www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(9): 321-326

www.thepharmajournal.com
Received: 02-07-2023
Accepted: 06-08-2023

N Anando Singh
Junior Agronomist, AICRP on Chickpea, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Sakhen Sorokhaibam
Subject Matter Specialist (Agronomy), Krishi Vigyan Kendra, Utlou, Bishnupur, Manipur, India

Kholu Mary
Research Scholar, Department of Agronomy, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Sonika Yumnam
Scientist (Plant Breeding), AICRP on Chickpea, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Jeti Konsam
Assistant Entomologist, AICRP on Maize, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Nilima Karam
Assistant Entomologist, AICRP on Soybean, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Nancy Khairakpam
Research Scholar, Department of Agronomy, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Corresponding Author:
Sakhen Sorokhaibam
Subject Matter Specialist (Agronomy), Krishi Vigyan Kendra, Utlou, Bishnupur, Manipur, India

Evaluation and assessment of farmers rice (*Oryza sativa* L.) varieties under Imphal valley condition

N Anando Singh, Sakhen Sorokhaibam, Kholu Mary, Sonika Yumnam, Jeti Konsam, Nilima Karam and Nancy Khairakpam

Abstract
A field study was carried out at Hijam Khunou, Thoubal District, Manipur during *Kharif* season 2017 to evaluate and assess the efficacy of farmers' rice varieties against the recommended state varieties and hybrids under Imphal Valley condition. A randomized block design (RBD) with three replications was adopted for designing the experiment. The study used nine different varieties of rice, viz., CAU R1, CAU R3, Arize-6444 (Gold), AZ-8433, Kathaiphou, Darum Phou, Rajen Phou, Sana Yanbi, and Kesho Phou at a spacing of 15cmx15cm between rows and 10cm x 10 cm between plants using one seedling per hill. The results of the experiment indicated that all nine rice varieties differed significantly in terms of the growth and yield contributing attributes. The maximum plant height (144.2 cm) was recorded in Rajen Phou. The maximum number of tillers hill^{-1} (10.3), number of reproductive tillers hill^{-1} (8.1), filled grains panicle^{-1}(199.4), grain yield (8900 kg ha^{-1}) and straw yield (14376 kg ha^{-1}) were found in AZ-8433. Higher panicle weight (4.1g), unfilled grains per panicle (49.2), stem thickness (2.5 cm), seed width (10.8 mm) and test weight (30.8 g) were observed in Darum Phou varieties. Longest panicle length (26.4 cm) was seen in Kesho Phou and seed length (10.2mm) in Sana Yanbi. Maximum days taken to reach 50% flowering (105 days) and maturity (140 days) were recorded in Arize-6444. The study also revealed that all the nine varieties were non-lodging, moderately resistant to stem borer, drought and bacterial leaf blight (BLB) disease. According to these findings hybrid variety AZ-8433 was performing better than the farmers' varieties and state recommended varieties as it gives higher grain yield. However, it took longer duration for 50% flowering and physiological maturity when compared to farmers' varieties.

Keywords: Farmers' rice varieties, hybrid rice, performance, growth, yield

1. Introduction

Rice (*Oryza Sativa* L.) is the stable food for half of the world's population and is the second most widely grown cereal in the world. The majority of Asians consume 60% of their daily calories from rice, making Asia the world's top producer of the grain. Asia produces and consumes rice in almost 90% of the world's land area. India, the nation with the largest rice-growing area in the world, only achieved productivity levels of 40.5% of those of the United States and 48.5% of those of China in 2009. According to Agricultural Statistics at a Glance 2015, rice is produced on 43.86 million ha in India, with a production level of 104.80 million tons and a productivity of roughly 2390 kg ha^{-1}. It is grown in a wide range of climatic and soil environments. Due to population growth, the demand for rice is expected to increase by approximately 40 percent within 30 years (Surridge 2004) [34].

Manipur has a deep-rooted agricultural tradition, with rice being a staple crop that sustains both the economy and the people. There is a lot of opportunity to boost the productivity of rice in Manipur. According to recent statistics, rice is cultivated in an area of 225.8 thousand hectare in Manipur with production of 602.2 thousand tonnes and a productivity of 2667 kg ha^{-1} during 2020-21 (Directorate of economics & Statistics, Ministry of Agriculture & Farmers Welfare, GoI). Manipur is endowed with many varieties of rice. In India in general, and North Eastern India in particular, there are a number of scented and unscented Farmers' Varieties (FVs) of rice available (Roy *et al*., 2014) [28, 29]. However, the cultivation of the landraces is now either lost or restricted to a few isolated areas due to the introduction and adoption of new improved varieties. A great concerned is being raised about the quick extinction of the traditional farmer's varieties, which were developed before the introduction of high-yielding, fertilizer-responsive, short-statured rice varieties that before helped the nation attain food security. Many of these varieties are considered that they developed greater significance as a result of climate change, which revived the relationship between evaluation, conservation, and seed propagation of such varieties. The detailed characterization of the varieties in the system of commercial seed production is essential for maintaining genetic purity (Chakrabarty *et al*, 2012) [8]. Even though rice is the main crop in Manipur, farmers are still facing various constraints such as limited supplies of high-quality seeds, a lack of appropriate high yielding varieties, a slow adoption of improved varieties, low to very low usage of fertilizers and poor crop emergence and crop stand that results in a smaller plant population, and a slow and ineffective transfer of technology (Das, 2015) [12]. So it is prime need to evaluate and assess farmers' rice varieties in Imphal. In consideration of these facts, research was conducted to evaluate the performance of farmers' varieties in comparison to hybrid and state-recommended varieties in the Imphal valley.

2. Materials and Methods

2.1 Sampling location and soil properties

A field experiment was conducted at Hijam Khunou, Thoubal District, Manipur (24º 27' 210''N latitude and 93º 56' 271'E longitude) during *Kharif* season 2017 The average rainfall during the crop growing season (June –November) was 275.67mm. The average maximum relative humidity was 92% and average minimum RH was 72%. And the average temperature during the crop season was ranging from 20-28ºC. The soil of the experimental field soil was clay in texture, soil pH of 5.61 which is acidic, medium range in available nitrogen (357.8 N kg ha^{-1}), low in available phosphorus (25.02 P_2O_5 kg ha^{-1}), medium in available potassium (267.7 K_2O kg ha^{-1}) and high in organic carbon (0.96%), deficient in sulphur (14 mg kg^{-1}), high in zinc (2.40 mg kg^{-1}) , boron (1.47 mg kg^{-1}), iron (35.2 mg kg^{-1}) and manganese (58.9 mg kg^{-1}) .

2.2 Crop Management

The experiment field was laid out in a randomized block design (RBD) with three replications comprising of nine varieties of rice were used for the study, viz., CAU R1, CAU R3, Arize-6444 (Gold), AZ-8433, Kathaiphou, Darum Phou, Rajen Phou, Sana Yanbi, and Kesho Phou. The first two varieties (CAU R1 and CAU R3) are developed by Central Agricultural University, Manipur and state recommended varieties, Arize-6444 (Gold) and AZ-8433 are hybrid rice and the remaining five varieties i.e. Kathaiphou, Darum Phou, Rajen Phou, Sana Yanbi, and Kesho Phou are farmers' varieties. Seed soaking was done on 26th June, 2017 and transplanted on 13th July,2017 at a spacing 15cmx15cm between rows and 10cm x 10 cm between plants using one seedling $hill^{-1}$. Fifty per cent of nitrogen (30 kg N ha^{-1}) and full dose of phosphate (40 kg P_2O_5 ha^{-1}) and potash (30kg K_2O ha^{-1}) were applied in the experimental plot just before sowing of the crop as basal dose. The remaining fifty per cent nitrogen (30 kg N ha^{-1}) was applied as top dressed. No artificial irrigation was given at any stages of the crop growing period.

2.3 Physical and chemical soil analysis

The soil texture was determined by the Bouyoucos Hydrometer method (Chopra and Kanwar, 1982) [9]. The soil pH was measured by using a digital pH metre and a 1: 2.5 soil-water suspension, as described by Jackson, 1973 [18]. The available nitrogen content of the soil samples was determined by using the alkaline potassium permanganate method (Subbiah and Asija, 1956) [3]. The available phosphorus content of soil was estimated by using Bray and Kurtz's method, 1945 and the available potassium was extracted from soil using neutral N ammonium acetate at 1:5 soil; the extract ratio and potassium concentration were determined by using a flame photometer (Jackson, 1973) [18]. Wet oxidation was used to determine the oxidizable organic carbon (Walkley and Black, 1934) [35]. Available sulphur was determined by $CaCl_2$-Extractable method (Williams and Steinbergs, 1969) [36]. Boron in soil was estimated by using Azomethine H method (Berger and Truog, 1939) [5]. And Zinc, Iron and Manganese were estimated by following DPTA extraction method (Lindsay and Norvel, 1978) [23].

2.4 Statistical analysis

Important growth and yield attributing parameters were observed, including plant height, number of tillers $hill^{-1}$, number of reproductive tillers $hill^{-1}$, panicle length, panicle weight, number of filled grains, test weight, straw yield ha^{-1} and grain yield $ha^{-1.}$ Five sample plants from each replication of the study's varieties were used to gather the data. The duplicated data were statistically analyzed using Fischer's method of analysis of variance (ANOVA), and Gomez and Gomez's 1984 interpretation was employed. However, 5% probability levels were used to analyze the results.

3. Results and Discussion

3.1. Plant height (cm)

A perusal of the data from Table 1 revealed that the plant height was differed significantly by different rice varieties. The range of plant height observed among the varieties was from 114.5 cm to 144.2 cm. The highest plant height (144.2 cm) was recorded in the variety Rajen Phou and significantly higher when compared to the rest of the varieties, followed by the hybrid variety Arize-6444(Gold) with a plant height of 128.3 cm. It was observed that the lowest plant height (114.5 cm) was recorded in the variety Kesho Phou. It's worth noting that the results indicate significant differences among the variety, which implies that genetic factors play a significant role in determining plant height. The variations in the genetic make-up of the different rice varieties may account for the differences in plant height. This outcome was in line with that of Roy *et al*. (2014) [28, 29], Das *et al.* (2012) [11], and Khatun (2001) [21], who observed that different rice varieties had different plant heights.

3.2 Number of tillers per hill

Indicators of successful crop establishment practices, good growth, and development include the number of tillers per $hill^{-1}$. According to Jamir and Gohain (2017) [19], it significantly influences the crop's potential production. The number of tillers $hill^{-1}$ among the varieties was found to be varied significantly (Table 1). The highest number of tillers $hill^{-1}$ (10.3) was recorded in two varieties AZ-8433 and CAU R1 followed by Arize-6444 (Gold) with 10.1 of tillers per hill which is statistically at par with AZ-8433 and CAU R1. However, the lowest number of tillers $hill^{-1}$ (7.0) was recorded in the variety CAU R3. The heterogeneity in the variety's genetic makeup is the cause of the variation in the number of effective tillers $hill^{-1}$. The same conclusion was reached by Roy *et al*. (2014) [28, 29] and Ramasamy *et al*. (1987) [27], who reported that differences in the number of tillers on $hill^{-1}$ were caused by varietal variation. Malini *et al*. (2006) [24] also stated that hybrid plants with significant positive standard heterosis produced plants with more productive tillers.

3.3 Number of reproductive tillers per hill
Grain yield is greatly influenced by the rice plant's tillering capacity. Among the various yield components productive tillers are very important as the final yield mostly depends on the number of panicles bearing tillers per unit area. The data from the Table 1 indicated that the number of reproductive tillers hill^{-1} was significantly affected by the different varieties that were examined. The highest number of reproductive tillers hill^{-1} (8.1) was recorded in the hybrid variety AZ-8433 followed by Arize-6444 (Gold) with 7.7 number of reproductive tillers hill^{-1} which is statistically at par with AZ-8433. And, the lowest number of reproductive tillers hill^{-1} (4.5) was recorded in three varieties viz., CAU R3, Rajen Phou and Kesho Phou. It is observed that hybrid rice varieties produced higher reproductive tillers hill^{-1} as compared to farmers' varieties and other varieties under study. Khatun (2020) [22] and Jisan *et al.* (2014) [20] concluded that, variation in number of tillers per hill might be due to varietal characters.

3.4 Days to 50% Flowering
As per the data presented on the Table 1, it was revealed that number of days taken to reach 50% flowering stage was differed significantly by different rice varieties. The maximum number of days (105 days) taken to reach 50% flowering was recorded in the hybrid variety Arize-6444 (Gold) followed by AZ-8433 (104 days) and was statistically at par with Arize-6444 (Gold) and the minimum days taken (71 days) to reach 50% flowering was recorded in CAU R1. It is evident from the data (Table 1) that hybrid rice varieties took more days to reach its 50% flowering stage as compared to other varieties. This might be due to the inherent characteristic of the varieties to take maximum number of days to reach 50% flowering. The heritability is a measure of the extent to which phenotypic variation is influenced by genetics. Similar result was also reported by Singh *et al.* (2019) [32]. Alam *et al.* (2014) [3], reported that there was a positive and significant correlation between the days to 50% flowering and the days to maturity.

3.5 Days to physiological maturity
The number of days for rice to reach physiological maturity varied statistically significantly by variety (Table 1). The maximum days taken to reach maturity (140 days) was observed in the hybrid variety Arize-6444 (Gold) followed by AZ-8433 recording 139 days and was statistically at par with Arize-6444 (Gold). However, as demonstrated in Table 1, the variety CAU R3 had the shortest maturation period (104 days). The results also showed that hybrid rice varieties require more time to mature than the other rice varieties under consideration. The aforementioned finding of variation in the number of days before physiological maturity agreed with Sarkar (2014) [16] and Ashrafuzzaman *et al*. (2009) [4].

Table 1: Performance of farmers' varieties against the recommended state varieties and hybrid under Imphal valley condition on growth attributes and no. of days taken for 50% flowering and physiological maturity

Varieties	Plant height (cm)	No. of tillers hill^{-1}	No. of reproductive tillers hill^{-1}	50% flowering (days)	Maturity (days)
CAU R1	126.9	10.3	5.9	91	130
CAU R3	117.9	7.0	4.5	71	104
Arize-6444 (Gold)	128.3	10.1	7.7	105	140
AZ-8433	122.0	10.3	8.1	104	139
Kathaiphou	114.6	8.7	5.0	102	137
Darum Phou	122.0	8.5	6.3	95	130
Rajen Phou	144.2	7.9	4.5	74	108
Sana Yanbi	118.8	9.0	6.3	103	138
Kesho Phou	114.5	8.0	4.5	92	127
Sem(±)	4.47	0.38	0.58	0.47	0.47
C.D.$_{0.05}$	13.38	1.13	1.75	1.41	1.41
CV (%)	6.3	7.3	17.2	0.9	0.6

3.6 Panicle length (cm)
A perusal of the data from Table 2 indicated that the panicle length was significantly influenced by different rice varieties. The range of panicle lengths observed among the varieties was from 20.3 cm to 26.4 cm. The longest panicle was recorded in Kesho Phou (26.4 cm) followed by AZ-8433 (25.3 cm), CAU R3 (25.2 cm), Darum Phou (24.3), CAU R1 (24 cm), Arize-6444 (23.8 cm) and Rajen Phou (23.4 cm). However they were statically at par with Kesho Phou. While the shortest panicle was recorded in Kathaiphou (20.3 cm) preceded by Sana Yanbi (21.3 cm). The results indicate significant differences among the varieties, which implies that genetic factors play a significant role in determining panicle length. This finding is consistent with studies by Sarkar (2014) [16], Chowhan *et al*. (2017) [10], and Abonmai *et al*. (2023) [1] who discovered that panicle length varied significantly between varieties.

3.7 Panicle weight (g)
There were significant differences in panicle weight (g) between the test varieties (Table 2). The maximum panicle weight (4.1 g) was recorded in Darum Phou and Sana Yanbi varieties, followed by the variety CAU R1 (4.0g), AZ-8433 (3.8 g) and Arize-6444 (Gold) with panicle weight of 3.4 g. However, they were found to be statistically on par with Darum Phou and Sana Yanbi varieties. These varieties produced relatively heavy panicles, indicating good grain yield potential. While minimum panicle weight (2.7 g) was recorded in the variety CAU R3. The results indicate that the panicle weight of rice varieties was significantly influenced, with notable variations between different Varieties. Genetic variations could explain why different rice cultivars have different panicle weights. Similar findings that variation affected panicle weight were also made by Singh *et al*. (2017) [31] and Abonmei *et al*. (2023) [1].

3.8 Number of filled grains per panicle
Data analysis showed that different varieties significantly affected the filled grains/panicle (Table 2). The hybrid variety AZ-8433 had the most filled grains/panicle (199.4), followed by Arize-6444 (Gold), which had 161 filled grains/ panicle

and the variety Kesho Phou had the fewest number of packed grains/panicle (117.5). In local rice cultivars, there are typically fewer spikelets/ panicle, according to Roy *et al*. (2014) [28, 29]. Variations in grain filling may have resulted from genetic, environmental, or cultural management strategies. According to Abonmei *et al*. (2023) [1] and Sarkar (2014) [16], who found that the yield was influenced by the filled grains/ panicle and the number of filled grains/panicle, this result is consistent with their findings.

3.9 Number of unfilled grains per panicle

Among the investigated rice varieties, there were substantial differences in the number of empty grains panicle-1 (Table 2). Darum Phou displayed the most unfilled grains panicles^{-1} (49.2), followed by the AZ-8433 hybrid variety (41.3), and Kathaiphou displayed the least amount (20.4). The outcome shows that there were substantial differences in the number of unfilled grains in panicle^{-1}. The genetic characteristics of the kinds may be the reason for the variation in the number of unfilled grains panicle^{-1}, according to Islam *et al*. (2013) [17]. This was consistent with the findings of Chowhan *et al*. (2017) [10] and Sarkar (2014) [16], who discovered that there were substantial differences in the amount of empty grains in panicle^{-1} among the rice varieties.

3.10 Test weight (g)

A perusal of the data from Table 2 revealed that test weight was differed significantly by different rice varieties. The 1000 grains weight of Darum Phou was found to be highest recording 30.8 g , followed by Sana Yanbi (29.7 g), Rajen Phou (29.4 g) and CAU R1 (29.3 g). However, Sana Yanbi, Rajen Phou and CAU R1 were statistically on par with Darum Phou. It might be because of its bigger grain size. The hybrid variety AZ-8433 had the lowest test weight (21.2 g), which may be because to its smaller grain size. The genetic diversity of the variety is what causes the discrepancy in test weight.. Bharath *et al*. (2018) [6] also supported that the hereditary characteristic of thousand-grain weight, an essential component in determining yield, is the one least affected by the environment. The findings were in line with those of Abonmei *et al*. (2023) [1], Chowhan *et al*. (2017) [10], and Sarkar (2014) [16] who discovered that rice varieties considerably affected the 1000-grain weight.

3.11 Stem thickness (cm)

The data from Table 2 showed that the range of stem thickness observed among the varieties was from 1.6 cm to 2.5 cm. Maximum stem thickness (2.5 cm) was observed in Darum Phou and Sana Yanbi which was closely followed by AZ-8433, Kathaiphou and Kesho Phou recording 2.4 cm stem thickness. While the minimum stem thickness (1.6 cm) was recorded in Rajen Phou. It was observed that maximum plant height i.e. Rajen Phou is having the least stem thickness. It was obvious that the stem thickness decreased with increase in plant height as Rajen Phou was having the maximum plant height under study. The result indicated that the stem thickness was significantly affected by different rice varieties which might be caused by variations in their genetic makeup.

3.12 Seed length (mm) and Seed width (mm)

From the data presented in Table 2, indicated that seed length (mm) and seed width (mm) were significantly affected due to different varieties. The maximum seed length (10.2 mm) and maximum seed width (10.8mm) were recorded in the variety Sana Yanbi and Darum Phou respectively. While the minimum seed length (8.1 mm) was recorded in the variety Rajen Phou and the minimum seed width (8.0 mm) was recorded in two varieties viz., Kathaiphou and Rajen Phou. The differences in Seed length and Seed width seen among the varieties under study might be caused by the genetic make-up of a particular rice variety as well as sink strength. The length and thickness of the rice grains were positively correlated with the 1000-grain weight of the rice, according to Fujita *et al*. (1984) [14].

3.13 Grain yield per ha (kg)

Grain yield is a crucial parameter determining a variety's potential. Table 2 shows significant differences in grain yields between rice varieties, with AZ-8433 having the highest yield (8900 kg ha-^{1}) and Arize-6444 (Gold) having the highest (8372) kg ha-^{1}. While the lowest grain yield was observed in Rajen Phou might be due to its small grain size. Hybrid rice varieties AZ-8433 and Arize-6444 (Gold) outperformed other rice varieties in growth, yield characteristics, and grain yield. These yields were positively associated with reproductive tillers, panicle length, panicle weight, number of grains, and 1000 grains weight. This result is supported by the findings of Sarkar (2014) [16], Islam *et al*. (2014) [16], and Mondal *et al*. (2005) [25].

3.14 Straw yield per ha (Kg)

Table 2 reveals significant differences in straw yield between various varieties. AZ-8433, a hybrid variety, produced the highest straw output at 14376 kg/ha, possibly due to its high number of tillers and reproductive tillers. Darum Phou and Sana Yanbi also had similar yields. CAU R3 had the lowest yield at 4978 kg/ha.

Table 2: Rice varieties performance under Imphal valley condition on yield attributes and yield parameters

Varieties	Panicle length (cm)	Panicle weight (g)	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	Stem thickness (cm)	Seed length (mm)	Seed width (mm)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
CAU R1	24.0	4.0	145.7	28.0	2.0	9.6	9.6	6737	11109
CAU R3	25.2	2.7	152.5	27.9	1.7	9.2	9.3	3847	4978
Arize -6444 (Gold)	23.8	3.4	161.0	24.5	2.1	9.5	8.5	8372	12911
AZ-8433	25.3	3.8	199.4	41.3	2.4	8.5	8.5	8900	14376
Kathaiphou	20.3	2.9	159.3	20.4	2.4	9.6	8.0	3889	9528
Darum Phou	24.3	4.1	124.5	49.2	2.5	8.4	10.8	6672	14065
Rajen Phou	23.4	3.5	159.4	35.0	1.6	8.1	8.0	3474	9883
Sana Yanbi	21.3	4.1	129.5	37.6	2.5	10.2	8.1	6450	13520
Kesho Phou	26.4	3.0	117.5	34.2	2.4	9.4	10.2	5911	12131
Sem(±)	1.07	0.28	11.19	3.05	0.17	0.06	0.06	272.84	1170.54
C.D.$_{0.05}$	3.20	0.84	33.48	9.13	0.52	0.18	0.19	816.13	3501.31
CV (%)	7.8	13.9	12.9	16.0	13.8	1.1	1.2	7.8	17.8

3.15 Reaction to lodging, stem borer, drought and bacterial leaf blight (BLB)

Lodging is the most common limitation on grain production. The nine rice varieties under study, as shown in Table 3, indicated no variation in resistance to lodging, lodging, stem borer, drought, or bacterial leaf blight. All varieties are non-lodging, moderately resistant to stem borer, drought, and bacterial leaf blight disease.

Table 3: Performance of rice varieties under Imphal valley condition on reaction against pest, disease, lodging and drought

Varieties	Reaction to lodging	Reaction to stem borer	Reaction to drought	Reaction to BLB
CAU R1	Non-lodging	resistant moderately	resistant moderately	resistant moderately
CAU R3	Non-lodging	resistant moderately	resistant moderately	resistant moderately
Arize-6444 (Gold)	Non-lodging	resistant moderately	resistant moderately	resistant moderately
AZ-8433	Non-lodging	resistant moderately	resistant moderately	resistant moderately
Kathaiphou	Non-lodging	resistant moderately	resistant moderately	resistant moderately
Darum Phou	Non-lodging	resistant moderately	resistant moderately	resistant moderately
Rajen Phou	Non-lodging	resistant moderately	resistant moderately	resistant moderately
Sana Yanbi	Non-lodging	resistant moderately	resistant moderately	resistant moderately
Kesho Phou	Non-lodging	resistant moderately	resistant moderately	resistant moderately

4. Conclusion

The study found that AZ-8433 rice variety yields higher than other rice varieties, including farmers' varieties and state recommended varieties. It is the best for maximum grain yield, straw yield, number of tillers, reproductive tillers, and filled grains/ panicle. However, some farmers' varieties have moderate yield potential and shorter duration. Hybrid rice varieties are better for higher yield, especially during the kharif season. This study may be repeated for further confirmation.

5. References

1. Abonmai T, Singh MS, Luikham E, Nabachandra L, Singh N, Singh NG. Evaluation of yield and yield attributing characteristics in upland red rice cultivars of Manipur; c2023.
2. Agricultural Statistics at a glance, Directorate of economics & Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India; c2015.
3. Alam MS, Islam MM, Hassan L, Begum SN, Gupta R. Study of Correlation, Magnitude of Genetic Diversity and Selection Indices in Popular Rice (*Oryza sativa* L.) Landraces of Bangladesh. International Journal of Innovation and Applied Studies. 2014;8(3):1329-1338.
4. Ashrafuzzaman M, Islam MR, Ismail MR, Shahidullah SM, Hanafi MM. Evaluation of six aromatic rice varieties for yield and yield contributing characters. Int. J Agric. Biol. 2009;11(5):616-620.
5. Berger KC, Truog E. Boron determination in soils and plants. Industrial & Engineering Chemistry Analytical Edition. 1939;11(10):540-545.
6. Bharath MS, Mohan MM, Vanniarajan C, Gridhari V, Senthil N. Genetic variability studies in ADT43/ Seeraga samba cross derivatives of rice (*Oryza sativa* L.). Electronic J Plant Breeding. 2018;9(4):1450-60.
7. Bray RH, Kurtz LT. Determination of total, organic and available forms of phosphorus in soils. Soil Sci. 1945;59:39-45.
8. Chakrabarty SK, Joshi MA, Singh Y, Maity A, Vashisht V, Dadlani M. Characterization and evaluation of variability in farmers' varieties of rice from West Bengal. Indian Journal of Genetics and Plant Breeding. 2012;72(2):136.
9. Chopra SL, Kanwar JS. Analytical agricultural chemistry Kalyani Publishers. Ludhiana, India; c1982.
10. Chowhan S, Haider MR, Hasan AFMF, Hoque MI, Kamruzzaman M, Gupta R. Comparative on farm performance of five modern rice varieties with two local cultivars. Journal of Bioscience and Agriculture Research. 2017;13(01):1074-1086.
11. Das B, Mannan MA, Das PK. Performance study of three high yielding varieties of Bangladesh and one exotic rice variety. B. Sc. Ag. Thesis. Agrotechnology Discipline, Khulna University, Khulna. c2012. p. 19-27.
12. Das M. Studies on crop establishment methods, cropping systems and varieties in submergence prone rainfed lowland rice ecosystem, M.Sc. (Agri.), Thesis on Agronomy, Institute of Agricultural Sciences Banaras Hindu University, Varanasi; c2015.
13. Directorate of economics & Statistics, Ministry of Agriculture & Farmers Welfare, Government of India.
14. Fujita K, Coronel V, Yoshida S. Grain filling characteristics of rice varieties (*Oryza sativa* L) differing in grain size under controlled environmental conditions. Soil Sci. Plant Nutri. 1984;**30**(3):445- 454.
15. Gomez KA, Gomez AA. Statistical Procedure for Agric.Res. 2nd ed. John Wiley and Sons: New York, USA; c1984. p. 680.
16. Islam MS, Paul SK, Sarkar MAR. Varietal performance of modern transplant Aman rice subjected to level of nitrogen application. J Bangladesh Agril. Univ. 2014;12(1):55-60.
17. Islam N, Kabir MY, Adhikary SK, Jahan MS. Yield performance of six local aromatic rice cultivars. IOSR Journal of Agriculture and Veterinary Science. 2013;6(3):58-62.
18. Jackson ML. Soil Chemical Analysis; Asia Publication House: Bombay, India; c1973. p. 165-167.
19. Jamir T, Gohain T. Study on Growth and Yield Performance of High Yielding Rice (*Oryza sativa* L.) Varieties under Rainfed Lowland Condition of Nagaland. International Journal of Bio-resource and Stress Management. 2017;8(5):622-627.
20. Jisan MT, Paul SK, Salim M. Yield performance of some transplant aman rice varieties as influenced by different levels of nitrogen. Journal of the Bangladesh Agricultural university, 12(452-2016-35815); c2014. p. 321-324.
21. Khatun R. Effect of variety and nitrogen on the performance of fine rice. M.Sc.(Ag) thesis, Bangladesh Agricultural University, Bangladesh; c2001.
22. Khatun S, Mondal MMA, Khalil MI, Roknuzzaman M, Mollah MMI. Growth and yield performance of six aman

rice varieties of Bangladesh. Asian Research Journal of Agriculture. 2020;12(2):1-7.
23. Lindsay WL, Norvell W. Development of a DTPA soil test for zinc, iron, manganese, and copper. Soil science society of America Journal. 1978;42(3):421-428.
24. Malini N, Sundaram T, Ramakrishnan SH, Saravanan S. Prediction of hybrid vigour for yield attributes among synthesized hybrids in rice (*Oryza sativa* L.). Research Journal of Agricultural and Biological Sciences. 2006;2(4):166-170.
25. Mondal MMA, Islam AFMS, Siddique MA. Performance of 17 modern transplant aman cultivar in the north region of Bangladesh. Bangladesh J. Crop. Sci. 2005;**16**:23-29.
26. Pradan A, Thakur A, Sonboir HL. Response of rice (*Oryza sativa*) varieties to different levels of nitrogen under rainfed aerobic ecosystem. Indian Journal of Agronomy. 2014;59(1):76-79.
27. Ramasany S, Chandrasekaran B, Sankaran S. Effect of spacing and seedlings hill-1on rice yield. International Rice Research Newsletter, IRRI, Philippines. 1987;12(4):49.
28. Roy S, Banerjee A, Pattanayak A, Roy SS, Rathi RS, Misra AK. Chakhao (delicious) rice landraces (*Oryza sativa* L.) of North-east India: collection, conservation and characterization of genetic diversity. Plant Genetic Resource. 2014;12:264-272.
29. Roy SK, Ali MY, Jahan MS, Saha UK, Ahmad-Hamdani MS, Hasan MM, *et al*, Evaluation of growth and yield attributing characteristics of indigenous Boro rice varieties. Life Sci. J. 2014;11(4):122-126.
30. Sarkar SC. Performance of five selected hybrid rice varieties in Aman season (Doctoral dissertation, Department of Agricultural Botany, Sher-e-Bangla Agricultural University, Dhaka-1207); c2014.
31. Singh DK, Pandey PC, Thapliyal SD, Nanda G. Yield and economics of rice (*Oryza sativa* L.) as influenced by establishment methods and varieties under mollisols of Pantnagar. International Journal of Current Microbiology and Applied Sciences. 2017;6(6):297-306.
32. Singh V, Rachana MP, Kumar S, Mishra JP, Singh SN, Tiwari D, *et al*., Performance of Hybrid Rice Cultivar (*Oryza sativa* L.) on Growth and Yield Attributes under Agro-Climatic Conditions of Allahabad Uttar Pradesh in Aman Season of Planting. International Journal of Current Microbiology and Applied Sciences. 2019;8(9):2970-2982..
33. Subbiah BV, Asija GL. A rapid method for the estimation of nitrogen in soil. Current Sci. 1956;26(5):259-260.
34. Surridge C. Feast or famine? Nature. 2004;428:360-361
35. Walkley A, Black IA. An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. Soil Sci. 1934;37(1):29-38.
36. Willams CH, Steinbarg SA. Soil sulphur fractions as chemical indices of available sulphur in some Australion soils. Aust. J Agric. Res. 1969;10:340-352.