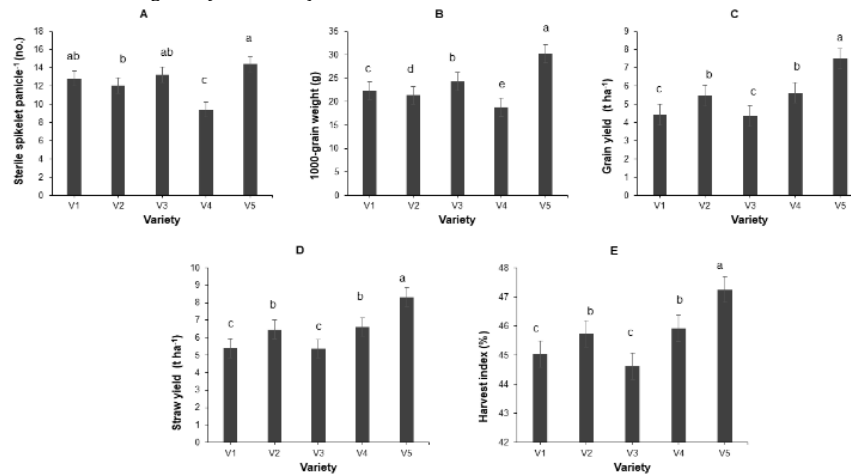


Figure 2: Effect of variety on different parameters.

Others details are same as shown in Figure 1.

3.1.2 Effect of Different Levels of Nitrogenous Fertilizers

The PH of *boro* rice was significantly impacted by various nitrogenous fertilizer dosages. The N₄ treatment produced the tallest plants (97.64 cm), which was statistically comparable to the 96.76 cm and 97.56 cm results from 50% RD of N from PM + 50% RD of N from urea treatments. Conversely, the PH that was lowest (93.6 cm) resulted from the absence of nitrogen treatment (Figure 3A). According to the study there is a positive correlation between the amount of nitrogen in the soil and PH, (Ferdush et al., 2020; Chhanda et al., 2021; Malik et al., 2014). At the 1% probability level, the number of TT was shown to be strongly impacted by varying quantities of nitrogenous fertilizer. The N₂ treatment produced the greatest number of TT (10.53), while the N₃ produced the lowest number of TT (9.26) (Figure 3B). Tillering is a critical trait for rice productivity, who noted a favorable effect of nitrogen management on the number of TT, also observed the conformity of this result (Salem et al., 2011; Badshah

et al., 2014). Significant effects were observed when nitrogenous fertilizer was applied at different rates to the ET. According to the study's findings, there was no nitrogen treatment when the lowest ET (7.58) was discovered and the highest number (10.07) was observed in N₄ (Figure 3C). Additionally, Ahmed et al. (2005) found that improved nitrogen management led to an increase in the number of ET. They found that an increase in tillers was significantly correlated with increased N absorption (Yoshida et al., 1972). Varying quantities of nitrogenous fertilizers had a notable impact on the PL. The treatment N₃ produced the longest panicles (23.19 cm), while the no nitrogen treatment produced the shortest (21.95 cm) (Figure 3D). In addition, the study found that PL varied in response to different nitrogen fertilization techniques (Tari et al., 2007). On the GPP, different nitrogenous fertilizer amounts had a considerable impact. Figure 3E shows that the N₄ produced the greatest GPP (117.90), while the treatment without nitrogen produced the lowest GPP (89.70). The study conducted study and reported similar findings (Salahuddin et al., 2009).

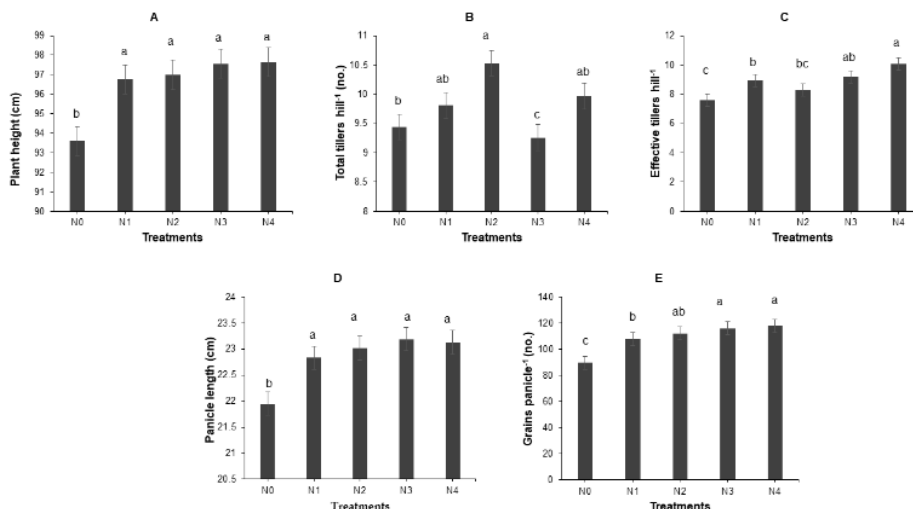


Figure 3: Effect of different levels of Nitrogen on different parameters.

N_0 = No nitrogen, N_1 = 100% of RD of nitrogen from urea (300 kg ha^{-1}), N_2 = 100% of RD of nitrogen from poultry manure (14.5 t ha^{-1}), N_3 = 50% of RD of nitrogen from urea and 50% of RD of nitrogen from poultry manure (150 kg ha^{-1} and 7.25 t ha^{-1}), N_4 = 100% of RD of nitrogen from USG (2.7 g per four hills).

The quantity of SPP was significantly impacted by varying nitrogenous fertilizer amounts. According to Figure 4A, the N_1 treatment produced the greatest number of sterile spikelet panicle $^{-1}$ (14.01), whereas the N_2 treatment produced the fewest (11.29). The treatment N_4 produced the largest grain weight (23.71 g), while the no nitrogen treatment produced the lowest grain weight (22.81 g) (Figure 4B). This may have occurred as a result of the rice plant's roots absorbing nitrogen, which affected the process of photosynthesis and the consequent storage of starch in sink cells like grain (Sarker et al., 2020). It also noted that the increased availability of N in the soil caused a change in the TGW (Hossain and Islam, 2008). According to the study, N plays a major role in increasing the protein content, which in turn raises grain weight (Chaturvedi, 2005). The grain production of *boro* rice was significantly impacted by varying

quantities of nitrogenous fertilizers. With one pellet weighing 2.7 g placed every four hills, the USG treated patch yielded the best grain production (5.95 t ha^{-1}). The N_3 treatment produced the second-highest GY (5.81 t ha^{-1}). However, in the case of no nitrogen treatment (control), the lowest was found at 4.38 t ha^{-1} (Figure 4C). Additionally, the study reported on differences in grain output caused by N fertilizer management (Shah et al., 2013; Das, 2011). Different amounts of nitrogenous fertilizers have a substantial impact on straw output. According to Figure 4D, the N_4 treatment produced the maximum SY (6.85 t ha^{-1}), while the control group (5.38 t ha^{-1}) produced the lowest yield. It similarly showed significant variance in SY (Shah et al., 2013; Das, 2011). The harvest index was greatly impacted by the various nitrogenous fertilizer concentrations. The plot with N_1 treated had the highest harvest index value (46.26%), while the plot with no nitrogen (control treatment) had the lowest harvest index value (44.79%) (Figure 4E). Using N_2 , N_3 , and N_4 , the harvest index values were obtained, which were 45.39%, 46.05%, and 46.08% accordingly. The results of the study, who noted that nitrogen significantly affected the rice harvest index, are supported by this finding (Sarker et al., 2020).

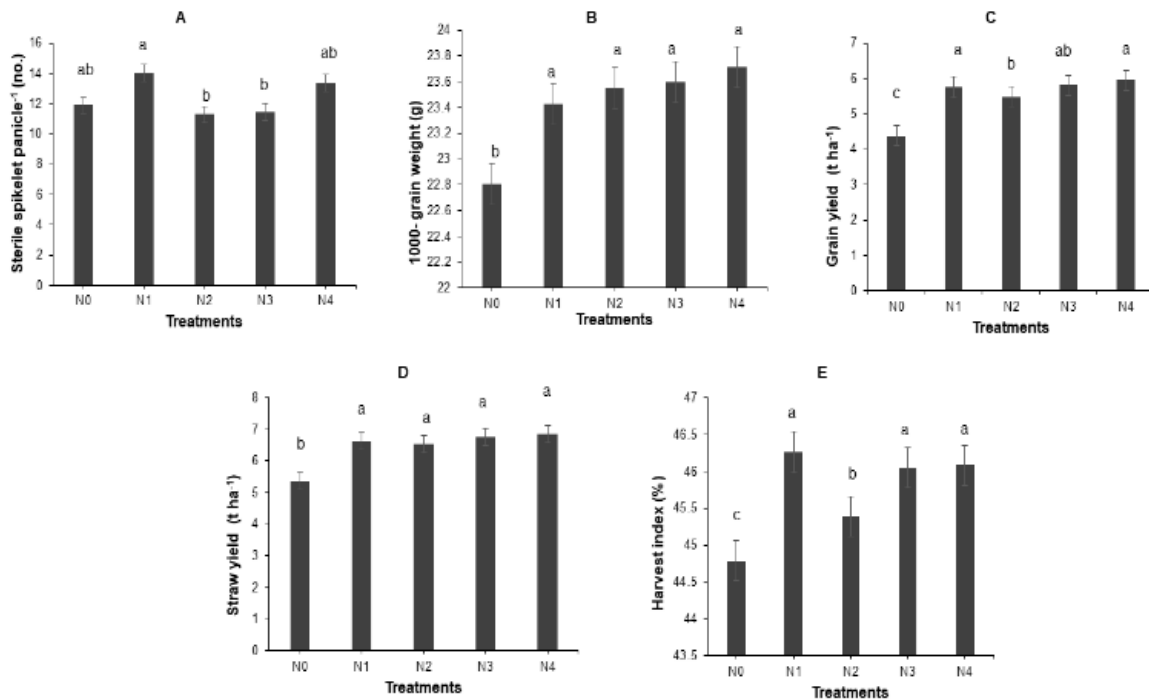


Figure 4: Effect of different levels of nitrogen on yield and yield attributes of rice.

Others details are same as shown in Figure 3.

3.1.3 Interaction Effect of Variety and Different Levels of Nitrogenous Fertilizers

PH was significantly impacted by the interaction of varying nitrogenous fertilizer amounts and variety. The combination of BRRi dhan71 \times N_3 produced the maximum PH (102.60 cm), whereas the combination of BRRi dhan29 \times control (no nitrogenous fertilizer applied) produced the lowest PH (84.56 cm) (Table 1). It has been noted that the combination of variety and varying nitrogenous fertilizer amounts has no discernible impact on the total number of tillers. Numerically, BRRi Hybrid dhan5 \times N_2 had the lowest number of TT (8.33) and BRRi dhan100 \times N_1 had the highest number of TT (11.56) for both combinations (Table 1). In addition, Salem et al. (2011) found that variety and nitrogen control increased the TT. The relationship between variation and various nitrogenous fertilizer dosages had a substantial impact on the ET. Table 1 shows that the interaction of BRRi Hybrid dhan5 \times N_4 had the maximum ET (11.47), while the interaction of BRRi Hybrid dhan5 \times no nitrogen (control) had the lowest ET (6.77). It also noted that the number of TT and ET was significantly impacted by the interaction between variety and degree of N (Jisan, 2014). According to the study, the quantity of efficient tillers increased rice plant productivity more than the TT (Haque and Haque, 2016). Different quantities of nitrogenous fertilizers did not significantly affect the GPP. The combination of BRRi Hybrid dhan5 \times N_4 showed the greatest number of PL (24.53 cm), whereas the combination of BRRi dhan29 \times no nitrogen (control) showed the lowest number (21.68 cm) (Table 1). The interplay between variety and varying quantities of nitrogenous fertilizers had a substantial impact on the GPP. The combination of BRRi Hybrid dhan5 \times 100% of RD of N from USG produced the greatest GPP (161.0), whereas the combination of BRRi dhan28 \times No nitrogen (control)

produced the lowest number (78.42) (Table 1). Different quantities of nitrogenous fertilizers and variety did not significantly affect the SPP. The interaction with BRRi Hybrid dhan5 \times N_1 showed the greatest SPP (17.54), while the interaction of BRRi dhan100 \times no nitrogen (control) showed the lowest number (8.84) (Table 1). The relationship between variance and different quantities of nitrogenous fertilizer was notable for a TGW. The combination of BRRi Hybrid dhan5 \times N_1 produced the largest TGW (30.65 g). On the other hand, the BRRi dhan100 \times no nitrogen treatment showed the lowest TGW (18.39g) (Table 1). The yield of grain was significantly impacted by the interplay between variation and varying nitrogenous fertilizer levels. The combination of BRRi Hybrid dhan5 \times N_4 produced the maximum GY (8.88 t ha^{-1}). The combination of BRRi Hybrid dhan5 \times N_1

produced the second-highest GY (8.06 t ha^{-1}). Conversely, BRRi dhan71 \times No (control) had the lowest grain production (3.57 t ha^{-1}) (Table 1). According to the study, the combination of nitrogen amount and variety has a substantial impact on rice grain output (Chamely et al., 2015). The results of the study are supported by this outcome (Hossain et al., 2018). The combination of BRRi Hybrid dhan5 \times N_4 produced the most SY (9.67 t ha^{-1}), while BRRi dhan71 \times no nitrogen produced the lowest SY (4.58 t ha^{-1}). The relationship between variation and varying nitrogenous fertilizer amounts had a noteworthy impact on biological production. The interaction between the BRRi Hybrid dhan5 \times N_4 treatment and the BRRi dhan71 \times N_4 treatment produced the highest BY (18.55 t ha^{-1}) and the lowest (8.15 t ha^{-1}) values, respectively (Table 1). The harvest index was significantly impacted by the combination of variety and varying nitrogenous fertilizer amounts. According to Table 1, the interaction between BRRi Hybrid dhan5 \times N_1 and BRRi dhan71 \times no nitrogen treatment had the highest harvest index value (48.02%) and the lowest value (43.6%).

Table 1: Interaction effects of nitrogen levels and varietal performance on yield and yield contributing characters of *boro* rice

Interaction (variety × level of Nitrogen)	PH (cm)	TT (no.)	ET (no.)	PL (cm)	GPP (no.)	SPP (no.)	TGW (g)	GY (t ha ⁻¹)	SY (t ha ⁻¹)	BY (t ha ⁻¹)	Harvest index (%)
V ₁ N ₀	94.78cde*	9.81	7.22hi	21.87	78.42j	11.74	22.06def	4.08ijk	5.07hij	9.16hij	44.53e-h
V ₁ N ₁	96.00a-e	10.53	8.44c-i	22.46	93.96g-j	14.84	21.94def	4.28ijk	5.05hij	9.33hij	45.86b-e
V ₁ N ₂	98.22a-e	0.26	8.44c-i	22.29	93.86g-j	10.65	22.57de	4.24ijk	5.43ghi	9.67hij	43.86gh
V ₁ N ₃	96.89a-e	9.97	8.66c-i	22.42	93.27g-j	12.77	22.52de	4.66f-j	5.613f-i	10.27f-i	45.32d-g
V ₁ N ₄	101.4ab	8.95	9.77a-f	22.1	94.09g-j	14.13	22.70d	4.93e-i	5.87e-h	10.79e-h	45.62b-f
V ₂ N ₀	84.56f	10.38	8.97b-i	21.68	92.51hij	13.94	20.29g	4.45g-k	5.44ghi	9.90ghi	45.00d-h
V ₂ N ₁	91.78e	10.24	8.57c-i	22.31	100.3f-i	12.05	21.44f	5.26d-g	6.22d-g	11.49d-g	45.73b-f
V ₂ N ₂	94.78cde	0.34	8.41c-i	23.28	109.1e-h	9.4d	21.56ef	5.94cd	7.04cd	12.99cd	45.80b-f
V ₂ N ₃	93.55de	10.22	9.11b-i	22.73	113ef	9.657	21.66ef	5.77cde	6.81cd	12.59cd	45.75b-f
V ₂ N ₄	91.78e	9.33	9.66a-g	23.09	111.6efg	15.34	21.97def	5.92cd	6.86cd	12.79cd	46.35bcd
V ₃ N ₀	96.78a-e	10.22	7.66e-i	21.70	83.56ij	10.78	23.97c	3.57k	4.58j	8.72ij	43.60h
V ₃ N ₁	101.4ab	11.27	9.44a-h	23.01	103.4e-h	16.2	24.04c	5.18d-h	6.22d-g	11.41d-g	45.43c-f
V ₃ N ₂	100.3abc	0.347	7.91e-i	22.57	106.5e-h	12.71	24.31c	4.34h-k	5.38g-j	9.73hij	44.56e-h
V ₃ N ₃	102.6a	9.99	7.55f-i	23.09	106.9e-h	11.6	24.57c	4.83f-i	5.83e-h	10.66e-h	45.26d-g
V ₃ N ₄	101.9ab	10	8.33c-i	22.64	102.8e-h	15.08	24.55c	3.86jk	4.85ij	8.157j	44.29fgh
V ₄ N ₀	94.33cde	10.22	7.29ghi	21.77	82.02ij	8.84	18.39h	4.14ijk	5.16hij	9.293hij	44.51e-h
V ₄ N ₁	96a-e	11.56	10.33a-d	22.38	105.2e-h	9.4	19.1h	6.02cd	6.99cd	13.02cd	46.25bcd
V ₄ N ₂	94.22cde	9.99	8.56c-i	23.23	120.4cde	9.41	18.97h	5.54def	6.57cde	12.11cde	45.73b-f
V ₄ N ₃	95.33b-e	9.11	10.67abc	23.56	117.3def	9.66	19.02h	6.06cd	7.06cd	13.13cd	46.18bcd
V ₄ N ₄	96.11a-e	9.667	11.11ab	23.28	120.1cde	9.74	18.75h	6.45c	7.27c	13.72c	46.95abc
V ₅ N ₀	97.55a-e	10.11	6.77i	22.70	112efg	14.14	29.32b	5.37def	6.40def	11.78def	45.62b-f
V ₅ N ₁	98.56a-d	11	7.77e-i	23.94	136.5bc	17.54	30.65a	8.06b	8.70b	16.77b	48.02a
V ₅ N ₂	97.44a-e	8.33	8.11d-i	23.71	130.7cd	14.29	30.32a	7.41b	8.35b	15.75b	47.02ab
V ₅ N ₃	99.44a-d	10.34	10.00a-e	24.16	149.9ab	13.57	30.24a	7.76b	8.49b	16.26b	47.76a
V ₅ N ₄	97a-e	8.553	11.47a	24.53	161a	12.49	30.59a	8.88a	9.67a	18.55a	47.90Aa
CV (%)	3.45	13.55	13.75	2.84	8.93	22.6	2.12	8.59	6.89	7.56	1.72
Level of significance	*	NS	*	NS	*	NS	*	**	**	**	*

Notes: As determined by the DMRT, a column figure with a common letter (s) or one without does not differ substantially; **= Significant at the 1% level of probability, *= Significant at the 5% level of probability, and NS= Not significant. Others details are same as shown in Fig. 1 and 3.

4. CONCLUSION

Along with the use of various cultural control strategies in rice, the use of competitive crop varieties to suppress the population of weeds is currently considered one channel for weed control. Since extremely competitive rice cultivars must be screened out, it is crucial to understand how well certain rice varieties compete with weeds. BRRI Hybrid dhan5 with USG application may be advised in order to increase grain yield and more successfully manage weeds throughout *boro* season, according to the study's findings. However, more research at various agro-ecological zones across the nation is required to validate this finding.

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CONFLICT OF INTEREST

The present publication does not contain any conflicts of interest, according to the authors.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Md. Fakhru Islam: Methodology, Investigation, Data curation, Writing – original draft. **Md. Liton Mia:** Methodology, Investigation, Formal analysis, Data curation, Conceptualization, Writing – review & editing. **Md Shafiqul Islam:** Writing – review & editing, Resources, Methodology, Investigation, Supervision. **Md. Romij Uddin:** Writing – review & editing, Methodology, Visualization, Supervision. **Md. Abdus Salam:** Writing – review & editing, Methodology, Data curation, Visualization, Investigation, Validation, Software, Supervision.

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