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# Yield and Economics of Black Rice as influenced by Integrated Nutrient Management Practices

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**ABSTRACT: A field experiment was carried out during *kharif*, 2022 at Agricultural College Farm, Bapatla to assess the impact of integrated nutrient management (INM) on yield and economics of black rice. The experiment was laid out in randomized block design with eight treatments and four replications. The results revealed that application of 50% RDN through Neem cake + 50% RDN through inorganic sources resulted in highest grain yield (4795 kg ha$^{-1}$) and straw yield (5699 kg ha$^{-1}$) of black rice, whereas the grain yield (2990 kg ha$^{-1}$) and straw yield (4022 kg ha$^{-1}$) of black rice were noticed under 100% RDN through organic sources. The data suggested that harvest index was not significantly influenced by integrated nutrient management practices. The highest gross returns (₹2,60,148 ha$^{-1}$), net returns (₹ 1,68,321 ha$^{-1}$) and B:C ratio (2.27) were recorded in treatment receiving 50% RDN through neem cake + 50% RDN through urea, 50% RDN through FYM + 50% RDN through urea, and 50% RDN through FYM + 50% RDN through urea respectively. The lowest gross return (₹ 1,57,545 ha$^{-1}$), net return (₹ 36,354 ha$^{-1}$) and the B:C ratio (0.30) were recorded with 100% RDN through organic sources.**

**Keywords:** Black Rice, INM, Gross Returns, Neem Cake, Net Returns, Urea.

## INTRODUCTION

Black rice is a variety of *Oryza sativa* L., commonly known as glutinous rice, that is cultivated primarily in the Asian continent (Kong *et al*., 2008). It is distinguished by its higher nutrient content compared to other rice species. Consumer preference has significantly increased regarding foods that contain beneficial compounds and essential nutrients necessary for the human body. Approximately 3 billion individuals worldwide experience malnutrition as a prevailing issue, primarily attributed to the inadequate intake of vitamins, minerals, and essential amino acids in their daily dietary practises (Welch, 2005).

The escalating costs of chemical fertilisers and the global energy crisis have prompted agronomists and soil scientists to shift their focus towards exploring alternative sources of nutrients. Soil degradation is a result of insufficient and unbalanced fertilisation practises, which in turn leads to nutrient depletion and the emergence of subsequent challenges in nutrient management. The implementation of an integrated nutrient management approach, which involves the simultaneous use of both organic manures and inorganic fertilisers, has been proposed as a highly effective strategy for promoting a healthy and sustainable soil system. This approach not only enhances crop productivity but also contributes to achieving food security and maintaining soil sustainability.

Black rice cultivation in Andhra Pradesh is limited to specific regions, namely Manyam, Vizianagaram, Vishakhapatnam, Srikakulam, as well as certain interior areas of the west and east Godavari districts. Due to the growing recognition of the significance of nutrition and the increasing consumer demand for the health benefits of black rice, farmers have initiated the cultivation of black rice in the plains of Andhra Pradesh. Furthermore, black rice offers a significant boost in yields for farmers compared to conventional rice varieties. Additionally, it should be noted that the market price for black rice paddy is typically 2-3 times greater than that of Grade-A paddy. A study was conducted to evaluate the effects of integrated nutrient management on the growth and productivity of black rice using different combinations.

## MATERIAL AND METHODS

A field experiment was conducted at Agricultural College Farm, Bapatla during the *kharif*, 2022-23. The experiment was laid out in a randomized block design with eight treatments and they were replicated four times. The treatments include $T_1$: 100 % RDN through Urea**,** $T_2$: 25% RDN through Neem cake + 75% RDN through Urea, $T_3$: 50% RDN through Neem cake + 50% RDN through Urea**,** $T_4$: 25% RDN through FYM + 75% RDN through Urea, $T_5$: 50% RDN through FYM + 50% RDN through Urea, $T_6$: 25% RDN through Vermicompost + 75% RDN through Urea, $T_7$: 50%

RDN through Vermicompost + 50% RDN through Urea, $T_8$: 100% RDN through organic sources (1/3rd N through Neem cake, 1/3rd N through FYM and 1/3rd N through Vermicompost applied as basal). The experimental site was sandy clay loam in texture, neutral in reaction (7.38), non-saline (0.39 dS $m^{-1}$) low in organic carbon (0.41), low in available nitrogen (238 kg $ha^{-1}$), medium in available phosphorous (31.36 kg $ha^{-1}$), medium in available potassium (248 kg $ha^{-1}$), deficit in available zinc (0.54 ppm) and sufficient in availability of iron content (5.6 ppm).

Application of manures and fertilizers was done as per the given treatments in experimental plots. The recommended dose of fertilizers (RDF) was 120 kg N, 60 kg $P_2O_5$ and 40 kg $K_2O$ $ha^{-1}$. In case of organic manures *viz.*, neem cake, vermicompost and FYM were applied in experimental plots as per the treatments which was two weeks prior to sowing and was thoroughly mixed in the soil with the help of spade to form a homogeneous blend with the soil.

The variety used in this study was 'BPT- 2841' which was not yet released, and the seedlings were transplanted manually. The application of nitrogen in the form of urea, phosphorus in the form of single super phosphate (SSP), and potassium as Muriate of Potash (MOP) was carried out. Standardised amount of nitrogen (N) was applied as basal, maximum tillering stage and at panicle initiation stage. Additionally, the entire amount of phosphorus (P) and potassium (K) were applied as basal during sowing, except in plots receiving 100% RDN through Urea.

The data obtained from the investigation were analysed using the statistical method of analysis of variance (ANOVA) to assess the impact of different parameters. The analysis of mean square errors necessitated the implementation of the least significant difference (LSD) test. The methodology incorporates a singular least significant difference (LSD) value at a significance level of 5%, acting as a demarcation between statistically significant and non-significant disparities among the means of various treatments.

## RESULTS AND DISCUSSION

Significantly highest grain yield (Table 1) was recorded in the treatment receiving 50% RDN through neem cake + 50% RDN through urea (4975 kg $ha^{-1}$), which was however comparable with those receiving 50% RDN through vermicompost + 50% RDN through urea (4660 kg $ha^{-1}$) and 50% RDN through FYM + 50% RDN through urea (4640 kg $ha^{-1}$). The lowest values of grain yield were found to be noticed in the treatment receiving 100% RDN through organic sources (2990 kg $ha^{-1}$). The increase in the grain yield can also be attributed to the increased rates of photosynthesis as nitrogen being the important constituent of chlorophyll, which led to the accumulation of these photosynthates in the vegetative parts of the plants, thereby ultimately resulting in the enhancement of growth as well as yield contributing characters. All these results are in line with the findings of Bhatt *et al*. (2023).

The analysis of the data regarding straw yield presented in Table 1 was found to be significantly higher in the treatment receiving 50% RDN through neem cake + 50% RDN through urea (5699 kg $ha^{-1}$), which was however found to be statistically on a par with those receiving 50% RDN through vermicompost + 50% RDN through urea (5275 kg $ha^{-1}$) and 50% RDN through FYM + 50% RDN through urea (5191 kg $ha^{-1}$). The lowest value was noticed with 100% RDN through organic sources (4022 kg $ha^{-1}$). The improvement in straw yield under integrated nutrient management practices might be due to the increased growth of vegetative characters *viz.* plant height and total number of tillers $hill^{-1}$ during all the phenophases of the crop. Besides providing the balanced nutrition these organic manures also led to the reduction of various nutrient losses along with the improvement in the soil characteristics like pore space, soil aggregation as well as the rhizosphere biota. These results are in line with the experimental findings of Harish Shenoy (2020); Jana *et al.* (2020).

Harvest index did not differ significantly among the various integrated nutrient management practices used in the present study. The highest harvest index was recorded in the treatment receiving 50% RDN through FYM + 50% RDN through urea (47.2) and the least was recorded in the treatment receiving 100% RDN through organic sources (42.6).

**Table 1: Grain yield, straw yield and harvest index as influenced by integrated nutrient management in black rice.**

| Treatments | Grain yield (kg /ha) | Straw yield (kg /ha) | Harvest index (%) |
|---|---|---|---|
| $T_1$ - 100 % RDN through Urea | 3712 | 4843 | 43.4 |
| $T_2$ - 25% RDN through Neem cake + 75% RDN through Urea | 4270 | 4960 | 45.9 |
| $T_3$ - 50% RDN through Neem cake + 50% RDN through Urea | 4975 | 5699 | 46.6 |
| $T_4$ - 25% RDN through FYM + 75% RDN through Urea | 3878 | 4866 | 44.4 |
| $T_5$ - 50% RDN through FYM + 50% RDN through Urea | 4640 | 5191 | 47.2 |
| $T_6$ - 25% RDN through Vermicompost + 75% RDN through Urea | 4038 | 4931 | 45.1 |
| $T_7$ - 50% RDN through Vermicompost + 50% RDN through Urea | 4660 | 5275 | 46.9 |
| $T_8$ - 100% RDN through organic sources | 2990 | 4022 | 42.6 |
| SEm± | 190 | 189 | 1.43 |
| CD (P = 0.05) | 559 | 556.4 | NS |
| CV (%) | 9.2 | 7.6 | 6.3 |

Data on economics (Table 2) indicated that, with respect to integrated nutrient management techniques in black rice the highest gross return (₹ 2,60,148 $ha^{-1}$) were recorded in treatment receiving 50% RDN through neem cake + 50% RDN through urea ($T_3$). This was however found to be on a par with those of 50% RDN through vermicompost + 50% RDN through urea ($T_7$) and 50% RDN through FYM + 50% RDN through urea ($T_5$).

The highest net return (₹1,68,321 $ha^{-1}$) was observed in treatment receiving 50% RDN through FYM + 50% RDN through urea ($T_5$), and it was found to be statistically at par with those of 50% RDN through vermicompost + 50% RDN through urea ($T_7$).

However, the highest B:C ratio (2.27) were obtained with 50% RDN through FYM + 50% RDN through urea ($T_5$) which was found to be statistically on a par with those of 100% RDN through inorganic sources ($T_1$). This might be due to increased cost of cultivation with respect to that of neem cake and vermicompost.

The lowest gross return (₹ 1,57,545 $ha^{-1}$), net return (₹ 36,354 $ha^{-1}$) and the B:C ratio (0.30) were recorded with 100% RDN through organic sources ($T_8$). These were in accordance with the research findings of Ranjitha *et al.* (2013); Shah and Kumar (2013); Garba and Oyinlola (2014); Juniarso *et al.* (2018); Tiwari *et al.* (2020).

**Table 2: Economics of black rice as influenced by integrated nutrient management.**

| Treatments | Gross returns (₹ $ha^{-1}$) | Net returns (₹ $ha^{-1}$) | B:C ratio |
|---|---|---|---|
| $T_1$ - 100 % RDN through Urea | 195286 | 131365 | 2.1 |
| $T_2$ - 25% RDN through Neem cake + 75% RDN through Urea | 223421 | 127314 | 1.3 |
| $T_3$ - 50% RDN through Neem cake + 50% RDN through Urea | 260148 | 131585 | 1.0 |
| $T_4$ - 25% RDN through FYM + 75% RDN through Urea | 203607 | 134617 | 1.9 |
| $T_5$ - 50% RDN through FYM + 50% RDN through Urea | 242381 | 168321 | 2.3 |
| $T_6$ - 25% RDN through Vermicompost + 75% RDN through Urea | 211736 | 136200 | 1.8 |
| $T_7$ - 50% RDN through Vermicompost + 50% RDN through Urea | 243551 | 156400 | 1.8 |
| $T_8$ - 100% RDN through organic sources | 157545 | 36354 | 0.3 |
| SEm± | 9513 | 9513 | 0.1 |
| CD (p = 0.05) | 27977 | 27977 | 0.3 |
| CV (%) | 8.8 | 14.9 | 12.5 |

## CONCLUSIONS

Based on the findings, it can be concluded that the combined application of 50% RDN through FYM + 50% RDN through urea showed greater impact pertaining to the economics point of view though the treatment receiving 50% RDN through Neem cake + 50% RDN through urea recorded significant results on overall crop yield when compared to the utilization of organic or inorganic sources solely. In contrast, the combined application of 50% RDN through vermicompost cake + 50% RDN through urea or 50% RDN through FYM + 50% RDN through urea as an alternative option has the ability to yield comparable results without adversely impacting the overall yield of black rice. However, this research needs further confirmation by carrying out the trail for few more seasons.

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**Conflict of Interest.** None.

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