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# Evaluation of improved varieties of rice (*Oryza sativa* L.) under environmental condition of Namsai, Arunachal Pradesh, India

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**ABSTRACT**

An experiment was performed for evaluation of improved varieties of rice under environmental conditions occurring at Namsai district of Arunachal Pradesh in Research Farm of Arunachal University. Studies were conducted during *Kharif* season for identifying the promising variety. Thirteen varieties, namely Deepthi; NPT Cul-1; Red MattaTriveni; Jyothi; Uma; Akhaya; Sapmpada; Aathiva; JS-7; Khamti Lahi; Thailand Lahi; MTU and Bora were assessed in replicated randomized block design with 2 replication. The results revealed that the varieties showed significant variations on growth and yield parameters viz; Plant height at the vegetative stage, Number of productive tillers, Number of days for panicle emergence, Crop duration, Number of grains per panicle, Length of panicle, Length of grain, 1000 grain weight, Yield per plot and Length/Breadth ratio of grains. From the above findings, it is observed that, considering the growth and yield parameters, improved rice varieties Uma and JS-7, exotic variety Thailand Lahi, indigenous variety Bora and Khamti Lahi were found to be promising under the Namsai condition of Arunachal Pradesh.

***Key words :*** *Oryza sativa, Varieties rice, Arunachal Pradesh*

## Introduction

*Oryza sativa* L (Rice, 2n=24) belonging to a Poaceae family contains 80% carbohydrate, 7-8% protein, 5% fat, and 3% fiber. The global per capita food consumption estimated in the years 2017 and 2018 was 53.7 kg and 53.9 kg, respectively (FAO, 2018). The estimated world paddy production was 757 million tonnes, whereas the food grains production in India was 291.95 million tonnes in 2019 (Malhotra, 2019). The paddy production of India was 117.47 million tonnes in 2019 (FAO, 2019). Most of the farmers of Arunachal Pradesh, particularly in the Namsai region, cultivate traditional and indigenous varieties of rice. They have low productivity in comparison to the improved and high-yielding varieties of rice popular in other parts of the country. However, numerous reports have shown indigenous cultivars having a wide diversity in physiological, ecological, and morphological characteristics (Jahan*et al*., 2003). So, it is essential to evaluate the performance of improved indigenous and traditional rice varieties to identify and popularize the promising ones. The present study was performed with the aim to evalu-

ate the performance of improved indigenous and traditional rice varieties under Namsai conditions.

## Materials and Methods

### Site of the Experiment

The field experiment was performed during the *Kharif* season at the Agricultural Research Farm of Arunachal University of Studies, Namsai, Arunachal Pradesh, Northeast India, during 2019-2020.

### Sample collection and parameter analysis

The improved paddy varieties like Akshaya, Athira, Bora, Deepthi, Jyothi JS-7, KhamtiLahi, MTU, NPT Cul-1, Red MattaThrivehi, Sampada, Thailand Lahi, Uma were cultivated following Randomized Block Design with 2 replications. The data on the following characters such as plant height at vegetative stage (cm), number of tillers per hill, grains number per panicle, the average grain length (mm), length of panicle (cm), weight of 1000 grain (g), number of days for panicle emergence, crop duration (days), yield per plot (kg) and length/breadth ratio of grains were noted during the experiment.

### Statistical analysis

Analysis of Variance was conducted with the help of SPSS software to estimate the variations among the rice varieties.

## Results

### Analysis of growth parameters of improved rice varieties

The results obtained from the present investigation of improved rice varieties (Oryza sativa L.) under Namsai conditions are shown in Tables 1 and 2. The data pertaining to the growth, yield attributes, quality, and correlation between these parameters were subjected to statistical analysis in order to test significant differences.The varieties significantly (P=0.05) varied for mean plant height at the vegetative phase. The height ranged from 82.30 cm in Jyothi to 158.60 cm in Thailand Lahi. The productive tillers ranged from 8.50 in KhamtiLahi to 14.70 in Akshaya. The number of days for panicle emergence ranged from 41 days in Red mattathriveni to 61.50 days in Sampada. The crop duration ranged from 110 days in Red mattathriveni to 150 days in Thailand Lahi. The number of grains per panicle varied from 82.50 in NPT Cul to 131.50 in Aathira.

It was observed that among thirteen varieties, the significantly highest number of grains per panicle were obtained from Aathira (131.50), followed by Deepthi (120), whereas the lowest was found in NPT Cul (82.50). The length varied from 20.45 cm in KhamtiLahi to 23.70 cm in Sampada. Significant variation was noticed among the varieties regarding grain length, ranging from 0.70 mm in Akshaya and Aathira to 1 cm in Jyothi and Sampada. The 1000 grain weight varied from 31.39 g in Bora to 20.79 g in Thailand Lahi. The yield per plot varied from 1.12

**Table 1.** Variation in growth parameters among the improved rice varieties

| Varieties | Plant height (cm) | Productive tillers | Days of panicle emergence | Crop duration |
|---|---|---|---|---|
| Akshaya | 132.50 | 14.70 | 57.50 | 145 |
| Bora | 94.45 | 13.30 | 47.50 | 125 |
| Jyothi | 82.30 | 11.65 | 42.50 | 120 |
| Uma | 121.75 | 14.00 | 60.00 | 145 |
| JS-7 | 104.60 | 9.50 | 52.50 | 137 |
| NPT Cul | 104.45 | 10.30 | 41.50 | 115 |
| Aathira | 110.85 | 11.30 | 52.00 | 137 |
| Sampada | 113 | 12.00 | 61.50 | 145 |
| Red mattathriveni | 95.40 | 11.80 | 41.00 | 110 |
| Deepthi | 124.10 | 10.70 | 55.50 | 140 |
| KhamtiLahi | 139.30 | 8.50 | 59.00 | 145 |
| MTU | 108.30 | 11.30 | 46.00 | 137 |
| Thailand Lahi | 158.60 | 11.30 | 61.00 | 150 |
| CD (P=0.05) | 6.44 | 1.14 | 4.64 | 11.14 |
| S.Em(±) | 2.09 | 0.37 | 1.51 | 3.61 |
| **CV (%)** | **2.58** | **4.54** | **4.09** | **3.79** |

kg in Uma to 0.39 kg in NPT Cul. The length and breadth ratio of grains ranged from 2.09 in Thailand Lahi to 1.02 in Uma. The plant height recorded at maturity differed significantly between the varieties. The significantly tallest variety was Thailand Lahi (158.60 cm), while the shortest plants were found under variety Jyothi (82.30cm). Plant height is controlled primarily by the genetic makeup of the plant and growing conditions, and the nutrients available are the secondary factors that affect plant height.

**Correlation between Yield and Plant Characters**

The correlation analysis was carried out for ten characters to know the nature of the relationship between yield and yield attributing characters (Table 3). Total yield/plot was found positively and significantly correlated with crop duration (0.73), number of days per panicle (0.70), number of grains per panicle (0.49), plant height at vegetative stage (0.40), length of panicle (0.31), number of productive tillers (0.12), the average length of the grain (0.17) and 1000 grain weight (0.03). The correlation matrix showed that the plant height at the vegetative stage had a significant correlation (positive) with the crop duration (0.79), number of days for panicle emergence (0.79), total yield per plot (0.40), length/breadth ratio of the grain (0.28), number of grains per panicle (0.11) and had a correlation (negative) with weight of 1000 grain (-0.37), the average length of the grain (-0.13), length/panicle (-0.14) and number of productive tillers (-0.07). Chhangte *et al*. (2019) conducted an experiment to study the degree and nature of association between the crop yield and its constituent characters as well as their indirect and direct effects on the grain yield in aromatic rice genotypes of the Northeast region of India. The result of path coefficient analysis revealed that the number of panicles/plant has the highest direct effect on the grain yield/plant followed by the weight of 1000 grain, wide of the leaf blade, panicle length, days to 50 percent flowering, and length of the leaf blade.

On the other side, number of productive tillers has showed a significant correlation (positive) with the panicle length (0.31) and with the weight of 1000 grain (0.14). It showed a negative association with the average length of the grain (-0.29) and the number of grains/panicle (-0.14). The number of days for panicle emergence showed a significant positive correlation with crop duration (0.94) and total yield per plot (0.70). It showed a negative correlation with the weight of 1000 grain (-0.11). Crop duration showed a significantly positive correlation with total yield/plot (0.73) and the number of grains per panicle (0.35). It showed a negative correlation with 1000 grain weight (-0.14).

The number of grains per panicle was significantly positively correlated with 1000 grain weight (0.60) and total yield per plot (0.49); however negative correlation was observed with the length/breadth ratio of grain (-0.21) and the average length of the grain (-0.08). Length of panicle also shows a

**Table 2.** Yield and Yield attributing characters of improved rice varieties

| Varieties | Grains/ panicle | Panicle length (cm) | Average Length of Grains (mm) | 1000 Grain weight (g) | Yield/ Plot (kg/sq.m) | Length and Breadth ratio of Grains |
|---|---|---|---|---|---|---|
| Akshaya | 113 | 22.70 | 0.70 | 28.50 | 0.69 | 1.84 |
| Bora | 118 | 21.28 | 0.90 | 31.39 | 0.83 | 1.43 |
| Jyothi | 99 | 21.90 | 1.00 | 24.94 | 0.63 | 1.80 |
| Uma | 102 | 22 | 0.80 | 24.93 | 1.12 | 1.02 |
| JS-7 | 127 | 23.23 | 0.90 | 31.19 | 0.97 | 1.43 |
| NPT Cul | 82.50 | 20.75 | 0.75 | 24.48 | 0.39 | 1.43 |
| Aathira | 131.50 | 22.35 | 0.70 | 26.46 | 0.89 | 1.43 |
| Sampada | 101.50 | 23.70 | 1.00 | 24.95 | 0.85 | 1.87 |
| Red mattathriveni | 103.50 | 22.38 | 0.80 | 25.94 | 0.59 | 1.72 |
| Deepthi | 120 | 20.85 | 0.90 | 30.57 | 0.77 | 1.36 |
| KhamtiLahi | 118.50 | 20.45 | 0.90 | 23.90 | 0.83 | 1.75 |
| MTU | 101.50 | 22.63 | 0.85 | 23.67 | 0.81 | 1.81 |
| Thailand Lahi | 102 | 22 | 0.90 | 20.79 | 0.95 | 2.09 |
| CD (P=0.05) | 17.91 | 3.99 | 0.06 | 2.36 | 0.09 | 0.33 |
| S.EM (±) | 5.81 | 1.29 | 0.02 | 0.77 | 0.03 | 0.11 |
| **CV (%)** | **7.53** | **8.31** | **3.38** | **4.12** | **4.96** | **9.38** |

significant correlation (positive) with total grains/panicle (0.31), length/breadth ratio of the grain (0.26), the average length of the grain (0.07), and the weight of 1000 grain (0.03).

The average length of grain showed a significantly positive correlation with the length/breadth ratio of the grain (0.30), total yield per plot (0.17), and negative correlation with the weight of 1000 grain (-0.05). 1000 grain weight showed a significantly positive correlation with total yield/plot (0.03) and a negative correlation with the length/breadth ratio of the grain (-0.48). The length/breadth ratio of the grain showed a significantly positive correlation with an average length of the grain (0.30), plant height at vegetative stage (0.28), and negative correlation with the weight of 1000 grain (-.48) and total yield/plot (-0.23). Similar outcomes were also stated by different researchers


**Fig. 1.** Agronomic practices and variables obtained in improved rice varieties

**Table 3.** Correlations between growth and yield of improved rice varieties

| Growth \ Parameters | PHVS | NPT | NDPE | CD | NGPP | LP | ALG | 1000 GW | TYPP | L/B RG |
|---|---|---|---|---|---|---|---|---|---|---|
| **PHVS** | 1 | | | | | | | | | |
| **NPT** | -0.07 | 1 | | | | | | | | |
| **NDPE** | 0.79 | 0.11 | 1 | | | | | | | |
| **CD** | 0.79 | 0.06 | 0.94 | 1 | | | | | | |
| **NGPP** | 0.11 | -0.14 | 0.31 | 0.3 | 1 | | | | | |
| **LP** | -0.14 | 0.31 | 0.17 | 0.2 | 0.09 | 1 | | | | |
| **ALG** | -0.13 | -0.29 | 0.13 | 0.0 | -0.08 | 0.07 | 1 | | | |
| **1000GW** | -0.37 | 0.14 | -0.11 | -0.14 | 0.60 | 0.03 | -0.05 | 1 | | |
| **TYPP** | 0.40 | 0.12 | 0.70 | 0.73 | 0.49 | 0.3 | 0.1 | 0.03 | 1 | |
| **L/B RG** | 0.28 | -0.10 | 0.07 | 0.13 | -0.21 | 0.2 | 0.3 | -0.48 | -0.23 | 1 |

**PHVS**- Plant height at the vegetative stage, **NPT**- number of productive tillers, **NDPE**- Number of days for panicle emergence, **CD**- Crop duration, **NGPP**- Number of days per panicle, **LP**- Length of panicle, **ALG**- Average length of grain, **1000GW**- 1000 grain weight, **TYPP-** Total yield per plot, **L/B RG –Length/Breadth ratio of Grains**

(Akhter *et al*., 2004; Chhangte *et al*., 2019 and Das *et al*., 2015).

## Discussion

Maximum height was observed in Thailand Lahi (158.60 cm), while the smallest plants were of variety Jyothi (82.30cm). Plant height is governed primarily by the genetic makeup of the plant and also by environmental conditions furthermore the nutrients available play a crucial role in plant growth therefore these are important factors influencing plant height. Similar results have been reported by Zhang *et al*. (2017). Das *et al*. (2015) examined 30 rice germplasm of exotic and local origin to ascertain the phenotypic as well as genotypic correlation among twenty one morpho-physiological and yield parameters and their indirect/direct contribution to the grain yield under boro season. The result obtained clearly indicated that the grain yield/plant had a significant correlation (positive) with the biological yield, harvest index, days to flowering, panicle length, grain/panicle, and the weight of the 1000 grain at both phenotypic as well as genotypic levels. Konate *et al*. (2016) observed the correlation between the grain yields with its component in rice lines. On the other side grain yield per plant shows a significant correlation (positive) with biomass and weight of stem. This result indicates that the selection based on phenotypic traits is important for the improvement of rice yield under natural environmental condition and is useful for developing new breeding lines for various phenotypic traits.

## Conclusion

The growth and yield parameters of the 13 varieties indicated that Uma and JS-7, out of the improved varieties, gave a better yield, and Thailand Lahi, as well as Khamti Lahi and Bora, was not a disappointment in terms of yield. However, Thailand Lahi and Khamti Lahi had a longer duration and tendency for lodging due to more plant height. Therefore, improved varieties such as Uma and JS-7 can also be further utilized along with Thailand Lahi, Khamti Lahi, and Bora for enhancing rice productivity and increasing the income as well as the livelihood of the farming community of Namsai district in Arunachal Pradesh. The study also suggests elaborative investigation involving more number of improved and indigenous varieties for identification of best-suited varieties for the region.

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