



# Effect of Integrated Nutrient Management on Yield of Black Aromatic Rice (*Oryza sativa* L. *indica*)

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

A field experiment was conducted at Himalayan University farm, Jollang, Itanagar, Arunachal Pradesh, during the kharif season of 2024-25 with treatments 8 replicated three in Randomized Block Design, to determine the effect of Integrated Nutrient Management on Yield of Black Aromatic Rice. The study recorded significant difference among treatments in terms of Grain yield, Straw yield and Harvest index of plant. The result revealed that the treatment T<sub>4</sub> (100% RDF + Vermicompost @ 3tha<sup>-1</sup>) was found to be best Treatment for obtaining maximum Grain yield, Straw yield and Harvest index.

**Keywords:** Black aromatic rice; FYM; integrated nutrient management; rhizobium; Randomized Block Design (RBD) and vermicompost.

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## 1. INTRODUCTION

Black rice refers to a variety of rice from the species *Oryza sativa* L. Subspecies indica. It has high levels of nutrients, high antioxidant property and is glutinous in nature. It is also known as purple rice, heaven rice, imperial rice, king's rice, prize rice and forbidden rice. Recently it was referred as "Super Food" (Saha, 2016). It is cultivated in South - East Asian countries (Kong et al., 2008).

"It is the staple food for more than 65% of the country's population and also the most important source for meeting the calorie and dietary protein needs of the people. Mostly, white or brown rice is consumed in the world whereas black rice is consumed by a very small portion of people in Asia during the special occasions. It is a medium-grain, no glutinous heirloom rice with a deep purple hue and a nutty, slightly sweet flavour. The dark colour of the grain is due to anthocyanin, a powerful antioxidant. Black rice has a deep black colour and usually turns deep purple when cooked. It is suitable for creating porridge, dessert, cake, bread, kheer, noodles and many other dishes. The Japanese researchers analysed the genome of 21 black rice varieties and found that the specific gene that triggers the plant to produce large amounts of anthocyanin" (Oikawa et al., 2015).

"The dark purple colour of Black rice is due to the high anthocyanin content, located in the pericarp layers. Anthocyanin pigment which is present in black rice has been documented as health promoting food ingredients because of antioxidant activity" (Takashi et al., 2001). "Due to growing demand, there has been increased interest in the alternative sources of anthocyanin, which is inexpensive sources of natural and stable pigments" (Hu et al., 2003). "The Black rice was also reported as good source of fiber, minerals, and several important amino acids" (Zhang et al., 2005). "Black rice also contains higher levels of proteins, vitamins and also relatively richer in the mineral contents such as Fe, Zn, Mn and P as compared to common white rice" (Suzuki et al., 2004).

"Integrated use of inorganic fertilizers, organic manures, green manures and crop residue are the only alternatives which may help in improving soil health and sustained productivity. Use of organic manures, green manures, crop residues along with inorganic fertilizers not only reduces the demand of inorganic fertilizers but also

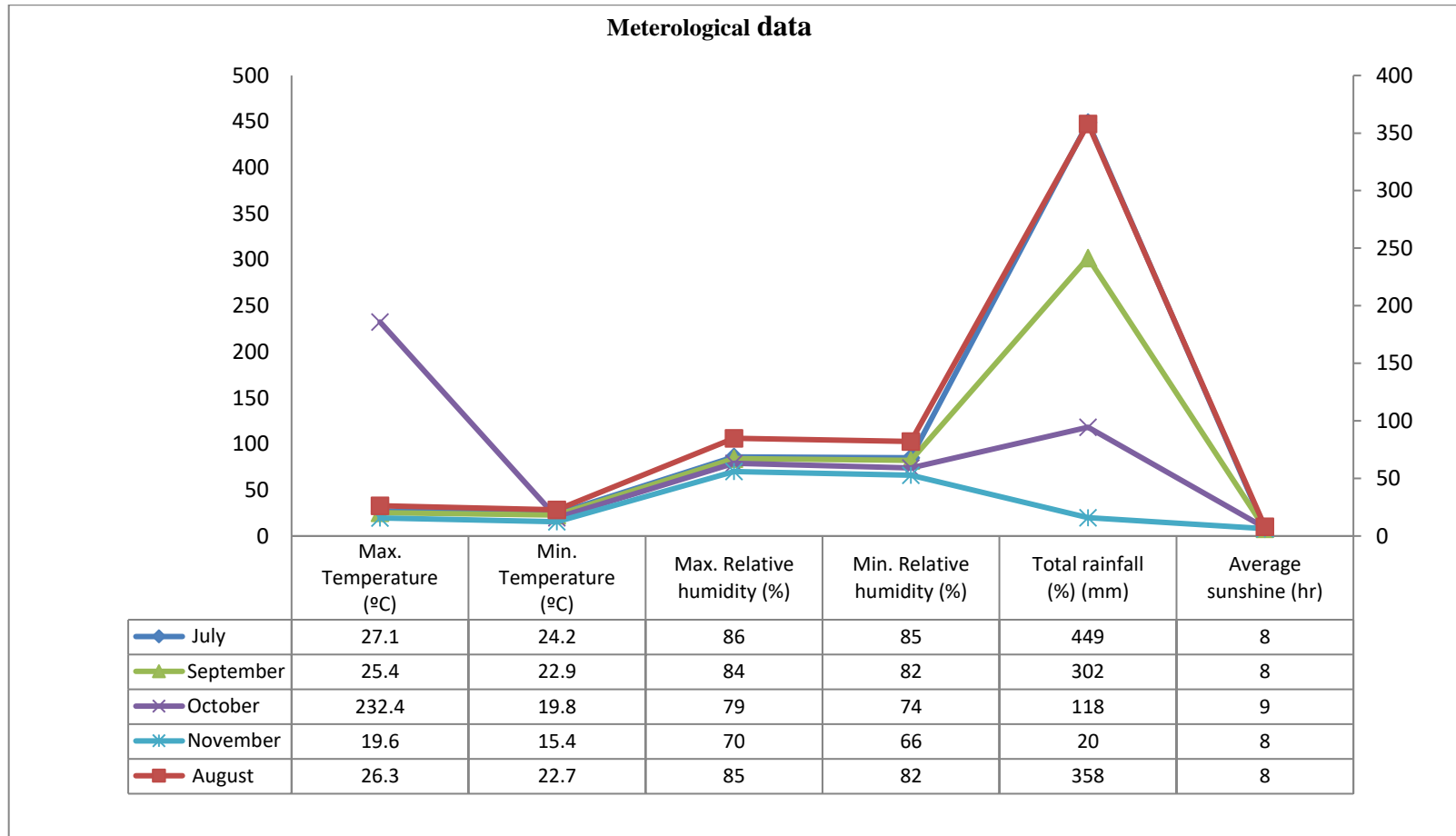
increases the efficiency of applied nutrients due to their favourable effect on physical, chemical and biological properties of soil" (Pandey et al., 2007).

FYM being store-house of both macro and micro nutrients which might have enhanced the metabolic process vis-à-vis enlarged source and sink capacity, which ultimately enhanced the grain and straw yields. The results agree with finding of Sowmya et al., (2011). "The growing interest in black rice (*Oryza sativa* L.) stems from its potential health benefits attributed to its unique starch and phytochemical compositions" (Tiranusornkij et al., 2019). "The inherent pigments of black rice, distinguished for their abundance in phytochemicals, notably anthocyanins, manifest a spectrum of pharmacological activities such as anti-diabetic" (Bhuyan et al., 2022). "Additionally, black rice is recognised to offer several health advantages such as boosting eye and heart health, protection against certain forms of cancer as it is highly antioxidant. The yield of black is substantially lower than other rice varieties. In northeast India, black rice is commonly cultivated in Manipur and indigenously called "chakhao". As the yield is very poor and chakhao is grown in very limited acreage by farmers in Manipur only for ceremonial and cultural purposes" (Sultana and Ningthoujam, 2023).

Black rice is a rainfed crop and is adopted in several states of northeast India. The introduction of black rice in the region will improve returns of the farmers, income of farmers, per capita income of farmers, the standard of living, and would promote doubling of farmers income. The high output of Black rice varieties would possibly improve the storage capacity, cropping system, and companion crops of the region. It would mitigate the shortage of rice grains and undernourishment by maintaining food security, industrial establishment and livelihood. Lingaiah et al. (2014)

## 2. MATERIALS AND METHODS

The Experiment was carried out at Agriculture field, Jullang, college of agriculture, Himalayan University, during the period of Kharif season of 29 June 2024. The experimental farm is situated at 27.074684, N latitude and 93.652878 E longitude with an average elevation of 320 meters. It was undertaken with the objective to analyse the different rice varieties and to assess their performance in Kharif season.



**Fig. 1. Meteorological data of weather parameters and total rainfall during the cropping season (*Kharif 2024-2025*)**

The Treatment includes, T<sub>1</sub> –Control, T<sub>2</sub> – 100% RDF + FYM @ 5tha<sup>-1</sup>, T<sub>3</sub> – 75% RDF + FYM @ 5tha<sup>-1</sup>, T<sub>4</sub> - 100% RDF + Vermicompost @ 3tha<sup>-1</sup>, T<sub>5</sub> – 75% RDF + Vermicompost @ 3tha<sup>-1</sup>, T<sub>6</sub> – 100% RDF + Rhizobium + PSB, T<sub>7</sub> – 75% RDF + Rhizobium + PSB, T<sub>8</sub> – 100% RDF + Rhizobium + PSB + Vermicompost @ 3tha<sup>-1</sup>. The experiment was carried out in Randomized Block Design (RBD) in the year 2024 – 2025.

The Climate condition of Itanagar is humid subtropical climate with distinct season. the rainy season usually starts from May and it extends up to September and from October onwards. The meteorological data of weather parameter. temperature, rainfall, relative humidity and sunshine hours recorded during the period of experimentation from July to November during the year 2024-2025 were obtained from meteorological observatory, for the period of the experimentation have been presented in the table. The mean minimum and maximum temperature recorded during the cropping season was 22.3 °C and 27.6 °C, respectively. The average relative humidity.

### 3. YIELD ATTRIBUTES

#### 3.1 Grain Yield

The Rice plants collected from each plot were manually threshed to remove the grains. After threshing, the grains were cleaned and dried under the sun until they reached a standard moisture content to ensure accurate and uniform weight measurements. The dried grain from each plot was weighed and recorded in kilograms. To allow for comparison between different treatments, the grain yield was then converted into kilograms per hectare (kg/ha).

#### 3.2 Straw Yield

After harvesting, rice plants from each plot were threshed to separate the grains, leaving behind the remaining plant parts such as stems, leaves, and unfilled spikelet and these referred as straw. This straw was then dried properly, and the total amount from each plot was measured using a digital weighing scale. The straw weight was recorded in kilograms per plot.

#### 3.3 Harvest Index

It was calculated by dividing economic yield by total biological yield (Donald ,1962) the following formula was used.

$$\text{Harvest index (HI)} = \frac{\text{Economic Yield}}{\text{Biological Yield}} \times 100$$

## 4. RESULTS AND DISCUSSION

The yield and development parameters of black aromatic rice were recorded under a Randomized Block Design (RBD) with three replications. Observations were taken for various traits such as grain yield, straw yield and harvest index. The data were statistically analyzed to compute the general mean, standard error (SEd), and critical difference (CD) for each trait.

### 4.1 Grain Yield

The grain yield (kg/ha), were recorded at harvested and presented in Table 1. The data shows that there is significant effect of different treatment on grain yield and this data are displayed in Table 1. and graphically depicted.

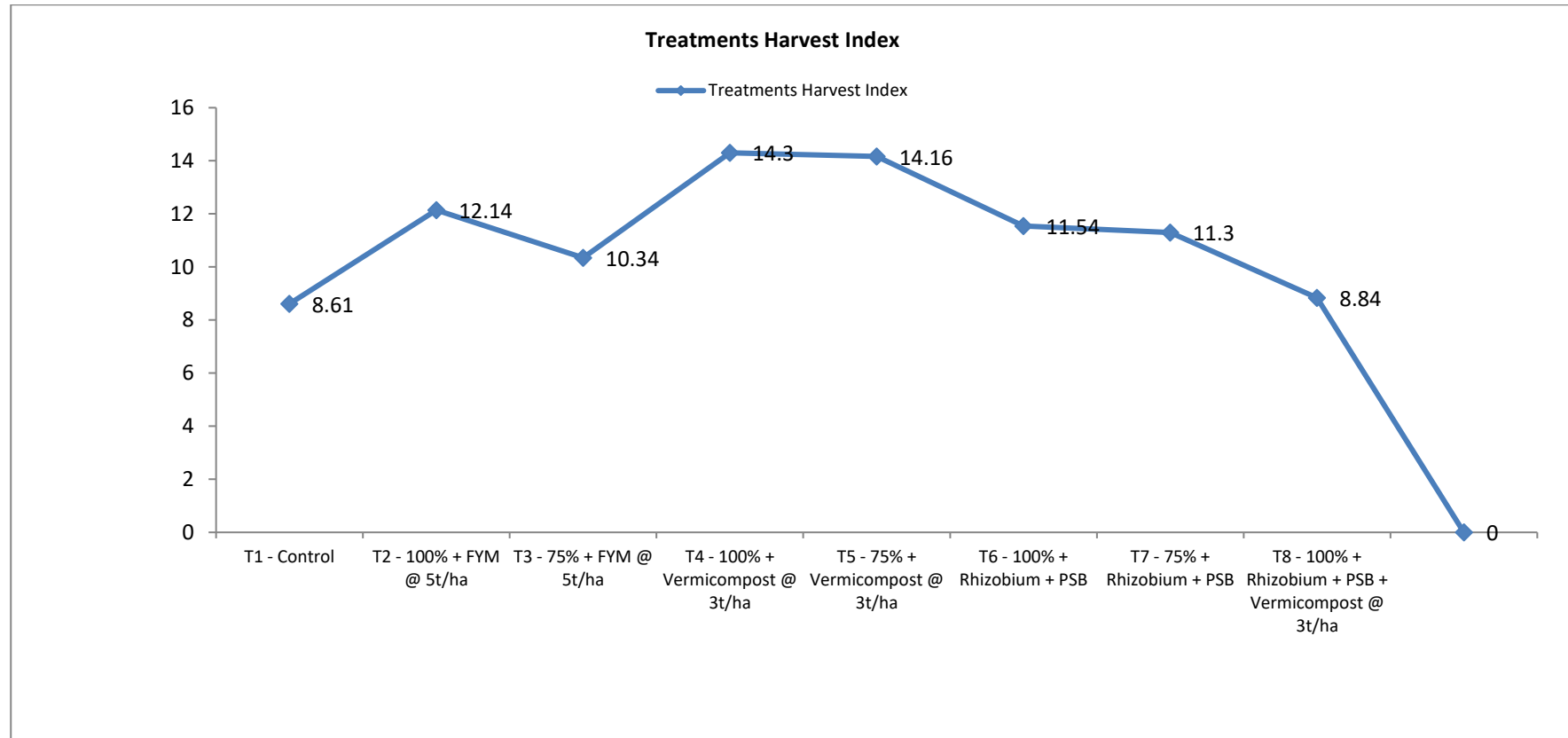
At harvest maximum grain yield was recorded at 2.06 kg/ha, was found in the treatment T<sub>4</sub>, (100% RDF + Vermicompost @ 3 t/ha), which was statistically significant. This was followed by T<sub>5</sub>, (75% + Vermicompost @ 3 t/ha) with grain yield recorded at 1.72 kg/ha. The lowest grain yield was recorded in the control treatment (T<sub>1</sub>), which received no additional nutrient supplementation, showed the lowest grain yield at 1.05 kg/ha.

The probable reason for the maximum grain yield in black rice in T<sub>4</sub> (100% RDF + Vermicompost @ 3 t/ha), could be due to the application of Vermicompost (VC) as an organic input for attaining sustainable agricultural production is a potential source of beneficial microorganisms, prime (NPK) and micro nutrients, enzymes and metabolites (Sinha *et al.*, 2009).

### 4.2 Straw Yield

The straw yield (kg/ha), were recorded at harvested and presented in table. The data shows that there is significant effect of different treatment on straw yield and this data are displayed in Table 2.

At harvest maximum Straw yield was recorded at 12.71 kg/ha, was found in the treatment T<sub>4</sub>, (100% RDF + Vermicompost @ 3t/ha), which was statistically significant. This was followed by T<sub>5</sub>, (75% RDF + Vermicompost @ 3 t/ha) with straw yield recorded at 12.09 kg/ha. The lowest straw yield was recorded in the control treatment (T<sub>1</sub>), which received no additional nutrient supplementation, showed the lowest grain yield at 9.05 kg/ha.



Graph 1. Effect of integrated nutrient management on harvest index of black aromatic rice

**Table 1. Effect of integrated nutrient management of grain yield of black aromatic rice**

Treatment	Grain Yield (Kg/ha)
T <sub>1</sub> – Control	1.05
T <sub>2</sub> – 100% RDF + FYM @ 5t/ha	1.46
T <sub>3</sub> – 75% RDF + FYM @ 5t/ha	1.29
T <sub>4</sub> – 100% RDF + Vermicompost @ 3t/ha	2.06
T <sub>5</sub> - 75% RDF +Vermicompost @ 3t/ha	1.72
T <sub>6</sub> – 100% RDF + Rhizobium + PSB	1.45
T <sub>7</sub> – 75% + RDF + Rhizobium + PSB	1.32
T <sub>8</sub> – 100% RDF + Rhizobium + PSB + Vermicompost @ 3t/ha	1.10
F test	S
SE(d±)	0.146622
CD (P=0.05)	0.314473

**Table 2. Effect of integrated nutrient management of straw yield of black aromatic rice**

Treatment	Straw yield (kg/ha)
T <sub>1</sub> – Control	9.05
T <sub>2</sub> – 100% RDF + FYM @ 5t/ha	11.37
T <sub>3</sub> –75% RDF + FYM @ 5t/ha	11.30
T <sub>4</sub> –100% RDF + Vermicompost @ 3t/ha	12.71
T <sub>5</sub> - 75% RDF +Vermicompost @ 3t/ha	12.09
T <sub>6</sub> – 100% RDF + Rhizobium + PSB	11.37
T <sub>7</sub> – 75% + RDF + Rhizobium + PSB	11.36
T <sub>8</sub> – 100% RDF + Rhizobium + PSB + Vermicompost @ 3t/ha	10.12
F test	S
SE(d±)	0.527373
CD (P=0.05)	1.131103

The probable reason for the maximum straw yield in black rice in T<sub>4</sub> (100% RDF + Vermicompost @ 3t/ha), could be due to application of vermicompost. Carried out a study to identify the effect of vermicompost on yield characteristics of paddy. The yield of paddy with the amendment of vermicompost showed notable increase in 12.71 kg plot<sup>-1</sup> vermicompost amendment with regular farmers practice. Jayakumar *et al.* (2011).

### 4.3 Harvest Index

The harvest index (%), were recorded at harvested and presented. The data shows that there is significant effect of different treatment on harvest index and this data are displayed in Graph 1.

At harvest maximum harvest index was recorded at 14.30%, was found in the treatment T<sub>4</sub>, (100% RDF + Vermicompost @ 3t/ha), which was statistically significant. This was followed by T<sub>5</sub>, (75% RDF + Vermicompost @ 3t/ha) with harvest index recorded at 14.6%. The lowest straw yield was recorded in the control treatment (T<sub>1</sub>), which received no additional nutrient

supplementation, showed the lowest grain yield at 8.84%.

The maximum harvest index recorded at T<sub>4</sub>, (100% RDF + Vermicompost @ 3t/ha), this might be the application of vermicompost during critical growth. Vermicompost significantly increased the water holding capacity, porosity, drainage as well as microbial activity in soil (Albanell *et al.*, 1988).

### 5. CONCLUSION

In conclusion, this study demonstrates that the utilizing of integrated nutrient management on black aromatic rice shows the most favourable outcomes across yield parameters *i.e* maximum grain yield (2.06 kg/ha), maximum straw yield (12.71 kg/ha) and highest harvest index (14.30%) after harvesting and moreover, it is seen that under T<sub>4</sub> (100% RDF + Vermicompost @ 3t/ha). The approach use of Vermicompost not only boosts productivity but also improves soil health, supporting sustainable agriculture in soils. T<sub>4</sub> demonstrated superior performance, showcasing optimal growth parameters proved to be the most

effective treatment among all the mentioned treatments.

### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

### REFERENCES

- Albanell, E., Plaixats, J., & Cabrero, T. (1988). Chemical changes during vermicomposting (*Eisenia fetida*) of sheep manure mixed with cotton industrial wastes. *Biology and Fertility of Soils*, 6, 266–269.
- Hu, C., Zawistowski, J., Ling, W. H., & Kitts, D. D. (2003). Black rice (*Oryza sativa* L. *indica*) pigmented fraction suppresses both reactive oxygen species and nitric oxide in chemical and biological model systems. *Journal of Agricultural and Food Chemistry*, 51, 5271–5277.
- Jayakumar, M., Sivakami, T., Ambika, D., & Karmegam, N. (2011). Effect of turkey litter (*Meleagris gallopavo* L.) vermicompost on growth and yield characteristics of paddy, *Oryza sativa* (ADT-37). *African Journal of Biotechnology*, 10(68), 15295–15304.
- Kong, L., Wang, Y., & Cao, Y. (2008). Determination of Myo-inositol and D-chiro-inositol in black rice bran by capillary electrophoresis with electrochemical detection. *Journal of Food Composition and Analysis*, 21(6), 501–504.
- Lingaih, N., Venkanna, V., & Cheralu, C. (2014). Genetic variability analysis in rice (*Oryza sativa* L.). *International Journal of Pure and Applied Bioscience*, 2, 203–204.
- Oikawa, T., Maeda, M., Oguchi, T., Yamaguchi, T., Tanabe, N., Ebana, K., Yano, M., Ebitani, T., & Izawa, T. (2015). The birth of a black rice gene and its local spread by introgression. *The Plant Cell*, 27, 2401–2414. <https://doi.org/10.1105/tpc.15.00310>
- Pandey, N., Verma, A. K., Anurag, & Tripathi, R. S. (2007). Integrated nutrient management in transplanted hybrid rice (*Oryza sativa* L.). *Journal of Agronomy*, 52(1), 40–42.
- Saha, S. (2016). Black rice: the new age super food (an extensive review). *American International Journal of Research in Formal, Applied & Natural Sciences*, 16(1), 16–322.
- Sinha, R. K., Heart, S., Valani, D., & Chauhan, K. (2009). Vermiculture and sustainable agriculture. *American-Eurasian Journal of Agricultural and Environmental Science*, 5(S), 1–55.
- Sowmya, C., Ramana, M. V., & Kumar, M. (2011). Effect of systems of rice cultivation and nutrient management options on yield, nutrient uptake and economics of rice. *Crop Research (Hisar)*, 42(½), 369.
- Sultana, S., & Ningthoujam, D. S. (2023). Evaluation of plant growth promoting potential and biocontrol activities of *Bacillus* sp. strain CA2, a rhizobacteria from *chakhao amubi*. *Journal of Soils and Crops*, 33(1), 78–84.
- Suzuki, M., Kimur, T., Yamagishi, K., Shinmoto, H., & Yamak, K. (2004). Comparison of mineral contents in 8 cultivars of pigmented brown rice. *Nippon Shokuhin Kagaku Kogaku Kaishi*, 51(58), 424–427.
- Takashi, I., Bing, X., Yoichi, Y., Masaharu, N., & Tetsuya, K. (2001). Antioxidant activity of anthocyanin extract from purple black rice. *Journal of Medicinal Food*, 4, 211–218.
- Zhang, M. W., Guo, B. J., & Peng, Z. M. (2005). Genetic effects on grain characteristics of *indica* black rice and their uses on indirect selections for some mineral element contents in grains. *Genetic Resources and Crop Evolution*, 52, 1121–1128.

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