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Influence of Planting Geometry on the Yield Performance of the Modern Boro Rice Variety BRRI dhan100

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Abstract: The study investigated the effects of different plant spacing treatments on the growth, yield components, and productivity of the modern rice variety BRRI dhan100 during the Boro seasons of 2022-23 and 2023-24. Six plant spacing treatments viz. T_1=20cm x 15cm, T_2=20cm x 20cm, T_3=25cm x 15cm, T_4=30cm x 15cm, T_5=25cm x 25cm and T_6=30cm x 30cm were designed with RCBD with three replications. Plant height, panicle length, thousand grain weight and spikelet sterility showed no significant variations among the treatments. However, tiller and panicle numbers varied significantly, with closer spacings (20cm × 15cm and 25cm × 15cm) producing the highest tillers and panicles hill^{-1} and m^{-2}, leading to higher grain yield. Wider spacing (30cm × 30cm and 25cm × 25cm) resulted in increased tillers hill^{-1}, exhibited superior individual plant biomass due to better resource availability but lower overall productivity. Grain yield was highest in 20cm × 15cm and 25cm × 15cm treatments, followed by 20cm × 20cm, due to enhanced tiller production, panicles, biomass efficiency thus increased grain yield. Closer spacing improved resource utilization and weed suppression, optimizing grain yield per unit area. Therefore, 20cm × 15cm or 25cm × 15cm spacing is recommended for the BRRI dhan100 to maximize productivity.

Keywords: spacing; tiller number; panicle number; grain yield; biological yield; harvest index.

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1. Introduction:

Rice (*Oryza sativa* L.) is one of the world's most important staple cereals, nourishing billions of people across diverse nations worldwide. The food security in Bangladesh is the synonym of rice security, as it is the primary and main cereal crop covering around 80% cultivable land. Among the food grains, individually rice is responsible for 97% of the total production and is crucial for the nutrition for nation, around 60% of total calories as well as 50% of protein intake for adults provided by rice (Biswas et al., 2022). The climatic condition, topography, and abundant rainfall is well-suited for the rice cultivation in Bangladesh. Bangladesh Bureau of Statistics (BBS, 2023) estimated that in the Fiscal Year 2022-23, farmers bagged about 3.91 crore tons of rice by using the area of 28.75 million ha and ranked as the third largest rice producer after China and India worldwide. One of the main factors for increased rice production is that farmers have shifted to cultivating high-yielding modern rice varieties with modern cultivation technique. The per capita consumption of rice in Bangladesh with an average of 179.9 kg per annum in contrast to the global average of 53.5 kg per annum (FAO, 2020). Over the years, the production of husked rice has surged from 12.97 million tons in 1977 to 37.96 million tons in 2021, despite of the population increase of 2.29 times during the same period (FAO, 2022). According to the projection of population for Bangladesh, the current population of 169 million will increase to 220 million by 2050 (UNFPA, 2022), the significance of rice production becomes even more pronounced. In a global context, the average rice yield ha^{-1} is 3.18 t ha^{-1}, with the national average for Bangladesh slightly exceeding at 3.25 t ha^{-1}, yet notably trailing behind Japan (5.00 t ha^{-1}) and China (4.74 t ha^{-1}) (FAO, 2022). Efforts aimed at enhancing rice yield through the proper management of water resources, crop practices, fertilizer management (Tonmoy et al., 2024), pest managements (Roy et al., 2024; 2025) and soil conditions have been underway for a considerable duration within the country, yielding beneficial outcomes. Nonetheless, the deficiency in proper knowledge and/or requisite information pertaining to the management practices of plant population density continues to represent a significant constraint. It is well-established that rice growth is influenced both qualitatively and quantitatively by variations in plant population densities.

Appropriate management practices need to be considered to get the higher yield of rice crop. Plant variety itself is a major element in determining rice yield, and yield-attributing traits and yield-influencing inputs, as well as spacing, are essential for the optimum possible rice grain production. For that, plant spacing is an important factor that playing a vital role on growth as well as development and finally the yield of rice (Karmakar et al., 2014; Miah et al., 1990). Since interplant spacing affects rice growth, development, and yield under all conditions, plant density has a major impact on rice production (Pandey et al., 2023). Plant height and yield also increased with the combination of organic and inorganic fertilizers (Biswas et al., 2020; Tonmoy et al., 2024). Individual plant performance increases linearly with increased plant spacing because it results in more functional leaves, leaf area, and total number of tillers per square unit area (Devi and Singh, 2000). Wider plant spacing results in less production per unit area, whereas closer spacing increases competition for growth elements including light, water, and nutrients, reducing crop yield. Planting geometry has an impact on how solar radiation is intercepted, coverage the crop canopy, accumulation of dry matter, and rate of the crop growth (Anwar et al., 2011; Rana et al., 2023). Optimum plant spacing is crucial for facilitating the appropriate growth of plants both in their aerial and underground parts by efficiently utilizing solar radiation and essential nutrients (Miah et al., 1990). Enhancement in photosynthetic efficiency and rice yield may be achieved through the implementation of spacing strategies that maximizes light interceptions. The physiological activities of rice plants may be affected by inadequate spacing, resulting in a potential yield decrease ranging from 26% to 30%. A significant proportion of the farmers practice random spacing, so rice plant cannot utilize proper nutrition and better yields. BRRI dhan100 is a newly released zinc enriched fine and modern rice varieties but lacking of optimized spacing. Therefore, the experiment was undertaken to investigate the responses under varying plant spacing and for better performance of Boro rice cv. BRRI dhan100.

2. Materials and Methods

The field experiment was conducted at the Research Farm of Bangladesh Rice Research Institute (BRRI), Regional Station, Sonagazi, Feni (Latitude: 22.80870N, Longitude: 91.38730E, Altitude: 12 masl) during 2022-23 and 2023-24 dry season (Boro season). The location of the experimental site is in the Agro Ecological Zone (AEZ) 18: Young Estuarine Floodplain (Fig. 1).

2.1. Soil and weather of experimental area

The soil of the experimental site is silty loam to silty clay loam, soil slightly saline pH is 8.2, slightly alkaline soil with a pH of 8.1 and a silty loam texture. Organic matter content is very low (1.4%), N, P, K, S & Zn medium. April through October experienced with tropical rainfall in the study area, with the remaining months observed sporadic rainfall. Furthermore, hot, and humid weather is associated with April and May, while milder weather is associated with December and February.

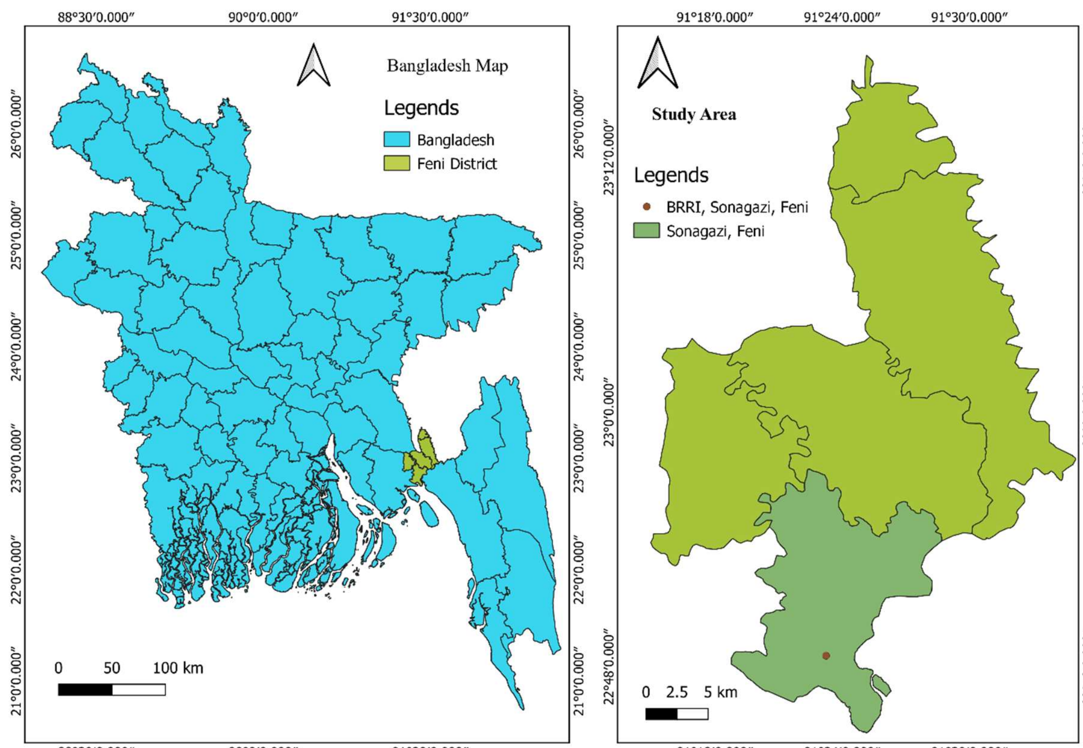

Figure 1. Study area map, BRRI Sonagazi, Feni

2.2. Experimental Design and Treatment

The experimental plot was laid out following the randomized complete block design (RCBD) with three replications. There were six planting geometries viz. T_1=20 cm x 15 cm, T_2=20 cm x 20 cm, T_3=25 cm x 15 cm, T_4=30 cm x 15 cm, T_5=25 cm x 25 cm and T_6=30 cm x 30 cm was used as treatments.

2.3. Seedbed Preparation

For raising quality seedlings in the seedbed, a common and established procedure was followed. The seedbed was prepared by puddles, followed by repeated (4-5 times) ploughing and laddering. Firstly, the seeds of BRRI dhan100 were soaked in water within a bucket for duration of 24 hours and pre-germinated seeds were then sown in a previously prepared moist seedbed at the BRRI regional station in Sonagazi, Feni research field on 1st week of December (for both dry seasons of 2022-23 and 2023-24). Weeds management was done as per requirement by manually and the bed was gently irrigated as requirement. Healthy as well as bold seeds of rice variety of BRRI dhan100 was sown for nursery, which ensured proper growth of all the seedlings in the seedbed.

2.4. Land Preparation and Transplanting

The land preparation was initiated after the onset of the winter season and accompanied by the application of pre-sowing irrigation within the designated experimental field. An initial ploughing was conducted utilizing a power tiller, succeeded by two subsequent deep ploughings employing a tractor-driven cultivator. Following each ploughing, planking was executed and subsequently layout was established. The raised seedlings were transplanted as per treatment for both the season. The transplanting procedure involved the use of seedlings of varying ages, specifically five weeks old for the 2022-23 season and six weeks old for the 2023-24 season. With the exception of the Nitrogen (124 kg ha^{-1}) application, total Phosphorus (22 kg ha^{-1}), Muriate of Potash (75 kg ha^{-1}), Sulphur (20 kg ha^{-1}) and Zinc (4 kg ha^{-1}) were applied as basal application before puddling and 2-3 seedlings were incorporated in the top 15 cm soil. The remaining nitrogen dosage was introduced as a top dressing in three equal divisions, strategically applied during the early tillering, maximum tillering, and panicle initiation stages, respectively. Additional standard agronomic practices were implemented as required throughout the entire duration of the crop growth period. Pretilachlor group herbicides, such as Rifit 500 EC @988 mL ha-1, were employed as pre-emergence weedicides within 5 days after transplanting (DAT) to manage weeds. In addition, at 25 DAT, hand weeding was done with a "Khurpi" to manage weeds. The rice was irrigated as needed until it reached the soft dough stage. The Cartap + Fipronil group, marketed as Suntap Plus 50WP, was applied @750g ha^{-1} to crops at the heading stage to avoid insect infestation. Azoxystrobin + Difenoconazole group, i.e., Amistar Top 325SC, was applied @500 mL ha^{-1} to manage the fungal disease at the heading stage during the experimental period.

2.5. Collection of Data

Data on vegetative stage (plant height, tiller number $hill^{-1}$, tiller number m^{-2}), yield components (panicle number $hill^{-1}$, panicle number m^{-2}, grains $panicle^{-1}$, 1000 grain weight, % spikelet sterility) etc. were collected. Five hills were randomly selected from each experimental plot for the record of plant height, tiller number $hill^{-1}$, panicle number $hill^{-1}$, panicle length, and the number of spikelets. The plant height was measured from the soil surface to the apex of the panicle subsequent to the flowering stage. From each plot, the crop was manually harvested by serrated edged sickles at physiological maturity when the panicles had about 85% ripened spikelets and the upper portion of spikelet's look straw-colored. The grain yield was adjusted with the moisture content of 14%. Per plot straw amount was calculated by subtracting the weight of grains from biological produce.

The spikelet sterility (%), biological yield, and harvest index (%) were calculated by using the following formula:

$$\text{Spikelet sterility (\%)} = \frac{Number\ of\ unfilled\ grain}{Total\ number\ of\ grains} \times 100$$

$$\text{Biological yield (t ha}^{-1}\text{)} = \text{Grain yield (t ha}^{-1}\text{)} + \text{Straw yield (t ha}^{-1}\text{)}$$

$$\text{Harvest Index (HI \%)} = \frac{\text{Grain Yield}}{\text{Biological Yield}} \times 100$$

2.6. Statistical analysis

Effects of different planting geometry data were analyzed by using the statistical software R-Studio (versions 2024.04.2+764). Analysis of variance (ANOVA) and 'least significance difference' (LSD) test at 5% probability level was used as mean separator by using "doebioresearch" package. Graph was performed by using "Rmisc" and "ggplot2" package. The "QGIS" program (version 3.22.9) was used to construct the study area map.

3. Results:

3.1. Effect of spacing on plant growth

The effect of different spacing on plant showed non-significant differences in both 2022-23 and 2023-24 seasons. The number of tillers showed statistically significant difference in both 2022-23 and 2023-24 seasons. In 2022-23, significantly the highest number of tiller $hill^{-1}$ was observed in T_6 (16.94) and T_5 (16.47). Whereas other treatments showed statically identical results. In 2023-24, T_6 (18.03) showed statically highest tiller number $hill^{-1}$, followed by T_5 (15.36). The number of tiller m^{-2} showed statistically significant difference in both 2022-23 and 2023-24 Boro seasons (Table 1). Statistically the highest number of tiller m^{-2} was found in T_1 (362.50) which was statistically identical with T_2 (336.81) in 2022-23. While, in 2023-24 T_1 (316.67) showed statistically significant difference and which was statistically identical with T_2 (288.89) and T_3 (273.00).

Table 1. Effect of spacing on growth parameters of BRRI dhan100 during 2022-23 and 2023-24 dry (Boro) season.

Treatment	Plant Height (cm)		Tiller Number hill^{-1}		Tiller Number m^{-2}	
(cm × cm)	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24
T_1 (20×15)	107.89	112.33	12.08 b	10.56 c	362.50 a	316.67 a
T_2 (20×20)	110.39	114.33	13.47 b	11.55 c	336.81 ab	288.89 ab
T_3 (25×15)	106.20	112.73	12.77 b	11.39 c	306.67 bc	273.00 ab
T_4 (30×15)	111.61	110.27	11.92 b	12.14 c	214.50 d	218.50 c
T_5 (25×25)	110.64	113.43	16.47 a	15.36 b	263.56 c	245.78 bc
T_6 (30×30)	108.78	110.03	16.94 a	18.03 a	152.50 e	162.25 d
Level of Significance	ns	ns	**	***	***	***
CV%	3.23	2.05	11.16	10.02	8.79	10.71
$LSD_{0.05}$	-	-	2.83	2.40	43.64	48.90

Footnote, LSD: Least significant difference; CV: coefficient of variation; ***: significance at 0.1%, **: significance at 1%; *: significance at 5%; ns: non-significance.

3.2. Effects of spacing on yield contributing traits

The number of panicle hill^{-1} also showed statistically significant result in Boro 2022-23. The highest number of panicle hill^{-1} was found in T_6 (15.31) and T_5 (15.03). Whereas other treatments showed statically identical results. In 2023-24, T_6 (17.17) showed statically highest panicle number hill^{-1}, followed by T_5 (14.69). The number of panicle m^{-2} also showed significant difference in both 2022-23 and 2023-24 seasons. In 2022-23, the highest number of panicle m^{-2} was found in T_1 (315.00) and which was similar with T_2 (299.31) and T_3 (272.00). In 2023-24, the highest number of panicle m^{-2} was found in T_1 (300.83) and which was similar with T_2 (275.00) and T_3 (258.00). While, panicle length showed statistically identical result in both 2022-23 and 2023-24. Statistically, the highest number of filled grain panicle^{-1} was found in T_1 (138.13) in 2022-23, while T_1 (195.54) also showed statically highest number of filled grains and which was identical with T_3 (175.78) in 2023-24 (Table 2). There was no significant difference of the number of unfilled grain panicle^{-1} in 2023-24, but significant difference in 2023-24. All treatment showed statically identical result of unfilled grain panicle^{-1} except T_6. The percent of spikelet sterility and thousand grain weight showed statistically non-significant result in both 2022-23 and 2023-24. The percentage of harvest index showed statistically significant in 2022-23 and non-significant in 2023-24. In 2022-23, all treatment showed identical result except T_2.

Table 2. Effect of spacing on yield and yield contributing traits during 2022-23 and 2023-24 dry (Boro) season

Treatment (cm×cm)	Panicles hill^{-1}		Panicles m^{-2}		Panicle Length (cm)		Grains panicle^{-1}		Spikelet sterility (%)		Thousand Grain Weight (g)		Harvest Index (%)	
	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24
T_1 (20×15)	10.50 b	10.03 c	315.00 a	300.83 a	24.32	23.33	138.13 a	195.54 a	10.28	9.40	17.62	17.45	51.72 a	50.47

T_2 (20×20)	11.97 b	11.00 c	299.31 a	275.00 ab	25.58	22.47	120.25 b	141.70 bc	12.05	11.32	17.78	17.89	49.29 b	52.80
T_3 (25×15)	11.33 b	10.75 c	272.00 ab	258.00 ab	23.79	22.33	119.72 bc	175.78 ab	9.76	8.05	17.40	17.84	53.23 a	49.14
T_4 (30×15)	10.58 b	11.53 c	190.50 c	207.50 c	23.84	21.66	107.18 bcd	143.91 bc	15.98	10.25	18.44	18.12	52.35 a	45.89
T_5 (25×25)	15.03 a	14.69 b	240.44 b	235.11 bc	24.53	22.50	103.79 cd	125.00 c	12.59	10.05	18.10	17.75	52.78 a	42.45
T_6 (30×30)	15.31 a	17.17 a	137.75 d	154.50 d	24.67	23.19	100.87 d	107.73 c	12.30	9.78	17.35	18.11	52.04 a	45.97
Level of Significance	*	***	***	***	ns	ns	**	*	ns	ns	ns	ns	*	ns
CV%	13.09	10.30	10.01	11.36	9.18	5.04	7.81	17.69	22.36	24.08	5.34	2.54	2.42	8.26
LSD	2.96	2.35	44.17	49.30	-	-	16.39	47.43	-	-	-	-	2.29	-

Footnote, LSD: Least significant difference; CV: coefficient of variation; ***: significance at 0.1%, **: significance at 1%; *: significance at 5%; ns: non-significance

3.3. Effect of spacing on yields

Spacing have direct effect on grain and straw yield. Grain yield showed statistically significant difference in both 2022-23 and 2023-24 Boro seasons. The highest grain yield was found in T_1 (6.23 t ha^{-1}) which was statistically identical with T_3 (6.07 t ha^{-1}) followed by T_2 (5.41 t ha^{-1}) and T_4 (5.38 t ha^{-1}) in 2022-23 Boro season (Fig.2). In 2023-24 Boro season, statistically highest amount of grain yield was observed in T_1 (7.26 t ha^{-1}) which was statically identical with T_3 (6.89 t ha^{-1}) and T_2 (6.42 t ha^{-1}). The amount of straw yield was found statistically significant in 2022-23 but non-significant in 2023-24 Boro seasons (Fig. 3). In 2022-23, the highest amount of straw yield was found T_1 (6.23 t ha^{-1}) and which was statically identical with T_1 (7.26 t ha^{-1}). The amount of biological yield showed statistically significant in Boro 2022-23 and non-significant difference in Boro 2023-24 seasons. In 2022-23, the highest amount of biological yield was observed in T_1 (12.04 t ha^{-1}) which was identical with T_3 (11.41 t ha^{-1}) and T_2 (10.97 t ha^{-1}, Fig. 4).

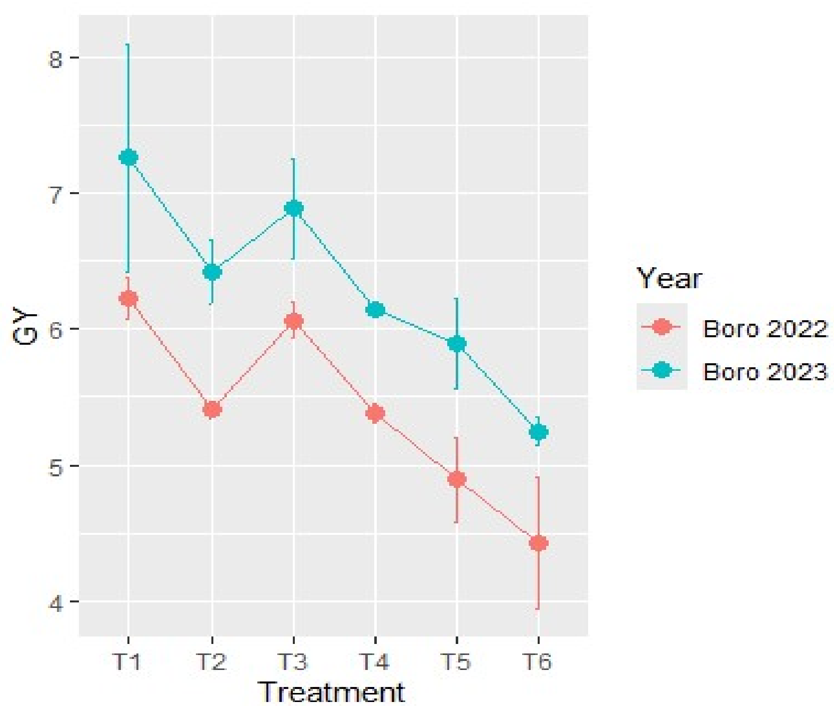

Figure 2. Effect of different spacing on grain yield (t ha^{-1}) in 2022-23 and 2023-24 Boro seasons

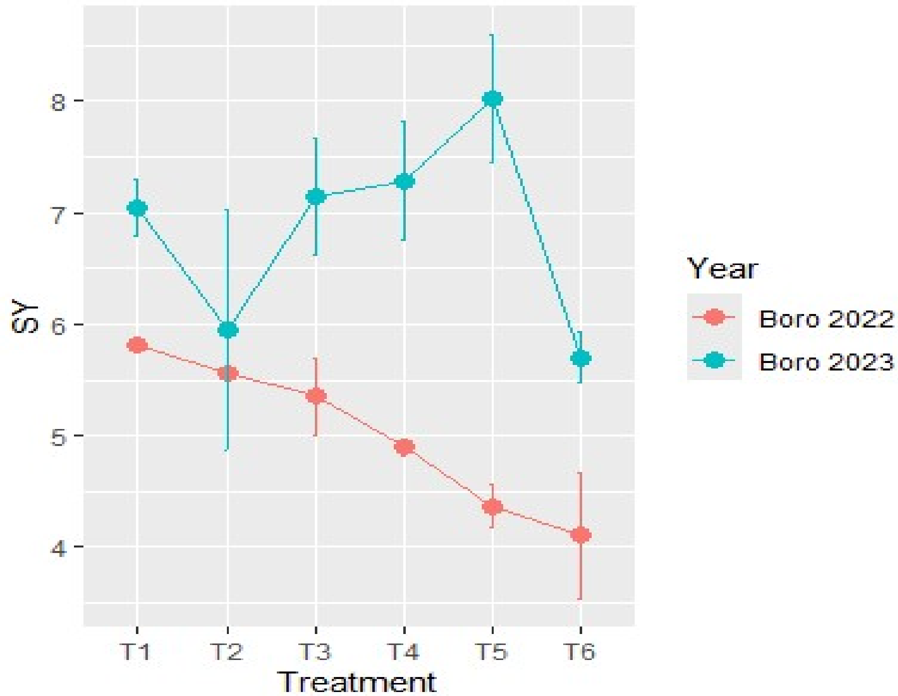

Figure 3. Effect of different spacing on straw yield (t ha^{-1}) in 2022-23 and 2023-24 Boro seasons

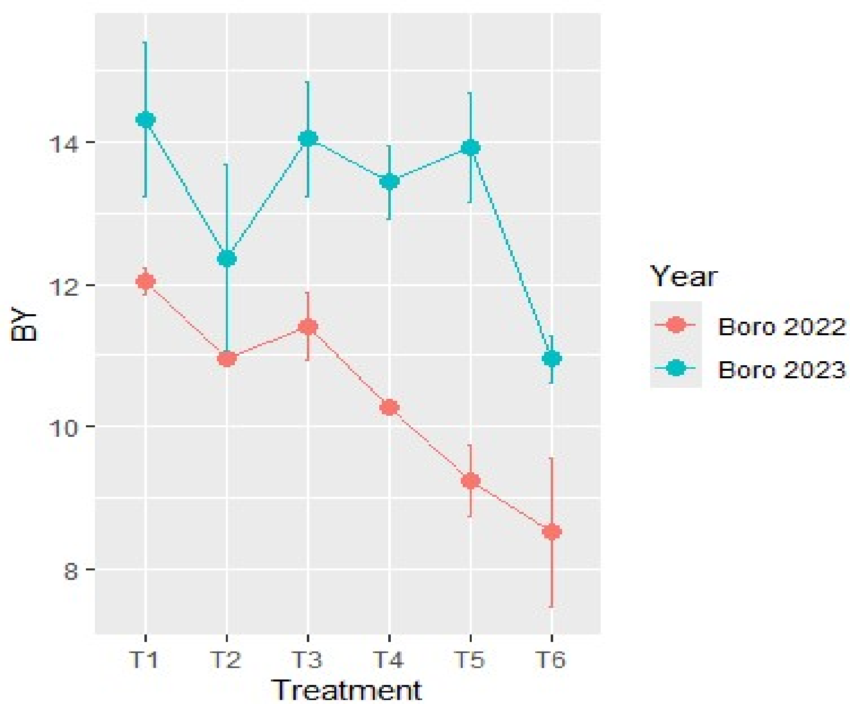

Figure 4. Effect of different spacing on biological yield (t ha^{-1}) in 2022-23 and 2023-24 Boro seasons

Footnote; T_1=20cm x 15cm; T_3=25cm x 15cm; T_5=25cm x 25cm; T_2=20cm x 20cm; T_4=30cm x 15cm; T_6=30cm x 30cm

4. Discussion:

Based on the study, our findings indicate that plant spacing did not significantly affect overall plant height in either the 2022-23 or 2023-24 Boro seasons. However, it affected the plant height remarkedly from closer to wider spacing and it ranged from 108 cm to 112 cm in T_1 to T_5, respectively in Boro 2022-23. Moreover, it also suggests that the spacing treatments used may not strongly influenced as key growth characteristics of BRRI dhan100 in Boro 2023-24. On the contrary, Karmakar et al., (2014) found that plant height of rice variety significantly affected by the plant spacing. It could imply that the crops demonstrate a degree of resilience to variations in spacing, perhaps due to their inherent growth pattern or their adaptability to different inter-plant distances. However, a non-significant effect of plant spacing on plant growth characteristics does not necessarily imply that spacing is unimportant; rather, it may indicate that the range of spacing used in this investigation did not include an extreme variation that would impact the growth significantly. Interestingly, the number of tillers hill^{-1} emerged an important yield component was exhibited statistically significant difference in the both years, indicating that tillering is more sensitive to spacing variations than other growth parameters. This response emphasizes the role of tillering as a ductile trait capable of adapting to the availability of resources, such as light and nutrients. Higher number of tiller hill^{-1}, panicle hill^{-1} counted in T_6 (30 cm × 30 cm) and T_5 (25 cm × 25 cm) in both the years underscore the efficacy of these treatments as optimal for maximizing tiller and panicle production. Adhikari et al., (2013) also reported higher spacing (30 cm × 30 cm and 25 cm × 25 cm) produced higher number of tillers and panicles hill^{-1}. But the maximum number of tiller m^{-2} and panicle m^{-2} were produced in closer spacing 20 cm ×15 cm (T_1), 20 cm ×20 cm (T_2) and 25 cm ×15 cm (T_3); (Table 2). Similar findings were reported by (Afroz et al., 2024; Moro et al., 2015). However, it is essential to balance tillering with other yield components, as excessive tillering may not always correlate with higher grain yields if it leads to resource competition at the reproductive stage. Higher spacing as well as closer spacing not good for highest yields by producing tiller and panicle number compared to optimum spacing. Wider spacing produced more tiller and panicle and water as well as nutrient get loss and underutilization of land as so, overall yield decrease, closer spacing produced fewer tiller, and panicle and here more competition for water, air, and nutrient, moreover insect can easily infest (Roy et al., 2025) and disease can easily spread (Afroz et al., 2024). Whereas optimum spacing produced optimal tiller and panicle, balanced completion for water, air and nutrition which resulted higher grain yield. Previous studies also supported our findings, spacing 20 cm × 20 cm and 25 cm × 15 cm attained highest yield by producing more tillers, effective tillers per unit area, higher leaf area index, higher plant height, and total dry matter accumulation (Afroz et al., 2024; Faisul-ur-Rasool et al., 2013; Uddin et al., 2011). At wider inter-row spacing, the biomass of individual plants exhibited a statistically significant increase when compared to those cultivated in closer proximity hills, regardless of the agricultural practices employed (Table 2). The primary determinant for the increased of individual plants biomass at wider inter-row distances was attributed to an enhanced tiller count, moreover, plants subjected to wider spacing demonstrated a more pronounced canopy angle across their closely-spaced hills, attributable to their elevated tiller count hill^{-1} (Thakur et al., 2010).

With an increased density of rice plant, the utilized area is maximized, leading to a higher grain yield. The dense canopy established by closely spaced rice plants provides shade to the soil, effectively inhibiting the proliferation of weeds. This phenomenon minimizes the competition for essential nutrients, water, and sunlight, thereby enhancing the overall productivity of the rice crop (Pandey et al., 2023). In scenarios of close spacing, rice plants engage in more vigorous competition for water and nutrients, culminating in a more effective utilization of these vital resources. This can lead to enhanced management of water and nutrients, ultimately contributing to improved health and productivity of the crop. Close spacing facilitates the rapid closure of the canopy, wherein the foliage of the rice plants forms a continuous cover over the agricultural field. This canopy plays a crucial role in conserving soil moisture, suppressing weed growth, and creating a microclimate that is conducive to optimal growth conditions. The implementation of close spacing in rice cultivation is critical for maximizing yield, minimizing weed competition, mitigating lodging, optimizing resource utilization, and fostering healthy crop development (Afroz et al., 2024; Pandey et al., 2023).

Spacing 20 cm ×15 cm (T_1) and 25 cm ×15 cm (T_3) had a direct and significant effect on grain yield in both 2022-23 and 2023-24 Boro seasons. These results are in alignment with the findings of Karmakar et al., (2014) and Pandey et al., (2023) who found that the plant spacing 20 cm x 15 cm produced the highest grain yield. This might be due to the highest number of panicle m^{-2}, filled grains $panicle^{-1}$, biological yield and harvest index were found in these spacing. This consistency across both seasons highlights the critical role of optimal spacing in maximizing grain yield. (Hasan et al., 2021; Sultana et al., 2012) documented that a planting spacing of 25 cm × 15 cm resulted in the highest grain yield, straw yield, biological yield, and harvest index. Whereas Moro et al., (2015) reported that 25 cm × 15, 20 cm × 20 cm spacing produced highest yield than 15 cm × 15 cm and 30 cm × 10 cm spacing. Densely arranged spacing accommodates the greatest number of hills per unit area, thereby facilitating the production of the maximum number of tillers; furthermore, the closer row spacing yielded the highest grain yield and straw yield, culminating in the superior biological yield as demonstrated by Paul et al., (2017). So that, wider spacing optimizes individual plant biomass, while closer spacing enhances canopy closure, maximization of nutrient uptake, and weed suppression. Grain yield showed significant differences, with the highest yields exhibited in T_1 (20 cm × 15 cm) and T_3 (25 cm × 15 cm), attributed to a greater number of panicles m^{-2}, filled grains $panicle^{-1}$, and a higher harvest index. These treatments effectively balanced vegetative and reproductive growth, ensuring optimal resource utilization and finally outcomes superior yields.

Therefore, the closer spacings engendered the development of a greater number of productive tillers, exhibiting superior performance across all morpho-physiological and yield-related parameters, thus culminating in higher grain yields in comparison to increased spacing. This phenomenon led to the generation of more quantity of dry biomass (enhanced photosynthetic material) compared to the less vigorous plants situated in closer spacing, thereby elucidating the markedly higher grain yields that were documented in the crops cultivated at wider intervals in contrast to those positioned at closer spacing.

5. Conclusion:

The study highlights the critical role of plant spacing in influencing the growth, yield, and yield-contributing traits of BRRI dhan100 in 2022-23 and 2023-24 Boro seasons. Plant height, panicle length, thousand grain weight, spikelet sterility (%) exhibited no significant variations across spacing treatments while the number of tillers m^{-2}, number of panicle m^{-2}, filled grains $panicle^{-1}$ demonstrated significant differences. Wider spacing (T6: 30 cm× 30 cm and T5: 25cm × 25 cm) produced higher tiller $hill^{-1}$, panicle $hill^{-1}$, while closer spacing (T1: 20cm × 15 cm and T2: 20 cm× 20 cm) resulted in a greater number of tillers and panicles m^{-2}. The optimal spacing for maximizing grain yield of BRRI dhan100 was 20 cm× 15 cm and 25 cm× 15 cm which consistently outperformed wider spacing across both years. These findings underscore the importance of fine-tuning spacing practices to achieve a balance between individual plant growth and overall field productivity, offering valuable insights for sustainable production of rice specifically BRRI dhan100.

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Data availability statement: Declare availability of your data and datasets.

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