J. Soils and Crops 33 (2) 397-401, December 2023

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

# EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON UPTAKE OF NUTRIENTS AND QUALITY IN DIRECT SEEDED RICE

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## ABSTRACT

**The present investigation in relation to "Effect of integrated nutrient management on uptake of nutrient and quality in direct seeded rice" was conducted during *kharif* season of 2021-22 at EAD Research farm, College of Agriculture, Nagpur. The field experiment was laid out in Randomized Block Design with three replications with nine treatment combinations. Vermicompost applied before sowing and PDKV- Sadhna seeds were treated with Azotobacter and PSB at the time of sowing. The grain yield of rice ( 36.34 q ha$^{-1}$),total uptake of nitrogen, phosphorus and potassium by rice grain and straw recorded the highest with the application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ + Azotobacter + PSB seed treatment. The highest total uptake of nitrogen, phosphorus and potassium was found to be 65.52 kg ha$^{-1}$, 13.37 kg ha$^{-1}$ and 78.81 kg ha$^{-1}$, respectively. The highest per cent of protein, carbohydrate, crude fibre and calcium were obtained with the application of different integrated plant management practices. The protein content was found to vary from 6.91 to 7.07 %, carbohydrate from 77.02 to 78.21 %, crude fibre from 0.63 to 0.78 % and calcium from 0.28 to 0.35 %.**

**( Key words: Vermicompost, Azotobacter, direct seeded rice, quality )**

## INTRODUCTION

Rice is the second most widely consumed cereal in the world next to wheat. It is the staple food for two third of the world's population. Among the cereal crops, it serves as the principal source of nourishment for over half of the global population, especially for south-eastern Asia, where 90% of the world production of rice is grown and consumed. It plays a vital role in our national food security, hence, the slogan 'Rice is Life' is most appropriate. Integrated nutrient management (INM) has an important role which improves efficiency of applied nutrients, maintain rice productivity and production. The increasing demand for rice grain production has to be achieved by using an integration of organic and inorganic fertilizers to maintain the sustainability in crop production (Datta and Singh, 2010). It has been estimated that one-forth of rice grown in the world is upland rice. Among many factors INM influence the crop yield under upland situation (Vipitha and Mathew, 2018). One of the fastest and effective ways to recycle organic materials is vermicomposting by which the organic wastes can be vermi stabilized into vermicompost. Vermicomposting is an eco-biotechnological process that transforms energy rich and complex organic substances into a stabilized humus like product called vermicompost. In vermicomposting, the capacity of feeding and excretion of earthworms is exploited to degrade organic materials and convert it into high grade manures i.e., Vermicompost. Production of conventional puddled transplanted rice is facing sever constraints because of water and labour shortages, scarcity and climatic changes. Direct Seeded Rice (DSR) has good potential to save water, reduce labour requirement and lowering greenhouse gas emission. The yield is comparable with transplanted rice if crop is properly managed.

## MATERIALS AND METHODS

The field experiment was carried out during *kharif* season of 2022. The soil of the field was slightly alkaline in reaction with medium in organic carbon, low in available nitrogen, low in available phosphorus and very high in available potassium, whereas sufficient in available sulphur and micronutrients.

The experiment was laid out in randomized block design in RBD with nine treatments each replicated thrice. Treatments were $T_1$- Absolute Control, $T_2$ -100 % RDF through chemical fertilizers (125:62.5:62.5 kg NPK ha$^{-1}$), $T_3$ - 125 % RDF through chemical fertilizers (156.25:78.12:78.12 kg NPK ha$^{-1}$), $T_4$-75% RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ , $T_5$ – 100 % RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ , $T_6$- 125 % RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$, $T_7$- 75% RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ + Azotobacter + PSB seed treatment, $T_8$ -100 % RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ + Azotobacter + PSB seed treatment and $T_9$ - 125% RDF through chemical

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fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment. The crop variety PDKV Sadhana was used with gross plot size of 3.4 m × 3.0 m . Application of Vermicompost and basal dose of chemical fertilizer was given at the time of drilling whereas nitrogen was given in two splits.The plant samples were digested using diacid and N (%) was estimated by Kjeldahl's method described by Piper (1966). P was determined by Vanado molybdate phosphoric yellow colour method Jackson (1973). Potassium was estimated by flame photometer by Jackson (1973). Carbohydrate was determined by Phenol-Sulphuric Acid method by Dubois *et al.* (1956). Crude protein % was computed by % of N multiplied by 6.25. Crude fibre (%) estimated by acid hydrolysis method as described by Anonymous (1977) and Calcium (%) was estimated by titration with standard EDTA as described by Jackson (1973).

# RESULTS AND DISCUSSION

### Effect of integrated nutrient management on uptake of nutrients by rice

Significantly higher grain yield of rice ( 36.34 q $ha^{-1}$) was recorded with the application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{1}$ + Azotobacter + PSB seed treatment followed by treatment received 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ . It might be due to the effect of integrated nutrient management which increases the nutrient supply and moisture content in soil. The data in relation to uptake of nitrogen was found to vary from 12.43 to 41.03 kg $ha^{-1}$ in grain and 5.13 to 65.52 kg $ha^{-1}$ in straw (Table 1). Significantly higher uptake of nitrogen by grain (41.03 kg $ha^{-1}$) was recorded with the application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{1}$ + Azotobacter + PSB seed treatment ($T_9$) and was on par with $T_6$ (38.50 q $ha^{-1}$) received 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$. Significantly higher uptake of nitrogen by straw (24.49 kg $ha^{-1}$) was recorded with the application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) and was on par with $T_6$ (22.40 q ha-1) received 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ and $T_8$ (18.32) received 100% RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment. The lowest uptake of nitrogen by grain (12.43 kg $ha^{-1}$) and straw (17.56 kg $ha^{-1}$) was recorded in control ($T_1$).

The maximum total N uptake was observed in 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) and was on par with treatment $T_6$ (60.90 q $ha^{-1}$) received 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ and minimum total N uptake was observed under control ($T_1$). This might be due to higher biomass of rice in respective treatments. A critical observation of the data reveals that in general the performance of treatment 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$), was better over other treatments in increasing the uptake of N in direct seeded rice. The highest N, P and K uptake was associated with treatment of soil test-based N, P and K application and vermicompost (Singh, 2006). This might be due to added fertilizers, FYM and green manure, resulted better availability of N, P, and K in soil to the rice crop. The application of chemical fertilizers ( NPK ) in combination with FYM significantly increased the total uptake of NPK and rice yield ( Kumar *et al.*,2014) .The increase in nutrient uptake was directly related to the crop yields. The healthy root system might have helped the plant in better absorption of nutrients and moisture from soil (Subehia and Sepehya, 2012).

### Effect of integrated nutrient management on uptake of phosphorus and potassium

The data in relation to content and uptake of phosphorus and potassium by rice as influenced by various treatments are presented in Table 2.

Significantly higher uptake of phosphorus by rice grain (9.44 kg $ha^{-1}$) and straw (3.93 kg $ha^{1}$) was recorded with the application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) and it was on par with the treatment $T_6$ (125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$) in grain. The lowest uptake of phosphorus by grain (1.39 kg $ha^{-1}$) and straw (0.38 kg $ha^{-1}$) was recorded in control ($T_1$).

The nutrient management practices had also significantly influenced the total P uptake (Table 2) with maximum uptake by the application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) and it was on par with treatment $T_6$ (125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$) and minimum under control ($T_1$). This might be due to higher biomass production of rice in different treatments. Though, P content in grain was not influenced by the treatments, the increase in grain and straw yields had reflected in higher P uptake. In general performance of treatment i.e. 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) was better over other treatments in increasing the uptake of P in direct seeded rice. This might be due to the soil containing higher phosphorus level by the addition of P through fertilizers and vermicompost which are larger sources of P. These treatments might have ensured steady supply throughout the growth period of crop due to increased P availability. Kumar *et al.* (2014) found that 125 % RDF + 5 t $ha^{-1}$ vermicompost recorded significantly higher N, P and K uptake in comparison to other treatments and this was followed by tretment 100 % RDF + 5 t $ha^{-1}$ vermicompost in rice crop. Sharma *et al.* (2010) also recorded higher total N and P uptake by rice with the application of 100 % NPK + FYM over 100% NPK (through fertilizer), as FYM was beneficial in enhancing the uptake of both nutrients compared to no organic manure application.

The uptake of K (Table 2) as influenced by different treatments, by grain, straw and total uptake ranged from 5.28 to 18.89, 14.58 to 59.92 and 19.86 to 78.81 kg $ha^{-1}$ respectively. The nutrient management practices had significantly influenced the K uptake in grain with maximum K uptake in treatment 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) and was on par with treatments $T_3$, $T_5$, $T_6$ and $T_8$. The minimum K uptake in grain was observed in control ($T_1$). This might be due to higher grain yield of rice in nutrient management practices.

Similarly, nutrient management practices significantly influenced the K uptake in straw with maximum K uptake in treatment 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) and was on par with treatment $T_6$ (55.18 q $ha^{-1}$) received 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$. All treatments were found significantly superior to control ($T_1$).

The nutrient management practices had significantly influenced the total K uptake with maximum uptake in 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) and was on par with $T_6$ (72.52 q $ha^{-1}$) received 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$. All treatments were significantly superior to control and significantly lowered total uptake of K was recorded under control ($T_1$). This might be attributed higher biomass production in various treatments. Kumar *et al*. (2014) found that treatment of 125 % RDF + 5 t $ha^{-1}$ vermicompost recorded significantly higher N, P and K uptake in comparison to other treatments and this was followed by 100 % RDF + 5 t $ha^{-1}$ vermicompost. Surendra *et al*. (2006) reported that application of farm yard manure and green manure increased the K content in both rice grain and straw. Application of different organic nutrients showed a significant variation in K uptake by rice grain and straw. The minimum K uptake in rice grain and straw were obtained from control where no fertilizers were applied. The combine application of farm manure and mineral fertilizer could induce an increase in the humus, nitrogen, available phosphorus and potassium (Kore *et al*., 2017).

**Effect of integrated nutrient management on quality parameters of rice**

The data in Table 3 reveals that total carbohydrate content by rice grain varied from 77.02 to 78.21 %. The highest carbohydrate content (78.21 %) was recorded in control ($T_1$) and the lowest carbohydrate content (77.02 %) was recorded with the application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) over remaining treatments.The highest crude fibre content (0.77 %) was recorded with the application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) over other treatments but statistically was found non-significant. Similar finding was quoted by Cortez and Altamirano (1972), who reported that crude fibre content in the maize grain may vary depending on the type and genotype.

The highest protein content (7.07 %) was recorded in treatment $T_9$ i.e., application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment and the lowest protein content (6.91 %) was recorded in control ($T_1$). The significant increase in protein content in seed of rice was due to increased nitrogen content in seed and nitrogen which is an integral part of protein; it may also be attributed due to increased availability of phosphorus, as it is a structural element of certain co-enzyme involved in protein synthesis. The calcium content by rice grain varied from 0.28 to 0.35 %. The highest calcium content (0.35 %) was recorded with the application of 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment ($T_9$) over other treatments but statistically was found non-significant. It can be concluded from the present study that, the use of 100 % and 125% RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment was found suitable nutrient practice for higher uptake of nutrients and quality of direct seeded rice.

**Table 1. Yield and uptake of nitrogen by direct seeded rice as affected by various treatments**

| | Treatments | Yield q ha$^{-1}$ | | Nitrogen uptake kg ha$^{-1}$ | | |
|---|---|---|---|---|---|---|
| | | Grain | Straw | Grain | Straw | Total |
| $T_1$ | Absolute Control | 11.25 | 13.50 | 12.43 | 5.13 | 17.56 |
| $T_2$ | 100% RDF through chemical fertilizers (125:62.5:62.5 kg NPK ha$^{-1}$) | 24.50 | 28.70 | 27.07 | 12.91 | 39.98 |
| T3 ) | 125 % RDF through chemical fertilizers (156.25:78.12:78.12 kg NPK ha$^{-1}$) | 31.36 | 36.85 | 34.71 | 16.58 | 51.29 |
| $T_4$ | 75% RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ | 20.87 | 24.48 | 23.16 | 11.50 | 34.66 |
| $T_5$ | 100% RDF through chemical fertilizers+ Vermicompost @ 2 t ha$^{-1}$ | 27.72 | 32.48 | 30.71 | 16.56 | 47.27 |
| $T_6$ | 125 % RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ | 34.69 | 40.74 | 38.50 | 22.40 | 60.90 |
| $T_7$ | 75% RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ + Azotobacter + PSB seed treatment | 21.46 | 25.15 | 23.82 | 13.32 | 37.14 |
| $T_8$ | 100% RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ + Azotobacter + PSB seed treatment | 28.90 | 33.93 | 32.07 | 18.32 | 50.39 |
| $T_9$ | 125% RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ + Azotobacter + PSB seed treatment | 36.34 | 43.74 | 41.03 | 24.49 | 65.52 |
| | SE (m)± | 1.61 | 2.40 | 1.10 | 0.54 | 1.86 |
| | CD at 5% | 4.74 | 7.06 | 3.25 | 1.58 | 5.46 |

**Table 2. Phosphorus and potassium content and uptake in grain and straw of direct seeded rice**

| | Treatments | P uptake(kg ha$^{-1}$) | | | K uptake(kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|
| | | Grain | Straw | Total | Grain | Straw | Total |
| $T_1$ | Absolute Control | 2.47 | 0.81 | 3.28 | 5.28 | 14.58 | 19.86 |
| $T_2$ | 100% RDF through fertilizers (125:62.5:62.5 kg NPK ha$^{-1}$) | 5.72 | 1.72 | 7.44 | 11.76 | 34.44 | 46.20 |
| $T_3$ | 125 % RDF through fertilizers (156.25:78.12:78.12 kg NPK ha$^{-1}$) | 7.21 | 2.21 | 9.42 | 15.05 | 44.95 | 60.00 |
| $T_4$ | 75%RDF through fertilizers +Vermicompost @ 2t ha$^{-1}$ | 5.00 | 1.71 | 6.71 | 10.22 | 30.35 | 40.57 |
| $T_5$ | 100%RDFthrough fertilizer+ Vermicompost @ 2 t ha$^{-1}$ | 6.65 | 1.94 | 8.59 | 13.58 | 41.57 | 55.15 |
| $T_6$ | 125%RDFthrough fertilizers+Vermicompost @ 2 t ha$^{-1}$ | 8.32 | 2.85 | 11.17 | 17.34 | 55.18 | 72.52 |
| $T_7$ | 75%RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ + Azotobacter + PSB seed treatment | 5.36 | 1.76 | 7.12 | 10.94 | 33.95 | 44.89 |
| $T_8$ | 100%RDF through fertilizers + Vermicompost @ 2 t ha$^{-1}$ + Azotobacter + PSB seed treatment | 7.22 | 2.71 | 9.93 | 14.73 | 46.14 | 60.87 |
| $T_9$ | 125%RDF through chemical fertilizers + Vermicompost @ 2 t ha$^{-1}$ + Azotobacter + PSB seed treatment | 9.44 | 3.93 | 13.37 | 18.89 | 59.92 | 78.81 |
| | SE(m)± | 0.63 | 0.012 | 0.93 | 1.78 | 2.05 | 2.10 |
| | CD at 5% | 1.86 | - | 2.75 | 5.28 | 6.07 | 6.19 |

**Table 3. Quality parameters of rice as influenced by various treatments**

| | Treatments | Carbohydrate (%) | Crude fiber (%) | Protein (%) | Calcium (%) |
|---|---|---|---|---|---|
| $T_1$ | Absolute Control | 78.21 | 0.63 | 6.91 | 0.28 |
| $T_2$ | 100% RDF through chemical fertilizers (125:62.5:62.5kg NPK $ha^{-1}$) | 78.05 | 0.60 | 6.91 | 0.29 |
| $T_3$ | 125 % RDF through chemical fertilizers (156.25:78.12:78.12 kg NPK $ha^{-1}$) | 77.93 | 0.72 | 6.92 | 0.29 |
| $T_4$ | 75% RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ | 77.91 | 0.73 | 6.94 | 0.31 |
| $T_5$ | 100% RDF through chemical fertilizers+ Vermicompost @ 2 t $ha^{-1}$ | 77.80 | 0.74 | 6.93 | 0.32 |
| $T_6$ | 125 % RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ | 77.57 | 0.75 | 6.96 | 0.33 |
| $T_7$ | 75% RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment | 77.52 | 0.76 | 6.95 | 0.33 |
| $T_8$ | 100% RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment | 77.09 | 0.76 | 6.99 | 0.34 |
| $T_9$ | 125% RDF through chemical fertilizers + Vermicompost @ 2 t $ha^{-1}$ + Azotobacter + PSB seed treatment | 77.02 | 0.77 | 7.07 | 0.35 |
| | SE(m)± | 0.04 | 0.61 | 0.06 | 0.01 |
| | CD at 5% | — | — | — | — |

# REFERENCES


Anonymous,1977. A manual of laboratory techniques. National Institute of Nutrition, Hyderabad. pp. 2-9.

Cortez, A. and C. W. Altamirano, 1972. Contributions to the lime treated corn flour technology. Nutritional improvement of maize. INCAP, Pub. pp. 99-106.

Datta, M. and N. P. Singh, 2010. Nutrient management in rice-based cropping systems as influenced by applying cattle manure alone or in combination with fertilizers in upland acid soils of Tripura. J. Indian Soc. Soil Sci. **58**(1): 94- 98.

Dubois, M., K. A. Gilles, J. K. Hamilton, P. T. Rebers and F. Smith, 1956. Colorimetric method for determination of sugars and related substances. Analytical Chemistry. **28** (3): 350-356.

Jackson, M. L. 1973. Soil Chemical Analysis, Prentice Hall of India, Pvt. Ltd., New Delhi.

Kore, Monali A.,Ommala D. Kuchanwar,Shweta B. Punekar and Sudarshan Goud, 2017.Characteristics of rice growing soils in Amgaon Tahsil of Gondia district. J.Soils and Crops. **27** (1)187-193.

Kumar Vinod,Ompal Singh, Ajay Chourasia, T.N.Thorat, S.S.Porte and A.K.S. Parihar, 2014.Effect of Integrated nutrient management on yield and lnutrient uptake of hybrid rice in partially reclaimed soil. J.Soils and Crops. **24** (2):241-246.

Piper, C.S. 1966. Soil and plant analysis. Hans Publishers, Bombay.

Sharma, K.L., D. Balaguruvaiah, M.V.S. Babu, B.R.Reddy,C.S.Rao, P.K.Mishra, J.K. Grace, G. Ramesh, M. Madhavi. K. Srinivas and U.K. Mandal,2010. Long-term impact of soil and nutrient management practices on soil quality in rainfed Alfisols at Anantapur in Andhra-pradesh. J. Dryland Agri.Res.and Develop.25 (1) :74-85.

Singh, V. 2006. Productivity and economics of rice (*Oryza sativa*) - wheat (*Triticum aestivum*) cropping system under integrated nutrient supply system in recently reclaimed sodic soil. Indian J.Agron. **54**: 81-84.

Subehia, S. K. and S. Sepehya, 2012. Influence of long-term nitrogen substitution through organics on yield, uptake and available nutrients in a rice-wheat system in an acidic soil. J. Indian Soc.Soil Sci. **60**(3): 213-217.

Surendra, S., R. N. Singh, J. Prasad and B. P. Singh, 2006. Effect of integrated nutrient management on yield and uptake of nutrients by rice and soil fertility in rainfed uplands. J.Indian Soc. Soil Sci. **54**(3): 327-330.

Vipitha, V.P. and P.B.Mathew, 2018.Residual effect of methods of planting, weed control Measures and nutrient management on yield attributes and yield of rice-cassava intercropped with groundnut cropping system. J.Soils and Crops. **28** (2):295-300.


**Rec. on 15.05.2023 & Acc. on 14.06.2023**