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Stability adaptability trial and yield performance of newly developed hybrid rice (*Oriza Sativa*) varieties

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ABSTRACT

The experiment was done in the Boro season (December-April) at the Supreme Rice Research Centre (SRRC) with the supervision of the USAID Project, Feed the Future, with the help of the United States of America and with technical assistance of the International Rice Research Institute (IRRI). IRRI provided six different types of hybrids of rice to the SRRC to carry out a multi-location trial with the aim of examining their adaptation and yielding performance under favourable climatic conditions. Biri Dhan - 87 was also sown as a check variety in order to compare with the newly released cultivars and the same was being done in other regions of Bangladesh. A randomized complete block design (RCBD) that had three replications was used at SRRC. Seedlings of 25 days old were transplanted at a rate of one seedling per hill with a spacing of 20 cm x 15cm. The morphophysiological data was recorded on the height of the plant, number of tillers per plant, panicle height and panicle number, thousand -kernel weight, grain length and width, yield, and disease incidence. Along with that, in the plant height, panicle length, spikelet fertility, grain type, thousand-kernel weight, yield at a moisture of 14% and number of effective tillers were also measured during the study. BHR-501, BHR-502, BHR-503, BHR-504, BHR-505 and BHR-506 were the six hybrid lines under investigation. BHR-506 gave the highest yield, then BHR-501, BHR-502, BHR-503, BHR-504, and BHR-505, respectively.

KEY WORDS

Rice; Adaptability; Trial; Yield; IRRI; SRRC

ARTICLE HISTORY

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Introduction

More than half of the world's population is fed on rice, and it is ranked second after maize as the largest cereal industry. In 1973, after close to 10 years of intensive research, Dr. Yuan Longping managed to come up with the prototype of a high-yielding hybrid rice cultivar, thus marking the beginning of a row of high yields that has since been sold to support the livelihood of small-holder farmers all over the world. The first commercial hybrid rice was introduced in China in 1976; many countries have since instituted hybrid rice breeding programmes, with India beginning its programme in 1989. Since the 1950s, the yield of rice has increased multiplicatively. Rice is a cereal that is a member of the Poaceae family, and it is the leading staple in the tropical world. It is grown over a wide range of environmental conditions, and its productivity is dependent on local climatic conditions. By the end of the twentieth century, 111 nations were involved in rice production with a total area of about 146.5 million hectares and out of this, over 90 percent are based in Asia [1]. Rice is the staple food of almost half of the global population, and 148.10 million people of Bangladesh [2]. The annual production of rice all over the world should be increased to 760 million tonnes to meet the increasing global population by 2020 [3]. Rice is the major staple in Bangladesh. Bangladesh is another country that produces a great amount of rice and is also a major consumer of rice [4]. There are three major seasons of cultivation, which are Aus (mid-March to mid-August), Boro (mid-June to November) and Bikram (mid-December to mid-June). About 50.92 % of the rice acreage in the country is boro rice and 60 % of boro rice is covered by the modern T.Boro varieties [5]. T.Boro is the main crop grown in the Ganges tidal floodplain (Agro-ecological zone 13). The agro-ecological environment in this area supports the mass production of T.Boro rice. This, in turn, places a lot of pressure on farmers and research institutions to enhance the production systems of rice due to the growing demand. The high rate of population increases and urbanisation is steadily decreasing the amount of cultivable land, which requires high productivity per unit acreage and propagation of modern variety (MV) cultivation. The most important source of employment in Bangladesh is rice farming. In Bangladesh, the cultivation in terms of crop intensity is minimal, and yields are mostly based on the traditional means; it is estimated that 80 per cent of arable land is under rice cultivation [5]. The current production of 310.32 tonnes of grain annually cannot be used to satisfy the demand of the 144 million consumers in Bangladesh, whose rate of growth is at 1.43 per cent/annum [5]. The resultant effect is that the government is importing 1.5million metric tonnes of food grains per year. Approximately 85 percent of the population in Bangladesh is rural and is mostly involved in farming. The government is more

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concerned with food security, whereby availability is increased [6]. One of the main strategies is the reduction of the spread of yield per unit area. There is little information on inequity between research-controlled and farmer-controlled systems hence, it is vital to expand the region under modern varieties to obtain increased output and employment.

Hybrid rice refers to those that are the result of a cross between genetically divergent parents; a hybrid may be much more productive than a traditional. International Rice Research Institute (IRRI) partners with other institutions to create high yield hybrid strains of rice. The ability of hybrid rice to surpass the performance of other cultivars makes it a key technology to meet the growing world rice demand. In the 1970s, a possible famine had been averted in China with its hybrid rice programme. Currently, hybrid rice bridges fill the gaps experienced in many areas and enhance the general yield capacity. Improved harvest leads to more incomes to farmers and more affordable rice. Our main target is to bring in hybrid rice with high standards in terms of yield heterosis (hybrid vigor), grain quality, environmental resistance to major stresses, insect resistance and disease resistance, and seed production. The IRRI started researching hybrid rice in the year 1979, and since then, with its research and development and deployment of hybrid rice in the tropical areas, has been at the forefront in the research work and development of hybrid rice. A growing range of hybrid types of rice is now available, allowing farmers to significantly increase rice production, and hence, the productivity and profitability.

This study was conducted in order to determine the best hybrid variety to use during the Boro season. In this, six forms of hybrids were chosen and tested depending on the days to maturity, the height of the plant, the number of effective tillers, the length of the pedicel, the spikelet fertility, the type of grain, the weight of 1000-grains and the yielding quality at 14-percent moisture condition.

Objectives

- To Study & evaluate the best performing & Adaptive hybrid rice varieties for Boro season in Aspect of Bangladeshi Soil & Climatic condition.
- To produce Quality Hybrid Rice seed for the Farmers.

Review and Literature

Rice (*Oryza sativa*) is one of the largest cereals and food staples, and initially it was categorised as a swamp grass. It is a food commodity that is widely eaten in most parts of Asia. Growing is mainly done in hot climatic regions, especially in Asia, Africa, the northern part of Italy and the west coast of North America. Rice provides about 80 per cent of the caloric intake in Asia and about one-fifth of the total human caloric intake worldwide [7]. In this regard, it is the third-largest agricultural commodity that is produced globally.

Rice is the main staple food of about 135m people in Bangladesh. The cereal is grown on an approximate 10.5million hectares of land, which has not been significantly altered in the last thirty years. Approximately 75 percent of the existing area under crop and more than 80 percent of the irrigated land are under rice. Boro rice provides about 50.92 percent of the total acreage of rice in Bangladesh, of which modern T. Boro varieties comprise 60 percent. Boro rice varieties have short durability, which brings benefits, such as the rapid production of crop, a larger volume of production in shorter periods, and as a result, could boost the income of the farmers and save on labor. The resistance of this cultivar to climatic changes before reaching maturity has been reported [8].

The study involved experimental research to determine the performance of the few varieties of Boro rice in comparison to dates of transplanting. The experiment involved three transplanting dates (26 July, 5 August and 15 August) and seven varieties with short relative days to maturity (BRRI Dhan 33, BRRI Dhan 39, BRRI Dhan 49, BRRI Dhan 56, BRRI Dhan 57, BRRI Hybrid Dhan 4 and Binadhan -7). The trial was set out in split-plot format with three replications; the main plots were used to transplant the date and sub-plot used to transplant varieties. Findings revealed that Binadhan-7 had a high grain yield (4.90 t ha -1), straw yield (5.58 t ha -1), biological yield (10.44 t ha -1), and harvest index (47.10 percent). On the other hand, BRRI 57 registered the lowest grain (3.27 t ha -1), straw (3.96 t ha -1), and biological yields (7.20 t ha -1). The field time of BRRI -Dhan -49 was the longest (120 -days after transplant, DAT), and BRRI -Dhan -57 had the shortest time (88 -DAT). Maximal values of plant height (119.12), total tillers per square metre (276.40), effective tillers per square metre (260.02), grains per panicle (109.19), grain yield (4.75 t ha -1), straw yield (5.22 t ha -1), biological yield (9.97 t ha -1) and harvest index (47.64 per cent) occurred on 26 July transplanting, decreasing on 5 August and then decreasing significantly on The experiment assumed that the best yields of Boro rice transplanted with Binadhan-7 can be obtained when transplanted on 26 July [9].

Razzaque and Rafiquzzaman compared the yield difference between demonstration plots (DP), which applied research-grade management, and non-demonstration plots (NDP), which had been managed by local farmers [10]. This yield difference of 1220kg/ha was measured over a number of years and the DP yields were found to be much higher than the NDP yields on average by about 25.15%. Increased quality of seed, best age of seedlings (30 days), reduced spacing, 12 seedlings per hill, equalized fertilization, and timely pest control were the reasons why DP was superior. Whereas DP had higher cultivation costs (Tk 2218 / ha -1 vs. less NDP costs), it can be observed that the benefit-to-cost ratios were significantly greater in the case of DP (2.28) than in the case of NDP (1.98).

Khan MN, *et al.*, compared six new Boro rice (BR11, BR22, BR3, BRRI Dhan 46, BRRI Dhan 54) with three delayed planting systems [11]. There was great variation in characteristics such as height of plants, number of days to the launching of panicles, flowering and maturity. BR22, BR23 and BRRI Dhan showed significant decreases in days to panicle initiation (6558, 6960 and 6255 days, respectively) compared to BR11 (7680 days). BR22 and BRRI Dhan flowered successively as planting date progressed (9286days and 8377days, respectively), and BR11 flowered between 109107days. BR22 and BR23 decreased their grain yields at the third set of planting (5.8- 5.0t ha-1 and 6.1- 5.1t ha-1, respectively) compared to BRRI Dhan 54, which remained similar (5.3- 5.2t ha-1). Other varieties produced between 5.7 -4.5 t/ha -1 (BRRI Dhan 46) and 6.2 -3.9 t/ha -1 (BRRI Dhan 44), but the control BR11 had a severe decline (4.4 -2.0 t/ha -1). As such, BRRI 54 was found to be the most appropriate one to use in delayed planting and it can be suggested as a reference point in breeding programs aimed at delayed planting cases.

Thanh NC et al., conducted an experiment to study rice production and marketing in the Mekong area, which revealed that the minimum, average, and maximum farm sizes per household were 0.5 ha, 2.2 ha, and 6.5 ha, respectively [12]. The households surveyed all year-round cultivated rice in the

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winter-spring (Dong Xuan-DX) and summer-autumn (He Thu-HT) seasons, but only 5520 percent cultivated rice in the autumn-winter (Thu Dong-TD) seasons. The overall yield during the DX season was 7.17 t/ha -1, and the yield during the HT and TD seasons was 5.17 t/ha -1 and 4.69 t/ha -1, respectively. The production of rice that can be attributed to the DX season was 45.20 per cent of the total production; the production of the HT and TD seasons was 33.70 per cent and 21.10 per cent, respectively. Drying processes were also different depending on season, marketing goals and the capacity of the farmer; sun-drying and mechanical drying were applied in conformity to these factors. There was still subpar post-harvest technology. In terms of consumption, 35 percent of households had no paddy to serve their families, but instead bought milled rice in the market, 65 percent of them home-milled it. Most of the rice was sold to traders (90 0.p.p.). The price of IR50404 type was far less than the one on other quality varieties at the 5-percent level of significance. It is therefore highly advised that farmers should minimize on the cultivation of the poor quality IR50404 variety and encourage high quality rice varieties to be used to export the product. The farmers thus turn to the government agencies and other related organizations to get a chance and boost rice prices to increase production and export capacity.

Mahmud AA *et al.*, developed a crop yield weather regression model that was used to estimate the future production of the Boro rice in the Barisal district during the 2000-2001 season [13]. The variables included in the model are the maximum, minimum and average temperature, diurnal temperature range, total precipitation, cumulative precipitation, net solar radiation, as well as soil water balance. In model estimation, stepwise regression was used. Individual equations were obtained in the local high-yielding variety (HYV) and all Boro rice, of the 42 nd and 45 th weeks of the 2000 calendar year, or in the 2 nd week of October and 1 st week of November, respectively. Such time points represent the reproductive and early-maturity of the Boro rice crop development. The 45th week equations were better than the 42nd week equations. The water satisfaction index (WSI) was among the variables that gave a statistically significant account of the Boro rice yield. At the 42 week, the local, HYV and all Boro rice had 1.23t/ha-1, 2.28t/ha-1 and 1.34t/ha-1 respectively, at the 45 th week, the yield was 1.43t/ha-1, 2.47t/ha-1 and 1.57t/ha-1 respectively. Boro rice in the Barisal district was estimated to have a lower average yield than the national average of 1.80 / ha -1, nevertheless, the estimates were very close to the actual yields of the past. Thus, the yield forecasted and production forecasted of Boro rice in the Barisal district can be viewed as a decent estimate of the actual production.

Biswas PL *et al.*, conducted research to compare the performance of two exotic hybrid rice, as a combination of the BB01/18 and BB02/18 in the 2018 Boro season in eight territories in Bangladesh, with the check variety being the BB03/18, to determine the yield performance of the two and their adaptation potential [14]. The cultivation method that was adopted in all the locations was transplanting, and broadcasting was used in Gopalganj. The exotic types were mostly welcome, due to their favourable plant structure, exuberant growth, high tiller proliferation, high panicle grain density, ability to resist significant diseases and pests, excellent canopy exposure at harvest, high yield, shattering resistance and high grain quality. BB 02/18 had a mean yield of 5.96 t/ha -1 and a maximum yield of 8.40 t/ha -1, whereas BB 01/18 had a mean yield of 5.26 t/ha -1 and a highest yield of 8.20 t/ha -1. The two hybrids obtained the same result (46.79 and 30.04 higher than the check variety, respectively). Moreover, the hybrids were found to be appropriate in broadcasting the Boro season, and the check type did not work under this approach. Overall, the hybrids also have good marketing opportunities in Bangladesh during Boro. The three hybrid varieties on average, had nearly 29.77 per cent more yields as compared to traditionally grown inbred varieties in the 2018 season.

The article by Chowhan S *et al.*, examined the effects of planting on the development and production of five modern rice varieties with the objective of identifying appropriate cultivars to use in late T [15]. Boro seasons in 2000 and 2001. The experimental cultivars were BR23, BRRI dhan33, BRRI dhan37, BRRI dhan38 and BRRI dhan39. Results showed that transplanting during the month of August was very risky because of the tidal water pressure which often led to loss of crops. The early September transplantation was the most suitable one to produce more grains. In particular, BR23, BRRI dhan37, and BRRI dhan38 were transplantable to the fourth week of September with yields of about 3 t ha -1 in the southern, tidal, non-salty areas of Bangladesh.

Riches CR *et al.*, introduced seven paddy modern varieties that are adapted to the Boro season and this has created hope to the farmers in Rajshahi, including the Barind tracts [16]. The new varieties Brridhan71, Brridhan75, Brridhan80, Brridhan87, and Brridhan90 have a higher yield-bearing capacity, drought resistance, and short growth cycle than the locally produced Swarna. Swarna is prone to illness and pests, which are carried by vectors, which have a negative impact on the yields. Introduction of these modern varieties, therefore offers massive benefits in food security and offers a solution to the issue of limited irrigation water. Since rice is a staple crop, there is need to boost its production, especially by alleviating the pressure of diseases and the adverse effects of climate change.

Khatun S *et al.*, also examined varieties of rice in the Amon region. The stability analysis of yield showed that Binadhan-16 and BRRI dhan33 produced 11.96% and 12.36% of the overall yield of the grain, respectively [17]. Binadhan-17 had the record of the highest thousand weight of seed (27.25g), and the highest yield of grains (6.13t/ha -1), which is much higher than the other varieties. The range of maximum vegetative growth was 5868 days after transplanting, which was when the Eco families reached the peak of dry-matter accumulation at 68 days post-transplant. Once again Binadhan-17 had the most filled spikelet's (164.89 per panicle), which was very far beyond those of its competitors. The sterility content of the spikelet's was highest in BRRI dhan39 (12.9 -1) and the grain produced by BRRI dhan33 (4.57 -1 ha -1) and Binadhan-7 (4.86 -1 ha -1) was statistically similar to that of BRRI dhan39 (4.49 -1 ha -1).

Materials and Methods

To compare the environmental adaptability and the yield performance of 6 varieties of hybrid rice, a field experiment was conducted. The experiment was also prolonged to allow making a comparative evaluation between the experimental genotypes and a control variety. The main aim of the study was to clarify the developmental processes and functional work of the plants during the Boro season.

The agronomic and physiological parameters that were registered were the following: seed bed parameters, field moisture content, filled grains, unfilled grains, thousand-grain weight (in grams), grain length, grain width, and related statistical measures.

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Additional phenological and management data were also measured and they included: 50 percent flowering time (days to 50 percent flowering, DFF), days to 50 percent physiological maturity, plant height at 50 percent physiological maturity, 80 percent maturity, number of hills per plot, number of panicles per hill, number of tillers, days to flowering, days to 50 percent maturity, seed soaking, date of transplanting seedling, and quality of the plot score.

Descriptionof the experimental site

Experimental period

Duration of the experiment was from December to April, 2023.

Experimental location

The present research work was conducted at Supreme Rice Research Centre (SRRC), Gopalpur, Trishal, Mymensing (Figure 1).

Figure 1. Geographical location.

Experimental details

Six hybrid Boro rice varieties were used as the planting materials in this experiment they are:

- BHR 501
- BHR 502
- BHR 503
- BHR 504
- BHR 505
- BHR 506

Experimental design and layout

The experiment was organized on the basis of Randomized Complete Block Design (RCBD) with three replicates. There were 18 plots that were put in place in six varieties. Each unit plot measured 4.3m×8.2m. The distance between hills was 150cm and distance between rows was 200cm, thus, the randomization was attained (Figure 2).

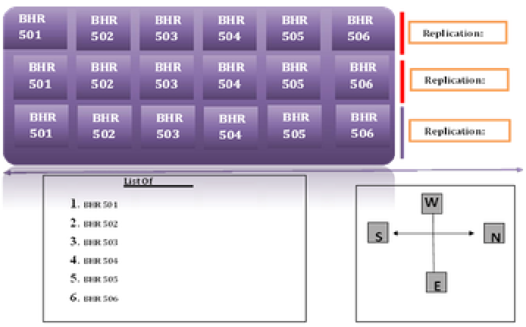

Figure 2. Field layout.

Seed collection

BHR-501, BHR-502, BHR-503, BHR-504, BHR-505, BHR-506. The Supreme Rice Research Centre (SRRC) of Trishal, Mymensingh, was the source of the seeds.

Raising of seedling on seedbed

The grown seeds were planted in a bed that was of a very high uniformity. The seedbed received irrigation in a slow and gradual manner. The seedbed was sprayed with the recommended fertilizer.

Field preparation

The plot we picked for the experiment got all opened up with a power tiller and was just left out in the sun for a whole week... well, 7 days to be exact. After that, it was good to go for transplanting. We got rid of the weeds and those stubbles, you know? Then, we divided up the experimental plot into smaller unit plots, following our experimental design which sounds fancy but is really just a way to keep things organized. Oh, and yeah, we mixed the fertilizers in with the soil of each unit plot like the details say below.

Fertilizers application

The fertilizers N, P, K, S and Zn form of urea, TSP, MoP, Gypsum, and Zinc sulfate, respectively were applied. The entire amount of TSP, Gypsum, Zinc sulfate, ¼ urea and ¼ MoP were applied at the time of land preparation. ¼ Urea and ¼ MoP were applied after 7-10 days of transplanting. ¼ urea was applied after 25-30 days of transplanting and the remaining ¼ Urea ¼ MoP were applied after 45/50 days of transplanting (Table 1) (Figure 3).

Table 1. Doses of fertilizers.

Fertilizer	Final land preparation (kg/ha)	2nd instalment (Kg)	3rd instalment (Kg)	Dose (kg/ha)
Urea	67.5	67.5	67.5	270
TSP	150			150
Mop	75		37.5	150
Gypsum	70			70
Zinc sulfate	10			10

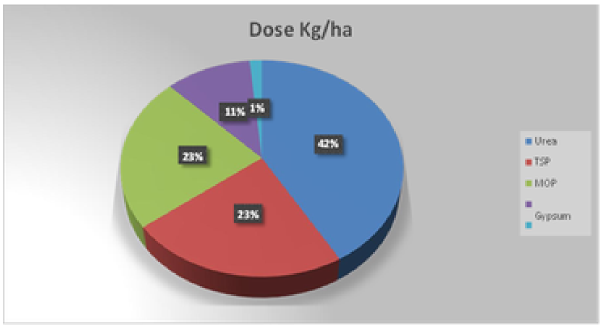

Figure 3. Ratio fertilizers doses.

Transplanting of seedling

Twenty-five-day-old seedlings were gently pulled out from the nursery, and then, they were transplanted into a well-prepared, puddle plot. We kept the spacing between plants at about 15cm, and for rows it was 20cm across all the varieties, just trying to keep things neat and organized. A week after transplanting, we checked all the plots for any missing plants. If we found any gaps, we'd fill them in with extra seedlings from the same

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source, whenever we needed to, of course. After that, we replicated the number of seedlings to make sure we kept the vibrancy up (Figure 4).

Figure 4. Transplanting of seedlings.

Intercultural operations

Intercultural operations were done to ensure the normal growth of the crop. Plant protection measures were followed as and when necessary, and intercultural operations were done.

Irrigation and drainage

In this Boro season, no artificial irrigation is needed for the crop since it was raining across the growing season. Moreover, a proper amount of adequate irrigation has given simultaneously.

Weeding

Weeding was done thrice to keep the plots free from weeds, which ultimately ensured better growth and development (Figure 5).

Figure 5. Removal of weeds.

General observations of the experimental field

Regular observations were made to understand the growth performance of the crop. In general, the field looked nice, and crop growth was satisfactory (Figure 6 and Figure 7).

Figure 6. Field observation.

Figure 7. Effect of diseases & pests, (A) Sheath rot of Rice, (B) Brown Spot of Rice, (C) Attack by the rice stem borer.

Cure to detected pathogen & pest

- For Rice Sheth blight & brown spot disease, Amister top (Azoxystrobin + Difenoconazole) were applied. @ 500ml/ha.
- Acimix 55 EC (Chlorpyrifos 50% + Cypermethrin 5%) has been applied repeatedly in every 30 days interval to cure the Rice stem borer @ 200 ml per acre (Figure 8-10).

Figure 8. Spraying to control effective disease & pest.

Figure 9. Removal of off-type plants.

Figure 10. 80 % flowering.

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Harvesting and processing

When 80% of the grains turned golden yellow, the crop was considered mature. Each plot's harvested crop was packaged individually, appropriately tagged, and transported to the threshing floor.

Statistical analysis

To determine the significant difference between the cultivars, the recorded data on various traits were statistically examined. The F (variance ratio) test was used to perform the analysis of variance for all the characters under investigation after the mean values of the various characters for each cultivar were determined.

Procedure of data & analysis plant height (cm)

At 60 and 90 DAT, we went ahead and harvested the crop and oh boy, the plant height, wow, it was all over the place, depending on what kind we were talking about. Turns out, with time and all those growth stages, plant height kind of crept up gradually. We recorded the height in centimeters (cm)... super precise, right? The data we gathered was basically the average height from 10 random hills we picked from the outer rows kind of started after two rows from the outside to keep it fair of each plot. So, to figure out the plant height, we measured from the soil surface all the way up to the leaf tip before heading and then to the panicle tip after heading. Pretty straightforward. The tallest plant at harvest was found in BHR-505 (128 cm), whereas the shortest plant was found in BHR-503 (110 cm) (Figure 11).

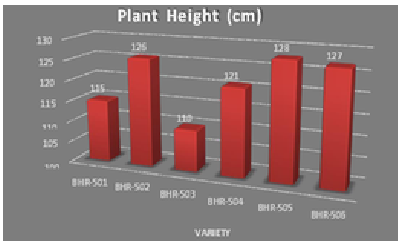

Figure 11. Mean plant height (cm) of different varieties (BHR-501 to BHR-506).

Phenotypic acceptability

According to the Supreme Rice Research Center (SRRC), the phenotypic acceptability was noted. Seedling vigor and phenotypic acceptability are influenced by a number of interrelated factors. For instance, the ability to tiller, plant height, leaf length, stunted development, rapid growth, thin population, V-shaped upright, and fading of leaves.

Days to maturity

The plants were counted as the number of days that passed between the date of sowing and the day that every head in each plot attained physiological maturity. Days to maturity had a big impact. BHR-506 displayed the first 90% maturity days at 130 days, while BHR-502 displayed the final 90% maturity days at 152 days (Figure 12).

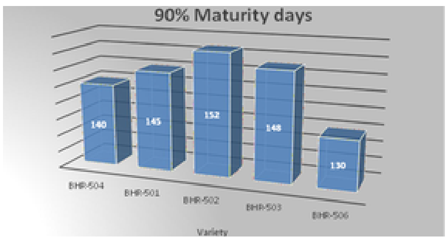

Figure 12. Number of days to attain 90% maturity for different varieties (BHR-501 to BHR-506).

Number of effective tillers hill/1

As the growth stages progressed, the number of tillers in each variety rose. At harvest, BHR-501, BHR-503, BHR-505, and BHR-506 yield the most tillers per hill [18]. However, at harvest time, BHR-504 generates a minimum of nine tillers per hill (Figure 13).

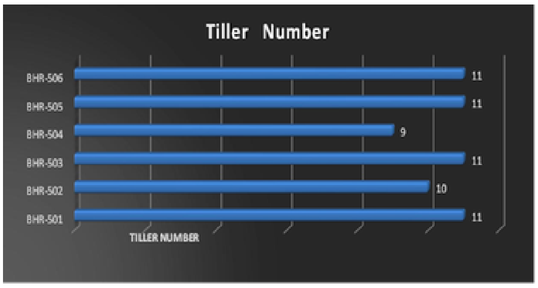

Figure 13. Tiller number recorded for different varieties (BHR-501 to BHR-506).

Number of panicles

A tiller was deemed effective if it contained at least one visible grain in the panicle. This was determined by averaging the same ten hills chosen at random from each plot's inner rows. BHR-504 had the most effective tillers per hill, while BHR-502 had the fewest effective tillers per hill (Figure 14).

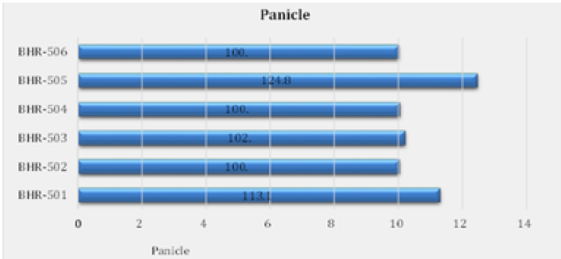

Figure 14. Panicle length was recorded for different varieties (BHR-501 to BHR-506).

Panicle length (cm)

The measurement was taken as the distance between the primary panicle's neck and tip. There has been a noticeable variation in panicle length. BHR-501 had the longest panicle (27.43 cm), whereas BHR-505 had the shortest (26.07 cm) (Figure 15).

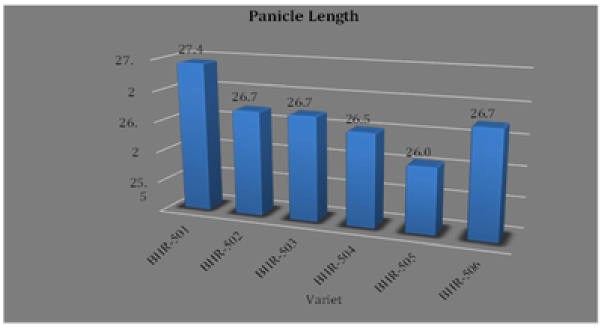

Figure 15. Mean panicle length of different varieties (BHR-501 to BHR-506).

Number of filled grain

Each panicle's spikelet's were tallied if they contained foodstuffs, which were regarded as grain. There is a considerable variance in the quantity of filled grains per panicle. The highest quantity of full grain (232) was produced

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by BHR-504. BHR-501 had the fewest full grains (164) (Figure 16).

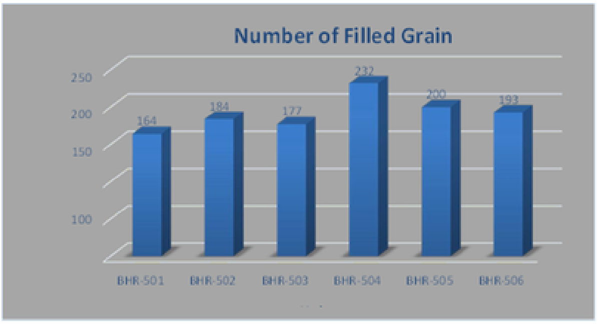

Figure 16. Number of filled grains recorded for different varieties (BHR-501 to BHR-506).

Number of unfilled grains sterile spikelet's panicle-1

Unfilled grain was defined as spikelet's with no food material inside, and the number of these spikelet's on each panicle was tallied. The results indicated that BHR-503 had the highest percentage of unfilled grain panicles. However, IBHR-502 has the fewest unfilled grain panicles (Figure 17).

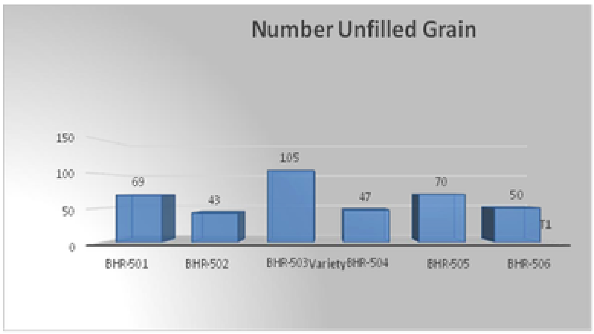

Figure 17. Number of unfilled grains recorded for different varieties (BHR-501 to BHR-506).

Spikelet fertility (SF)

Spikelet fertility was defined as the ratio of filled grain to total number of grains, or %SF = filled grain/total number of grains. BHR-505 had the highest spikelet fertility rate, whereas BHR-501 had the lowest rate (Figure 18).

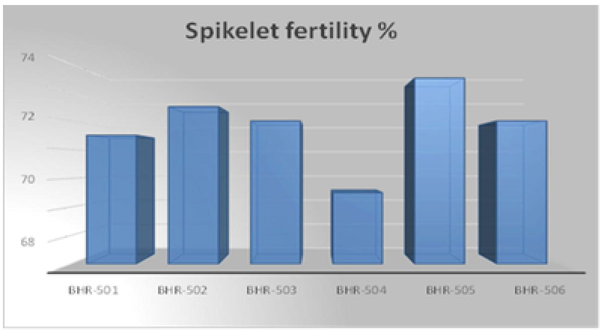

Figure 18. Spikelet fertility (%) recorded for different varieties (BHR-501 to BHR-506).

1000-grain weight (g)

From the seed stock taken from five sample hills in each plot, 1,000 clean, dried grains with 14% moisture were counted and weighed using an electric balance. A 14% seed moisture content was used to alter the weight. BHR-501 had the maximum weight of 1000 grains (28.627 grams), while BHR-506 had the lowest weight (20.67 grams) (Figure 19).

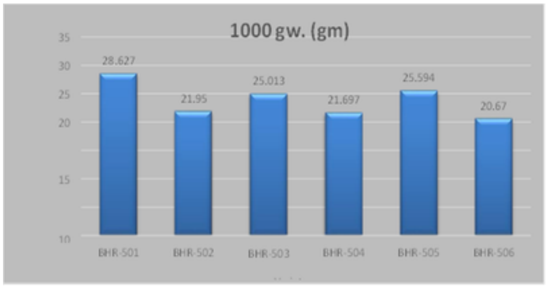

Figure 19. Thousand-grain weight (g) of different varieties (BHR-501 to BHR-506).

Grain type

Grain type calculated by using the ratio of average length and breadth from 10 randomly selected grains.

Scale for grain type

Coarse(C) = <2.6

Medium coarse (MC) = 2.7- 2.9

Medium slender (MS) = 3- 3.2

Slender (S) => 3.3

Grain yield (t ha-1)

With the exception of the border line, the entire plot was harvested, manually threshed, cleaned, and weighed using a sensitive balance before being converted to a moisture content of 14%. In this case, the high grain yield (10.13 t/ha) was achieved by BHR-505. Conversely, BHR-503 yielded the least amount of grain (8.60 t/ha) (Figure 20).

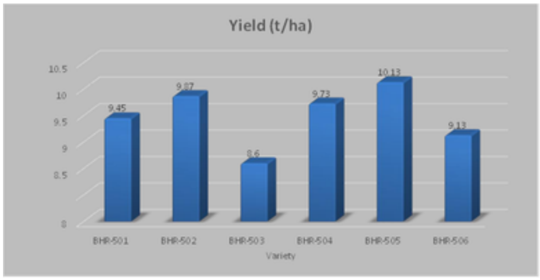

Figure 20. Grain yield (t/ha) of different varieties (BHR-501 to BHR-506).

Results and Discussion

Days to maturity

Days to maturity were measured at several DAT, with notable variations amongst the cultivars. BHR-503 and BHR-505 had the longest maturation period (152 days), whereas BHR-505 had the shortest maturation period (130 days).

Plant height

Plant height was measured prior to harvesting, and it varied greatly between the kinds. BHR-505 (128 cm) was the tallest plant at the time, while BHR-503 (110.5 cm) was the shortest.

Number of effective tillers

Varying kinds produced very varying amounts of effective tillers and hills. BHR-3, BHR-505, and BHR-506 had the most effective tillers per hill, whereas BHR-504 had the fewest.

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Panicle length

There was a noticeable variation in panicle length. BHR-501 had the longest panicle (27.43 cm), whereas BHR-505 had the shortest (26.07 cm).

Filled grains

Different varieties exhibited notable variation in the quantity of packed grains per panicle. The highest quantity of packed grains per panicle was produced by BHR-504. BHR-501 had the fewest grains per panicle.

Unfilled grains

The amount of unfiled grains per panicle varied significantly among the types. The results indicated that BHR-503 had the most unfilled grains per panicle. However, BHR-502 had the fewest empty grains per panicle.

Spikelet fertility %

A notable variation in spikelet fertility percentage has been noted. BHR-502 had the highest spikelet fertility (81%), while BHR-503 had the lowest seed fertility (63.01%).

Grain type

Grain all the varieties used in this experiment were slender type.

Thousand-grain weight

There were notable differences between the several cultivars in terms of 1000 grain weight. BHR-501 had the highest 1000 grain weight (28.627g), while BHR-506 had the lowest 1000 grain weight (20.670g).

Yield at 14% M (t/h)

The cultivars' yields differed considerably. In this case, the high yield (10.13 t/ha) was produced by BHR-505. However, at 14% moisture content, BHR-503 yielded the least quantity (8.60 t/ha) (Table 2,3).

Table 2. Agronomic characters of different rice varieties produced in this experiment. ARD- Adaptive Research Department.

SL	Variety	DTM	PH (CM)	ET No.	PL (CM)	FG No.	UFG No.	SF%	GT	1000 Gwt	Yield at 14%M (t/h)
1	BHR501	148	115	11	27.43	164	69	70	s	28.627	9.45
2	BHR502	152	126	10	26.72	184	43	81	s	21.95	9.87
3	BHR503	149	110	11	26.71	177	105	63	s	25.013	8.6
4	BHR504	151	121	9	26.52	232	47	83	s	21.697	9.73
5	BHR505	153	128	11	26.07	200	70	74	s	25.594	10.13
6	BHR506	151	127	11	26.74	193	50	79	s	20.67	9.13

DTM- Days to maturity, PH- Plant height ET- Effective tiller PL- Penicle Length, FG- Filled grain penicle, UFG- Unfilled grain panicle, SF- Spikelet fertility, GT- Grain type S- (Slender) ,1000gwt – Thousand grain weight.

Table 3. Agronomic performance of different hybrid rice varieties produced in this experiment.

SL	Variety	Plant type	Growth vigor	Stem color	Flag Leaf Position	Unifor- mity	Abnormal Plant rate	Lodging	Shattering
1	BHR501	Indica	1	G	Erect	Yes	0	No	No
2	BHR502	Indica	1	G	Erect	Yes	0	No	No
3	BHR503	Indica	1	G	Erect	Yes	0	Yes	No
4	BHR504	Indica	1	G	Erect	Yes	0	No	No
5	BHR505	Indica	1	G	Erect	Yes	0	Yes	No
6	BHR506	Indica	1	G	Erect	Yes	0	No	No

Growth vigor (1= Extra vigorous, 3= Vigorous, 5= Normal, 7= weak, 9= Very weak)

Conclusion

The field experiment went down at the Supreme Rice Research Centre (or SRRC, if you wanna keep it short) in Trishal, Mymensingh. This whole thing ran from December 2022 to April 2023, and it was all about checking out how these new hybrid rice varieties, BHR-501, BHR-502, BHR-503, BHR-504, BHR-505, and BHR-506, adapted and performed yield-wise.

So, the plot size was 4.35m × 8.2m, and there were 6 different rice varieties being tested, each replicated three times. That makes it 18 unit plots total (yep, that's 6 × 3). Everything was managed just right, done at the right times and all that jazz.

The experiment's setup, it was totally random for every replication, sticking to an experimental design. They used a Randomized Complete Block Design (RCBD) for this. The seedlings were 25 days old when they were transplanted with rows 20 cm apart and within rows, 15 cm apart, just one seedling per hill, which yeah, seemed pretty standard.

There were some significant differences noted in terms of growth, yield, and all those factors that contribute to yield. They collected data on growth stuff like plant height (in cm), tillers per hill, and how long it took to hit 50% flowering across different days post-transplanting. Also tracked yield stuff such as effective tillers per hill, panicle length, grains per panicle, the number of filled versus unfilled grains, 1000-grain weight, and overall grain yield (tha–1). They picked 10 hills randomly (not counting the edges, of course) from each plot before harvesting to gather all this data. Then they harvested everything once it was mature. Data were gathered from those randomly selected hills per plot, and by the end, they recorded yield after taking the whole plot down.

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Now, here's the twist BHR-505 totally stole the show, outperforming all the other varieties when it came to yield. The rest can be ranked in terms of yield performance as: BHR-502, BHR-504, BHR-501, BHR-506, and finally BHR-503.

Recommendation

- BHR-505 performed better than other varieties, considering the highest amount of yield at a desired time.
- This variety is very well adapted to our country Soil & climatic conditions.
- Farmers of Bangladesh are highly recommended for the cultivation of these rice varieties in Bangladeshi cropland to gain maximum Yield at a very short time.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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