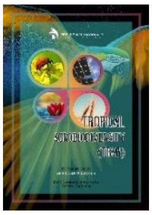
ZIBELINE INTERNATIONAL™ PUBLISHING

ISSN: 2716-7046 (Online)
CODEN: TARGCA

Tropical Agrobiodiversity (TRAB)

DOI: http://doi.org/10.26480/trab.01.2024.55.61



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RESEARCH ARTICLE

THE IMPACT OF NITROGENOUS FERTILIZER ON WEED GROWTH IN BORO RICE

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ARTICLE DETAILS

Article History:

Received 20 March 2024
Revised 25 April 2024
Accepted 06 May 2024
Available online 10 May 2024

ABSTRACT

The key component is nitrogen, which is also essential for the production of rice. From November 2021 to May 2022, an experiment was carried out at the Bangladesh Agricultural University (BAU), Mymensingh, at the Agronomy Field Laboratory, to investigate the impact of nitrogenous fertilizer on weed development and *boro* rice yield. Five different levels of nitrogenous fertilizers were used in the experiment: no nitrogen (control) (N_0), 100% of RD of N from urea (N_1), 100% of RD of N from poultry manure (N_2), 50% of RD of N from urea + 50% of RD of N from poultry manure (N_3), and 100% of RD of N from USG (2.7 g per 4 hills) (N_4). The five *boro* rice cultivars included in the experiment were BRRI dhan28 (V_1), BRRI dhan29 (V_2), BRRI dhan71 (V_3), BRRI dhan100 (V_4), and BRRI Hybrid dhan5 (V_5). Three replications and a randomized complete block design were used to establish up the experiment. According to the experimental data, BRRI dhan29 had a maximum weed density and dry weight at both the sample days and was heavily infested with weeds. BRRI Hybrid dhan5 and BRRI dhan71 had the lowest dry weight and weed density, respectively. Weeds were recorded using the quadrate method. The maximum dry weight (4.47 g m^{-2}) and weed density (31.80 m^{-2}) were found in BRRI dhan29 at 20 DAT. The maximum dry weight (4.06 g m^{-2}) and weed density (27.40 m^{-2}) were similarly found in BRRI dhan29 at 40 DAT. However, at 20 DAT and 40 DAT (33.60 m^{-2} and 4.06 g m^{-2}, respectively), the weed density (38.40 m^{-2}) and dry weight (4.50 g m^{-2}) were highest in N_1 (100% of RD of N from urea). The maximum weed density (41.67 m^{-2} and 36.33 m^{-2}) at 20 DAT and 40 DAT, respectively, in the treatment of V_4N_1 (BRRI dhan100 with 100% of RD of N from urea applied) was produced by the interaction of cultivar and nitrogen. At 20 and 40 days after treatment, the maximum dry weight of weed (5.22 g m^{-2} and 4.5 g m^{-2}) was seen in the V_1N_1 treatment (BRRI dhan28 with 100% of RD of N from urea). According to the findings of the study, BRRI Hybrid dhan5 with application of UGS may be suggested in managing weed more successfully during *boro* season.

KEYWORDS

Impact, Nitrogenous fertilizer, Weed growth, *Boro* rice cultivars

1. INTRODUCTION

The most significant cereal crop in the world is rice (*Oryza sativa* L.), which provides the majority of the world's population with food. Rice, wheat and maize account for 49% of all the calories consumed by people with 23% coming from rice, 17% from wheat and 9% from maize. As a result, rice accounts for roughly one-fourth of all calories ingested globally (Farhat et al., 2023). Bangladesh's economy depends heavily on the production of rice, which significantly boosts up the GDP, creates jobs and increases food supply. Bangladesh's rice-based agricultural system has a significant impact on the agrarian economy of this nation and accounts for 13.47% of its gross domestic product (GDP) (BBS, 2021). Bangladesh's food and nutrition security is a strategic objective and a resilient rice system is a key component (Timsina et al., 2018). Along with achieving rice production self-sufficiency in recent years, the nation has also been increasingly integrating into the export market (BER, 2015).

Currently, Bangladesh produces approximately 37.61 MT of rice on 11.70 million hectares of land (BBS, 2021). Three different rice-growing seasons occur in Bangladesh: '*aus*' (March to July), '*aman*' (July to December), and '*boro*' (December to May). *Aus, aman* and *boro* rice take up about 11.15%, 47.93% and 40.91%, respectively, of the total planted area (BBS, 2021). The most significant and most produced crop in Bangladesh is *boro*, which is the only one of these. In order to produce 19.89 million metric tons of *boro* rice, 4.79 million hectares of land are used (BBS, 2021). A substantial portion of this enhanced rice production roughly 66% of the country's total rice production has been made feasible by the adoption of new rice varieties (Islam et al., 2023). A major step toward Bangladesh's rice system being robust will be the production of 19.89 million tons of *boro* rice in 2021 (MOA, 2021).

The most crucial nutrient and a crucial input in the production of rice is nitrogen (Hasan, 2008). The development, growth, and yield of rice throughout vegetative stages are impacted. The inappropriate use of fertilizer, which also results in high production costs, may cause the yield of improved rice varieties to decrease. Many high yielding enhanced varieties may not respond as expected due to improper N fertilizer management. An ideal nitrogen level supports appropriate plant growth and grain production, which leads to a higher yield (Wang, 2005). The special characteristics of wet land soil encourage nitrogen loss by ammonia volatilization, denitrification, leaching and surface run-off. When rice is grown in Bangladesh during the *boro* season, nitrogen losses are a problem.

Therefore, it is necessary to develop realistic strategies for using nitrogenous fertilizer more effectively. The slower release of nitrogenous fertilizers with deep placement has been recommended to reduce nitrogen losses. According to a study, urea super granule (USG) is a

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Cite The Article: Md. Liton Mia, Md. Abdus Salam (2024). The Impact Of Nitrogenous Fertilizer On Weed Growth In Boro Rice. *Tropical Agrobiodiversity, 5(1): 55-61.*

fertilizer that may be applied to the decreased zone of rice soil, or the rice root zone, at a depth of 8 to 10 cm (Savant et al., 1991). In a field infected with weeds, rice plants do not assimilate nitrogen as quickly as weeds do, especially when nitrogen levels are high (Nyarko and De Datta, 1993). Less nitrogen was available for the rice plants as a result of *Echinochloa crusgalli*'s enhanced growth and seed production, which was found to be correlated with an increase in nitrogen rate (Chauhan and Abugho, 2013).

Because of this understanding how nitrogen influences the behavior of weed infestations as well as the development and yield of transplanted *boro* rice requires efficient nitrogen management. Few notable studies have been conducted on this topic to yet, and there is also a lack of knowledge regarding the best sources, mixes and dosages of nitrogenous fertilizers for *boro* rice-based cropping systems to boost output. To maximize production and efficiently control weeds, it is therefore necessary to put time and thought into formulating appropriate nitrogen management for specific types. The aim of this study was to determine how nitrogen management affected weed development and transplant *boro* rice varieties' yield performance.

2. Materials And Methods

2.1 Experimental period

At the Agronomy Field Laboratory of the Bangladesh Agricultural University in Mymensingh, Bangladesh, the experiment was conducted during the *boro* season, November 2021 to May 2022.

2.2 Experimental Site

The experimental site is situated at a latitude of 24°25"N and a longitude of 90°50"E, and it is approximately 18 meters above sea level. According to UNDP and FAO, the dark gray, non-calcareous floodplain soil under the Sonatola Series of Old Brahmaputra alluvial soil is included in Agro-ecological zone-9 (UNDP and FAO, 1988). The medium low land used for the experiment had a pH of 6.5, was relatively flat, and had a silt loam texture.

2.3 Experimental design

Three replications and a randomized complete block design (RCBD) were used to set up the experiment. There were twenty-five possible combinations of treatments. There were seventy-five-unit plots in all. The unit plot measured 5 m 2 (two meters by 2.5 meters). Plot to plot and replication to replication distances were 0.5 m and 1.0 m, respectively, when the experiment was laid out on January 10, 2022.

2.4 Experimental treatments

In this experiment, there were two sets of treatments as follows: Variety (5) is a factor in the BRRI: dhan28 (V_1), dhan29 (V_2), dhan71 (V_3), dhan100 (V_4), and BRRI Hybrid dhan5 (V_5). The nitrogen level (factor B) is five. Zero nitrogen (N_0), 300 kg ha^{-1} of urea (N_1) (100 RD of nitrogen), 14.5 t ha^{-1} of poultry manure (N_2) (100 RD of nitrogen), 150 kg ha^{-1} and 7.25 t ha^{-1} of urea and 50% of RD of nitrogen from poultry manure (N_3), and 2.7 g of USG (N_4) nitrogen per four hills are the different amounts of nitrogen.

2.5 Land preparation

On December 30, 2021, the experimental field was first prepared using a powered tiller. On January 10, 2022, the ground was irrigated. After three rounds of plowing and cross-plowing with a country plough, the earth was thoroughly puddled, and the field was leveled using laddering. The field was cleared of stubble and weeds. Two days prior to the planned transplanting date, the last puddling was finished. The layout was completed on schedule and in accordance with the treatment plan design. Ultimately, a basal fertilizer dose was given and each plot was prepared for transplanting in accordance with the experiment's design.

2.6 Fertilizer application

Urea, zinc sulphate, gypsum, triple superphosphate (TSP), and muriate of potash (MoP) were applied to the field at rates of 300–100–160–110–10 kg ha^{-1}, respectively in accordance with the guidelines for *boro* rice provided by the Bangladesh Rice Research Institute (BRRI, 2018). As per treatment specification no nitrogenous fertilizer was applied in 15 plots.

2.6.1 Basal application

The final land preparation in each plot involved applying the full amount of MoP, zinc sulphate, TSP and gypsum as the basal dose.

2.6.2 Application of urea

Urea was top dressed as per treatment specification in three equal splits at 15 DAT, 30 DAT and 45 DAT, respectively in 15 plots. For getting 100% of recommended dose of N from urea, it was applied @ 300 kg ha^{-1}.

2.6.3 Application of poultry manure and urea

A total of fifteen plots were treated exclusively with poultry manure (100% of the necessary dose of nitrogen from PM) at a rate of 14.5 t ha^{-1}. The poultry manure was obtained from the poultry farm. Fifty percent of the prescribed dose of nitrogen (N) from urea (@ 150 kg ha^{-1}) and fifty percent of the recommended dose of N from poultry manure (7.25 t ha^{-1}) were applied to fifteen further plots. Poultry manure was used as the last step in land preparation to ensure appropriate decomposition, and urea was top dressed in three equal splits at 15 DAT, 30 DAT, and 45 DAT.

2.6.4 Application of USG

Nitrogen from urea super granule (USG) was applied to the remaining 15 plots at 100% of the prescribed dose. After transplanting for ten days, USG pellets (2.7 g) were manually placed in the center of four hills separating two neighboring rows, at a depth of eight centimeters, in the root zone.

2.7 Transplanting of seedlings

On January 13, 2022, seedlings were moved into the experimental plots with lots of puddles. For every variety, there was a 25 cm by 15 cm spacing. At the time of transplanting, the plots' soil was kept moist but not allowed to stand water.

2.8 Application of Pre-emergence herbicide

A single hand weeding was completed after 30 days after the pre-emergence herbicide Pretilachlor (Commit) @ 1 L ha^{-1} was sprayed by hand sprayer at 2 DAT in 4-5 cm standing water in the plots.

2.9 Collection of weed data

2.9.1 Weed density

Weed density data was obtained at 20 and 40 days after planting from every unit plot. According to a study, data on the number of weeds collected from every plot throughout the vegetative growth stage of the rice plants using a 0.25 m × 0.25 m quadrate (Cruz et al., 1986). Outside of 1 m^2 center zones, the quadrate was randomly positioned in three locations. The species-by-species counts of the weeds in the quadrate were transformed to numbers m^{-2} by multiplying by four.

2.9.2 Weed dry weight

After uprooting, cleaning, separating the weeds by species, and drying them in the sun, the samples were placed in brown paper bags with labels and dried in an electric oven set to 80°C for 72 hours, or until a steady weight was achieved. Following drying, the dry weight of the weeds was measured using an electric balance and translated to grams per square meter.

2.10 Statistical analysis

Weed parameters and yield-contributing characteristics data were collected, collated, and properly tabulated for statistical analysis. Utilizing the "Analysis of Variance" technique and the computer program MSTAT, the acquired data were statistically examined. Duncan's Multiple Range Test (DMRT) was used, as appropriate, to determine the significance of the mean difference between the treatments (Gomez and Gomez, 1984).

3. Results And Discussion

3.1 Infested weed species in the experimental fields

The experimental field was infested by six weed species from three families. One species of wide leaf, four species of grass, and one species of sedge were among the six types of weeds. Table 1 lists the weed's morphological type, family, scientific name, life cycle, and local name in the experimental plot. According to an experiment conducted at BAU, *Paspalum scrobiculatum*, *Fimbristylis miliacea* and *Cyperus rotundus* were the three most significant weeds in transplanted *boro* rice fields (Bari et al., 1995). However, a group researcher noted that the three major weed species in transplant boro rice fields were *Eriocaulenc enerseem*, *Lindernia antipola*, and *Fimbristylis miliacea* from the same location (Mamun et al., 1993).

Table 1: Infesting weed species in the experimental plot

SL No.	Local name	Scientific name	Family	Morphology type	Life cycle
1	Anguli ghas	*Digitaria sanguinalis* L.	Poaceae	Grass	Annual
2	Angta	*Panicum repens* L.	Poaceae	Grass	Perennial
3	Arail	*Leersia hexandra* L.	Poaceae	Grass	Perennial
4	Chesra	*Scirpus juncoides* L.	Cyperaceae	Sedge	Perennial
5	Kachuripana	*Eichhornia crassipes* L.	Pontederiaceae	Broadleaf	Perennial
6	Shama	*Echinochloa crusgalli* L.	Poaceae	Grass	Annual

3.2 Weed density

3.2.1 Effect of variety

Variety had significant effects on weed density 20 days after transplanting, with a 1% probability level. BRRI Hybrid dhan5 had the lowest weed density (26.27 m^{-2}) and was statistically similar to BRRI dhan71 (26.67 m^{-2}) and BRRI dhan28 (28.33 m^{-2}). The highest weed density (31.8 m^{-2}) was found in BRRI dhan29, which was also statistically similar to BRRI dhan100 (30.6 m^{-2}) and BRRI dhan28 (28.33 m^{-2}) (Figure 1). At the 1% probability level, variety also had significant effects on the density of weeds 40 days after transplanting. The results indicate that BRRI dhan29 had the highest weed density (27.4 m^{-2}) and was statistically similar to BRRI dhan100 (26.13 m^{-2}). On the other hand, BRRI Hybrid dhan5 had the lowest weed density (21.40 m^{-2}) and was statistically similar to BRRI dhan71 (22.47 m^{-2}) and BRRI dhan28 (24.27 m^{-2}) (Figure 1). The ability of crop species to compete for resources varies, even among species that are similar. Weeds were suppressed by the cultivars with the lowest weed density because they were more capable of competing with weeds for resources.

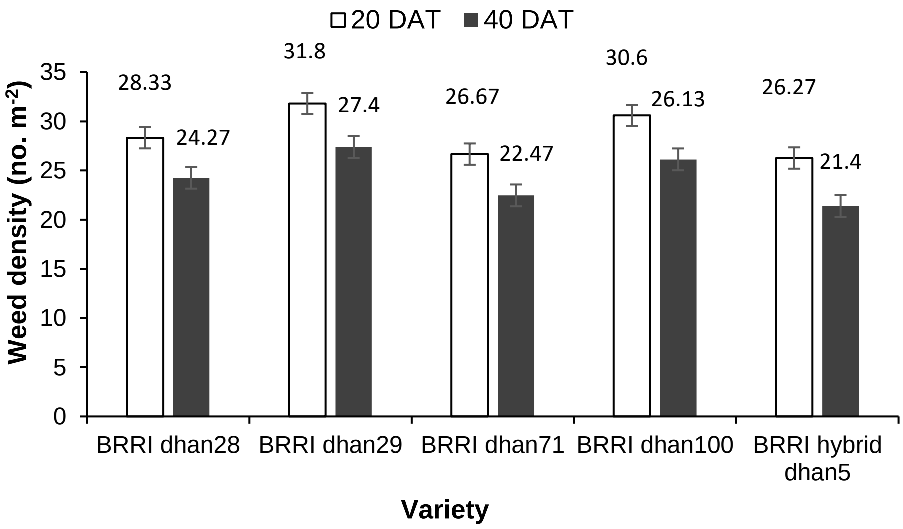

Figure 1: Effect of varietal performance on weed density

3.2.2 Effect of different levels of nitrogenous fertilizers

Weed density was significantly influenced by nitrogen management at 20 DAT. The highest number of weeds was found in 100% of RD of N from urea applied plot (38.40 m^{-2}) and the lowest number of weeds was found in 100% of RD of N from USG applied plot (19.53 m^{-2}) (Figure 2). Weed density was also influenced by nitrogen management at 40 DAT. The highest number of weeds was found in 100% of RD of N from urea applied plot (33.60 m^{-2}) and the lowest number of weeds was found in 100% of RD of N from USG applied plot (15.73 m^{-2}) (Figure 2). The weeds' lower availability of nitrogen than rice plants and the rice plants' rapid growth could be the cause of the lowest weed density observed after applying USG.

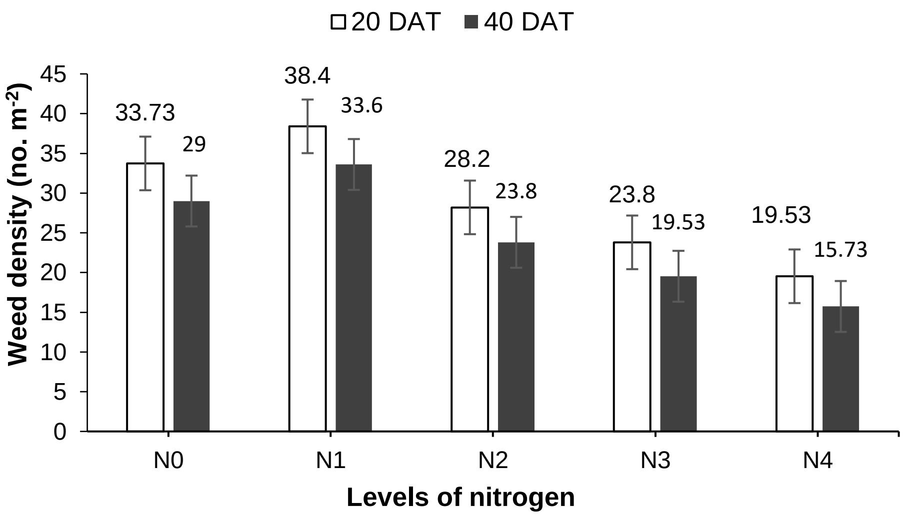

Figure 2: Effect of nitrogen levels on weed density

N_0 = No Nitrogen, N_1 =100% of RD of N from urea, N_2 =100% of RD of N from PM, N_3 =50% of RD of N from urea + 50% of RD of N from PM, N_4 = 100% of RD of N from USG

3.2.3 Interaction effect of variety and different levels of nitrogenous fertilizers

At 20 DAT, it was discovered that there was a strong interaction between the variety and various levels of nitrogenous fertilizers and weed density. Table 2 shows that the interaction of V_4N_1 (BRRI dhan100 × 100% of RD of N from urea) had the highest weed density (41.67 m^{-2}) and V_3N_4 (BRRI dhan71 × 100% of RD of N from USG) had the lowest weed density (17.00 m^{-2}). At 40 DAT, the interaction between variation and various nitrogenous fertilizer levels was also observed to be significant. Table 2 shows that the interaction of V_4N_1 (BRRI dhan100 × 100% of RD of N from urea) had the highest weed density (36.33 m^{-2}) and V_3N_3 (BRRI dhan71 × 50% of RD of N from PM + 50% of RD of N from urea) had the lowest weed density (13.00 m^{-2}).

Table 2: Interaction effect of various cultivars and nitrogen levels on weed density

Interaction (Variety × Levels of Nitrogen)	Weed density (no. m^{-2})	
	20 DAT	40 DAT
V_1N_0	33.33a-e*	28.00a-d
V_1N_1	40.00ab	36.00ab
V_1N_2	26.00e-k	21.67dh
V_1N_3	23.00g-k	19.33e-i
V_1N_4	19.33ijk	16.33ghi
V_2N_0	36.67abc	32.00abc
V_2N_1	37.67abc	32.67abc
V_2N_2	35.67a-d	22.00d-g
V_2N_3	26.33e-j	18.67f-i
V_2N_4	22.67g-k	26.33c-f
V_3N_0	30.67c-g	31.33abc
V_3N_1	35.67a-d	22.67d-g
V_3N_2	27.00d-i	19.00f-i
V_3N_3	23.00g-k	13.00i
V_3N_4	17.00k	31.00abc
V_4N_0	35.67a-d	22.67d-g
V_4N_1	41.67a	36.33a
V_4N_2	28.67c-h	21.33d-i
V_4N_3	25.67e-k	17.33ghi
V_4N_4	21.33h-k	27.67b-e
V_5N_0	32.33b-f	31.67abc
V_5N_1	37.00abc	18.33f-i
V_5N_2	23.67f-k	16.00ghi
V_5N_3	21.00h-k	13.33hi
V_5N_4	17.33jk	24.67c-g
Level of significance	**	**
CV (%)	16.53	18.27

* According to DMRT, a column figure with common letter(s) or without letter(s) does not differ significantly. NS = Not significant, **= Significant at 1% level of probability. V_1= BRRI dhan28, V_2 =BRRI dhan29, V_3 =BRRI dhan71, V_4= BRRI dhan100, V_5 =BRRI hybrid dhan5, N_0 = No Nitrogen, N_1 =100% of RD of N from urea, N_2 =100% of RD of N from PM, N_3 =50% of RD of N from urea + 50% of RD of N from PM, N_4 = 100% of RD of N from US

3.3 Weed dry weight

3.3.1 Effect of variety

At 20 DAT, cultivars had no noticeable effect on the dry weight of the weed. In terms of numbers, BRRI dhan71 had the lowest weed dry weight (3.85 g m^{-2}). The highest weed dry weight was obtained in BRRI dhan29 (4.46 g m^{-2}) (Figure 3). However, at 40 DAT, cultivar had a significant effect on the dry weight of the weed. BRRI dhan71 has the lowest dry weight of weeds (3.46 g m^{-2}). BRRI dhan29 (4.06 g m^{-2}) had the highest dry weight of weeds (Figure 3). Reduced weed biomass indicates a variety's potential to suppress weeds, although the opposite is also true. One may evaluate a variety's capacity to suppress weeds by evaluating the biomass of weeds under weedy conditions (Zhao et al., 2006). The lowest weed dry weight obtained in BRRI dhan71 due to its tall stature which is more competitive than weed (Sarker, 1979).

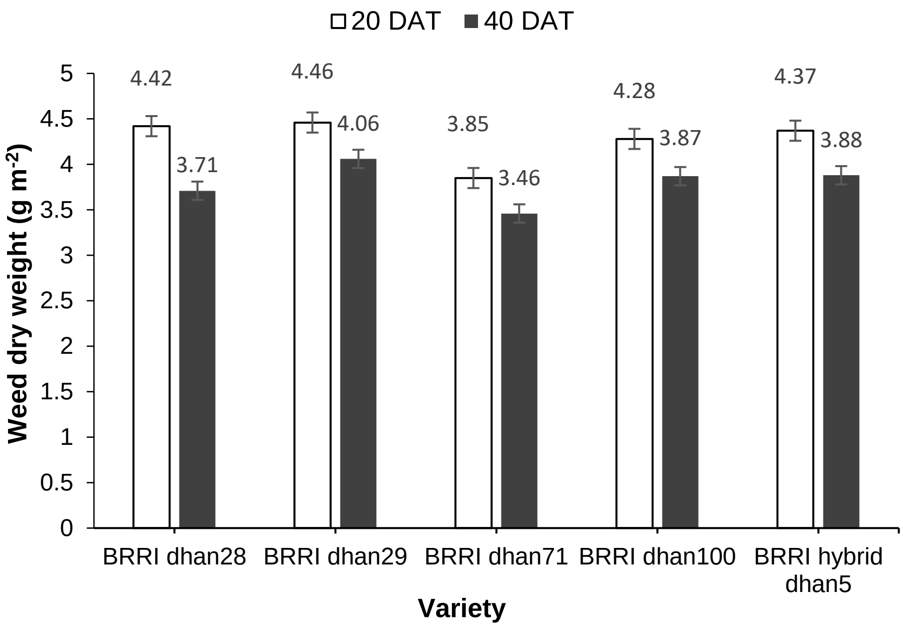

Figure 3: Effect of varietal performance on weed dry weight

3.3.2 Effect of different levels of nitrogenous fertilizers

At 20 DAT, nitrogen fertilizers significantly affected the dry weight of the weeds.

The highest weed dry weight was obtained in 100% of RD of N from urea applied plot (4.50 g m^{-2}). The lowest weed dry weight was obtained in USG applied plot (3.53 g m^{-2}) (Figure 4). Nitrogen also showed significant effect on weed dry weight at 40 DAT. The highest weed dry weight was obtained in 100% of RD of N from prilled urea applied plot (4.06 g m^{-2}). The lowest weed dry weight was obtained in poultry manure applied plot (3.46 g m^{-2}) (Figure 4). According to Rahayu et al. (2019), variations in nitrogen management have also been associated with variations in weed dry weight.

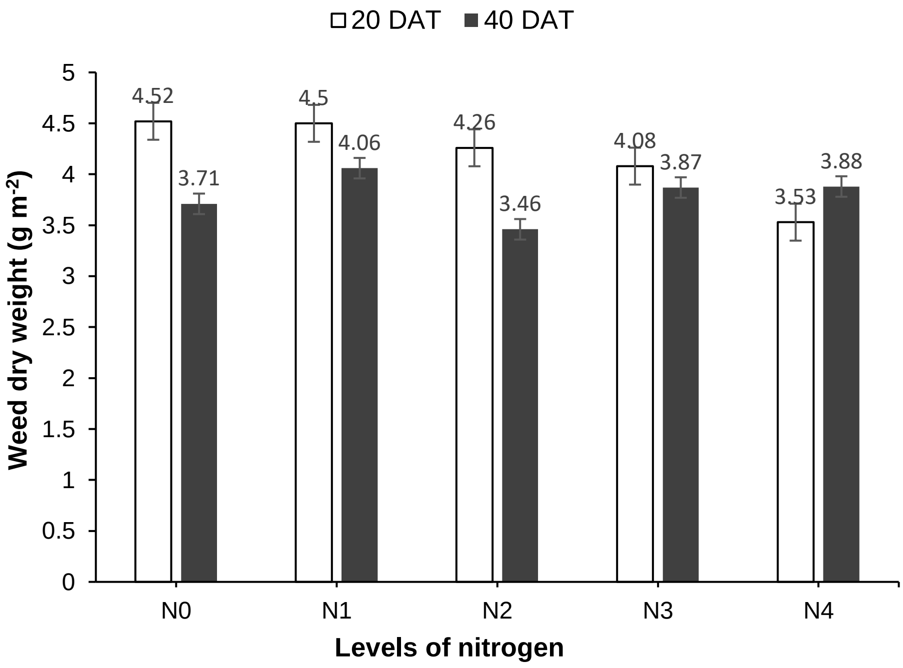

Figure 4: Effect of nitrogen levels on weed dry weight

N_0 = No Nitrogen, N_1 =100% of RD of N from urea, N_2 =100% of RD of N from PM, N_3 =50% of RD of N from urea + 50% of RD of N from PM, N_4 = 100% of RD of N from USG

3.3.3 Interaction effect of cultivar and different levels of nitrogenous fertilizers

At 20 DAT, the interaction between the cultivar and various nitrogenous fertilizer dosages on the dry weight of the weed was found to be non-significant. The interaction of (V_1N_1) (BRRI dhan28 × 100% of RD of N from urea) had the highest weed dry weight, numerically, at 5.22 g m^{-2}, and (V_3N_4) (BRRI dhan71 × 100% of RD of N from USG) had the lowest weed dry weight, numerically at 3.23 g m^{-2} in Table 3. At 40 DAT, the interaction between variety and various nitrogenous fertilizer levels on weed dry weight was not found to be significant. The combination of (V_1N_1) (BRRI dhan28 × 100% of RD of N from urea) (4.50 g m^{-2}) and (V_4N_4) (BRRI dhan100 × 100% of RD of N from USG) (3.00 g m^{-2}) had the highest and lowest weed dry weight, respectively (Table 3).

Table 3: Interaction effect of various variety and nitrogen levels on weed dry weight

Interaction (Variety × Levels of nitrogen)	**Weed dry weight (g m^{-2})**	
	20 DAT	40 DAT
V_1N_0	4.33	3.50
V_1N_1	5.22	4.50
V_1N_2	4.38	3.66
V_1N_3	4.53	3.66
V_1N_4	3.66	3.23
V_2N_0	5.02	4.26
V_2N_1	5.10	4.46
V_2N_2	4.34	4.03
V_2N_3	3.96	4.00
V_2N_4	3.90	3.56
V_3N_0	3.96	3.46
V_3N_1	4.50	4.10
V_3N_2	3.76	3.36
V_3N_3	3.83	3.53
V_3N_4	3.23	2.86
V_4N_0	4.80	4.46
V_4N_1	5.00	4.43
V_4N_2	4.33	4.03
V_4N_3	3.93	3.43
V_4N_4	3.33	3.00
V_5N_0	4.50	3.80
V_5N_1	5.16	3.73
V_5N_2	4.50	3.23
V_5N_3	4.16	3.50
V_5N_4	3.53	3.00
Level of significance	NS	NS
CV (%)	16.16	15.4

* According to DMRT, a column figure with common letter(s) or without letter(s) does not differ significantly. NS = Not significant, **= Significant at 1% level of probability. V_1= BRRI dhan28, V_2 =BRRI dhan29, V_3 =BRRI dhan71, V_4= BRRI dhan100, V_5 =BRRI hybrid dhan5, N_0 = No Nitrogen, N_1 =100% of RD of N from urea, N_2 =100% of RD of N from PM, N_3 =50% of RD of N from urea + 50% of RD of N from PM, N_4 = 100% of RD of N from USG

4. Conclusion

The experimental findings demonstrated that BRRI dhan29 had a maximum weed density and dry weight at both sample days and was heavily infested with weeds. On the other hand, BRRI Hybrid dhan5 and BRRI dhan71 had the lowest weed density and weed dry weight. The application of USG resulted in the lowest weed density and dry weight, while the 100% RD of N from prilled urea displayed the highest weed density and dry weight. Based on the study's findings, it might be suggested that BRRI Hybrid dhan5 be applied along with USG to more successfully control weed during *boro* season.

Acknowledgements

The authors would like to thank Bangladesh Agricultural University, Mymensingh, Bangladesh's BAURES for providing the funding required for the project "Effect of nitrogenous fertilizer management on the growth of weed of rice" (Project No.: 2021/18/BAU).

References

Bari, M.N., Mamun, A.A., Anwar, S.M.S., 1995. Weed infestation in transplant aman rice affected by land topography and time of transplanting. Bangladesh Journal of Agricultural Science, 22 (2), Pp. 227-235.

BBS (Bangladesh bureau of statistics), 2021. The yearbook of agricultural statistics of Bangladesh, statistics and information division, ministry of planning, government of people republic of Bangladesh.

BER, 2015. Bangladesh Economic Review 2015, Ministry of Finance, Government of the People's Republic of Bangladesh, Bangladesh Secretariat, Dhaka, Bangladesh. Pp.120.

Chauhan, B.S., Abugho, S.B., 2013. Growth of Echinochloa glabresces in response to cultivar and density. Journal of Crop Improvement, 27(4), Pp. 391-405.

Cruz, E.D., Moody, K., Ramos, M.B.D., 1986. Reducing variability sampling weeds in upland rice (Oryza sativa). Philippine Journal of Weed Science, 13, Pp. 56-59.

Farhat, M., Mia, M.L., Talukder, S.K., Yesmin, S.S., Monira, S., Zaman, F., Hasan, A.K., Islam, M.S., 2023. Assessment of combined effect of Eleocharis atropurpurea and Fimbristylis dichotoma residues on the yield performance of T. aman rice. Journal of Food Agriculture and Environment, 4 (1), Pp. 11-16. https://doi.org/10.47440/JAFE.2023.4103

Gomez, A.K., Gomez, A.A., 1984. Statistical Procedures Agricultural Research (2nd edn.), John Wiley and Sons, New York. Pp. 207-215.

Hasan, M.R., 2008. Effect of nitrogen sources and spacing on the growth and yield of T. aman rice (cv. BRRI dhan31). MS thesis. Department of Agronomy. Sher-e-bangla Agricultural University. Pp. 25-73.

Islam, M.S., Sarker, A.K., Mia, M.L., Talukder, S.K., Neshe, F.A., Sarkar, M., Zaman, F., 2023. Effect of Seedlings Per Hill and Harvesting Time on The Yield Performance of Purple Rice. European Academic Research, 11 (5), Pp. 637-647.

Mamun, A.A., Karim, S.M.R., Hoque, A.K.M., Begum, M., Kamal, M.M., Uddin, M.I., 1993. Weed survey in wheat, lentil and mustard crops under Old Brahmaputra Floodplain and Young Brahmaputra and Jamuna Flood Plain Agroecological zones. Bangladesh Agriculture University Research Program, 7, Pp. 160-172.

MOA, 2021. Weekly Crop Production Report Ministry of Agriculture, Government of the People's Republic of Bangladesh, Dhaka.

Rahayu, M., Yudono, P., Indradewa, D., Hanudin, E., 2019. The diversity and physiological activities of weeds in land cultivated with various corn cultivars and fertilized with various nitrogen doses. Biodiversitas Journal of Biological Diversity, 20 (3), Pp. 622-628. https://doi.org/10.13057/biodiv/d200302

Nyarko, A.K., De Datta, S.K., 1993. Effect of light and nitrogen and their interaction on the dynamics of rice-weed competition. Weed Research, 33, Pp. 1-8. https://doi.org/10.1111/j.1365-3180.1993.tb01911.x

Sarker, P.A., 1979. Study on varietal response to planting geometry and in transplanted rice. Allahabad Farmer, 50 (4), Pp. 357-358.

Savant, N.K., Dhane, S.S., talashilkar, S.C., 1991. Fertilizer News. International Fertilizer Development Centre. USA. Fertilizer News, 36 (3), Pp. 19-25.

Timsina, J., Wolf, J., Guilpart, N., Van Bussel, L., Grassini, P., Van Wart, J., Hossain, A., Rashid, H., Islam, S., Van Ittersum, M., 2018. Can Bangladesh produce enough cereals to meet future Demand? Agricultural Systems 163, Pp. 36-44. https://doi.org/10.1016/j.agsy.2016.11.003

UNDP, FAO, 1988. Land Resources Appraisal of Bangladesh for Agricultural Development. Report 2. Agro-ecological Regions of Bangladesh. Bangladesh Agricultural research council, Dhaka-1207. pp. 212-221.

Wang, G.X., 2005. Efficient amount of nitrogen application for grain filling at full panicle stage in mid-season hybrid rice. Beijing, China science press. Acta Agronomica Scinica, 33 (3), Pp. 449-454.

Zhao, D.L., Atlin, G., Bastiaans, L., Spiertz, H.J., 2006. Cultivar Weed-competitiveness in Aerobic Rice: Heritability, Correlated Traits, and the Potential for Indirect Selection in Weed-free Environments. Crop Science, 46, Pp. 372–380. https://doi.org/10.2135/cropsci2005.0192