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YIELD PERFORMANCE OF BWMRI RELEASED WHEAT VARIETIES IN THE BORDER REGIONS OF BANGLADESH

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Abstract

A field experiment was conducted during the *Rabi* season of 2023–24 in three upazilas, Haripur, Baliadangi, and Ranishankoil, of Thakurgaon district of northern Bangladesh to assess the feasibility of BWMRI released new varieties against an existing exotic one (Indian origin. Seven wheat varieties (BWMRI Gom 1, BWMRI Gom 2, BWMRI Gom 3, BWMRI Gom 4, BARI Gom 30, BARI Gom 32, BARI Gom 33) taking an Indian variety, Sorna/China 3 as control. The experiment was laid out in RCBD with three replications. The unit plot size was 4 m × 5 m. Seeding was done on 21 November 2023 in a continuous pattern at 20 cm line apart. The highest yield was observed in BWMRI Gom 2 (5.30 t ha^{-1}) and BWMRI Gom 4 (5.10 t ha^{-1}) against the lowest yield (3.23 t ha^{-1}) in Sorna/China 3. The yields of BARI Gom30, BARI Gom 32, BARI Gom 33, and BWMRI Gom 1 were comparable, ranging from 4.33 to 4.57 t ha^{-1}. It was concluded the yield performance of BWMRI Gom 2 and BWMRI Gom is superior to Sorna/China 3 in these areas.

Introduction

Wheat is the second most significant cereal crop in Bangladesh, playing a crucial role in ensuring food security and supporting rural livelihoods (FPMU, 2024). In recent years, wheat consumption in the country has seen a notable increase, primarily driven by the expansion of the processed food industry, changes in dietary preferences, and the growing demand for bakery products and snacks (The Daily Star, 2025). As more bakeries and snack producers emerge across the country, the demand for wheat flour has risen sharply. This growing consumption underscores the importance of wheat in the national food system and economy. However, despite the increasing demand for wheat, the area available for wheat cultivation remains limited, mainly due to competition from other crops such as maize, *boro* rice, and other *rabi* (winter) crops. This competition poses a challenge to the expansion of wheat production, making it essential to explore ways to improve wheat yield and productivity in the country (FAO, 2025).

Thakurgaon, a district situated near the Indian border, stands out as the most productive region for wheat cultivation in Bangladesh. According to the Department of Agricultural Extension (DAE) in 2023-24 season over 0.031 million hectares of land were cultivated for wheat in Thakurgaon with a total production of 0.12 million tons (DAE, 2023). This makes Thakurgaon a significant contributor to the country's wheat supply. Despite this, most farmers in the region continue to rely on wheat varieties imported from India, which have been traditionally adapted to the region's agro-climatic conditions. However, the reliance on foreign varieties raises questions about their long-term sustainability, particularly in the face of changing climate conditions and emerging pest and disease challenges (Hossain and Da Silva, 2013).

In response to these concerns, the Bangladesh Wheat and Maize Research Institute (BWMRI) has developed new wheat varieties specifically designed to address the unique challenges faced by Bangladeshi farmers in that particular region. These new varieties exhibit enhanced tolerance to terminal heat, which is crucial in the context of climate change, as rising temperatures pose a significant threat to wheat yields. Additionally, these varieties show improved resistance to diseases that often affect wheat crops in Bangladesh, further increasing their potential for higher productivity (BWMRI, 2020-21). The BWMRI varieties also promise increased yield potential, making them an attractive alternative for farmers seeking to improve their crop output (BWMRI, 2021).

Given the importance of wheat in Bangladesh's food security and economic structure, it is crucial to assess the performance of these newly developed wheat varieties against the Indian varieties currently in use, especially in boarder area. (Alam *et al.,* 2021) The findings of this experiment are expected to offer critical information about the potential advantages of adopting BWMRI wheat varieties over exotic one considering climate resilience, disease resistance, and overall productivity.

Materials and Methods

The on-farm trial was conducted in three upazilas: Haripur, Baliadangi, and Ranishankoil of Thakurgaon district located at the AEZ 1: Old Himalayan Piedmont Plain (Fig. 1), during Rabi 2023–24. The field was medium high land having the soil properties presented in the Table 1. A total of seven wheat varieties were used in the experiment, including BWMRI Gom 1, BWMRI Gom 2, BWMRI Gom 3, BWMRI Gom 4, BARI Gom 30, BARI Gom 32, BARI Gom 33, against one check, the Indian variety, China 3/Sorna. The experiment was laid out in RCB design with three replications in each site. The unit plot size was 20 square meters (5m × 4m). Seeds were sown on 21 November 2023 in a continuous pattern with line to line 20 cm distance. The BWMRI recommended seed rate, fertilizer dosage, and crop management practices were performed. Soil properties were analyzed at the Soil Science Lab, BWMRI, Dinajpur and the recorded data were analyzed with R software.

Table 1. Soil properties of the experimental field

Properties	Value	Implication
Soil pH	5.97	Near neutral
Sand content	67.7%	Rapid drainage
Silt content	15.36%	Moderate retention
Clay content	16.97%	Some retention
Texture	Sandy loam	Dries quickly
Flood risk	Above flood level	Safe, drought-prone
Sand/Silt ratio	4.4	Dominant sand
Silt/Clay ratio	0.91	Slightly more silt

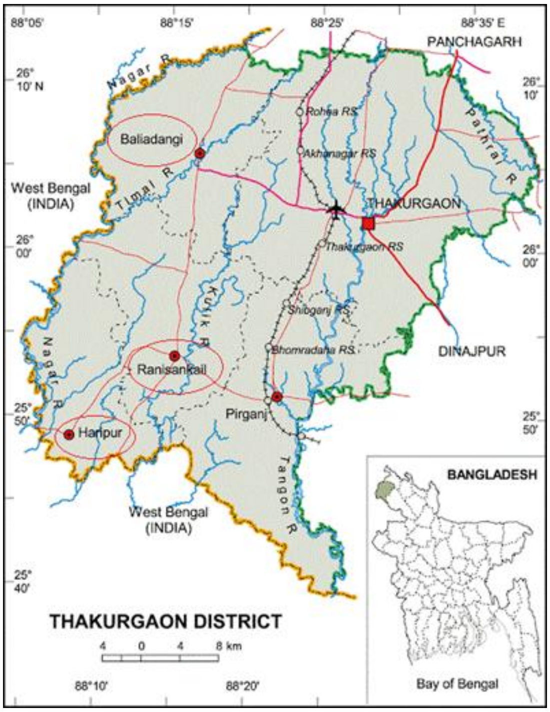

Fig. 1. Map showing the sites of on-farm trials

Results and Discussion

Data presented in Table 2 revealed that the height of the plant (cm), number of spikelets and grains per spike, and weight (g) of thousand grains (TGW), as well as the grain yield (t ha^{-1}) (Fig. 2) varied significantly among the varieties. BARI Gom 33 was the tallest plant (102.3 cm) among the eight varieties. BWMRI Gom 1, BWMRI Gom 2, BWMRI Gom 3, BWMRI Gom 4, and BARI Gom 30 had moderate heights, ranging from 93 to 97.5 cm. The Indian variety, Sorna/China 3, was the shortest (79.9 cm), followed by the BARI Gom 30 (86.3 cm). Moreover, BWMRI Gom 2, BWMRI Gom 3, BWMRI Gom 4 and BARI Gom 33 had the statistically similar highest number of spikelets per spike of around 18. The lowest spikelets/spike (14) was recorded from the Sorna/China 3 followed by the rest of the varieties.

Table 2. Effect of varieties on the yield attributes and yield of wheat

Variety	Plant height (cm)	Grain per spike (No.)	Spikelets per spike (No.)	TGW
BWMRI Gom 1	94.0bc	47ab	15b	51b
BWMRI Gom 2	97.5b	43bc	18a	58a
BWMRI Gom 3	96.0bc	51a	17a	46d
BWMRI Gom 4	95.5bc	42bc	17a	56a
BARI Gom 30	93.0c	44b	16b	47cd
BARI Gom 32	86.3d	43bc	16b	49bc
BARI Gom 33	102.3a	49a	18a	48cd
Sorna/China 3	79.9e	40c	14c	44e
LSD (0.05)	1.37	4.14	0.83	1.22
CV (%)	2.54	5.88	5.49	4.22

TGW: Thousand grain weight; LSD: Least significant difference; CV: Co-efficient of Variance. Means with similar letters are significantly identical

Furthermore, BWMRI Gom 1, BWMRI Gom 3, and BARI Gom 33 had the statistically similar highest number of grains per spike (47–51). China 3 recorded the lowest grains (40). The rest of the varieties had a moderate number of grains per spike, ranging from 42 to 44. The heaviest grains (1000-grain weight) were recorded from BWMRI Gom 2 (58 g), which is statistically similar to BWMRI Gom 4 (56 g), followed by BWMRI Gom 1 (51 g). The lowest grain weight was recorded from Sorna/China 3 (44 g). The weight of the rest of the varieties ranged from 46–49 g. The highest values of several yield-contributing characters might have been attributed to the highest grain yield in BWMRI Gom 2 (5.30 t ha^{-1}) and BWMRI Gom 4 (5.10 t ha^{-1}) (Figure 1). The lowest yield (3.23 t ha^{-1}) was observed in China 3. The yields of BWMRI Gom 1, BWMRI Gom 3, BARI Gom 30, BARI Gom 32, and BARI Gom 33, ranged from 4.26 to 4.57 t ha^{-1}. Differences in grain yields among the varieties might be due to the inherent genetic quality of varieties that might have been influenced by the different yield contributing characteristics viz., number of spikelets, grains per spike, and weight of 1000- grains in this study.

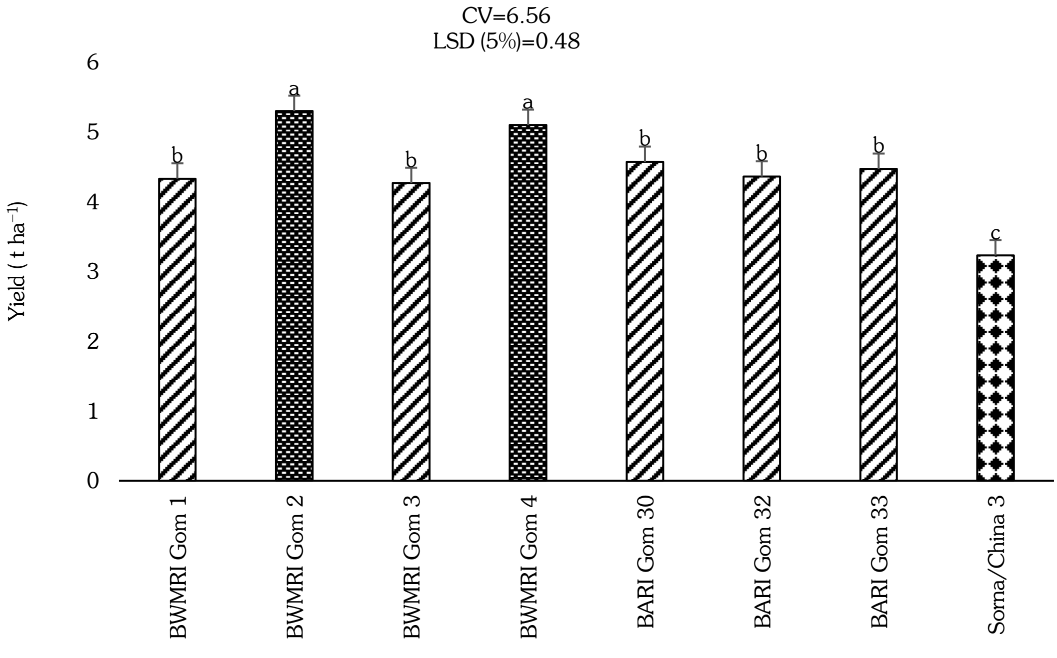

Fig. 2. Effect of varieties on the grain yield (t ha^{-1}) of wheat

The yield performance of wheat varieties is influenced by a complex interplay of genetic, environmental, and management factors. Genetically, each variety has a distinct yield potential, which is determined by key traits such as tiller number, spike length, grains per spike, and seed weight (Chairi *et al.*, 2020). Modern wheat breeding efforts aim to enhance both yield potential and stress resilience to adapt to changing environmental conditions (Yaghoubi Khanghahi *et al.*, 2021). Environmental factors such as temperature, rainfall, and soil fertility significantly impact yield, with varieties exhibiting varying levels of performance under different climatic stresses (Guijarro-Real *et al.*, 2025). Furthermore, management practices, including sowing date, nutrient management, plant density, and irrigation, play a critical role in unlocking the genetic potential of a variety, ensuring it can thrive under local conditions (Kumar and Kumar, 2025). Yield performance is also closely tied to yield components such as the number of effective tillers, grains per spike, and seed weight, which collectively contribute to the overall productivity of the variety (B. Alam *et al.*, 2024). Moreover, genotype-environment-management (G × E × M) interactions underscore the importance of considering both genetic traits and environmental conditions when assessing yield, as varieties may perform optimally in some environments while underperforming in others (Martínez-Peña *et al.*, 2023). Therefore, wheat breeding should not only focus on selecting high-yielding varieties but also ensure that agronomic practices are optimized to allow these varieties to express their full potential in specific environmental and management contexts. Understanding and addressing these factors is crucial for improving wheat production and ensuring food security in diverse agricultural conditions.

Conclusion

The results of this on-farm trial demonstrated that all the tested BWMRI developed wheat varieties outperformed the Indian variety Sorna/China 3 in the tested areas. These findings indicate that BWMRI varieties are better suited to boost wheat production, achieving superior yields and enhanced agronomic characteristics that could effectively substitute the Sorna/China 3 variety in Indian border regions of Thakurgaon district.

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