*Eco. Env. & Cons. 31 (4) : 2025; pp. (1455-1458)*
*Copyright@ EM International*
*ISSN 0971–765X*

**DOI No.: http://doi.org/10.53550/EEC.2025.v31i04.018**
**Website:** www.envirobiotechjournals.com

# Synergistic Effect of Organic and Inorganic Sources of Nutrients on Biological properties of soil, Growth attributes and Yield of Direct Seeded Rice (*Oryza sativa* L.)

***Anjali Chauhan[1], Sushil Kumar Yadav[1], Anand Kumar Diwakar[1], Jyoti Singh[1], Mithilesh Kumar[2], Manu Shashwat[1], and Vikas Yadav[1]**

***[1]Department of Soil Science and Agricultural Chemistry, ANDUA&T, Kumarganj, Ayodhya 224 229, U.P., India***
***[2]Department of Silviculture and Agroforestry, ANDUA&T, Kumarganj, Ayodhya 224 229, U.P., India***

(Received 7 July, 2025; Accepted 25 September, 2025)

**ABSTRACT**

A field experiment was conducted at Student Instructional Farm, ANDUA&T, Kumarganj, Ayodhya (U.P), during the Kharif seasons of 2024-25. The experimental site is located within the Agro climatic zone of middle gangetic plain, which is characterized by fertile soil and favourable climatic condition for direct seeded rice. the experiment was carried out by using randomised block design(RBD) to ensure statistical reliability and reduce the variability, include ten treatment combination with each replicated three times. This research experiment aimed to observed the crop performance and their interaction with treatment under the field condition. The study focused on assessing the Growth and Yield of soil properties for optimizing the rice crop production. The results showed that the highest Microbial Biomass Carbon (162.6 µg MBC $g^{-1}$ soil), Soil Dehydrogenase activity (48.88 µg TPF g $soil^{-1}$ day), Alkaline Phosphatase (38.45 µg PNP released $g^{-1}$ soil $h^{-1}$), Total soil microbial count bacteria (13.9 cfu 106 $g^{-1}$ soil), actinomycetes (10.9 cfu 104 $g^{-1}$ soil) and fungi (7.9 cfu 103 $g^{-1}$ soil) was observedand at harvest stage highest Plant height was recorded at $T_9$ with (105.22cm), and maximum number of tiller per $m^2$ was recorded in $T_9$ (182), Dry matter accumulation at harvest stage in rice was observed in $T_9$ (1127.22 $gm^{-2}$), highest (54.88 q $ha^{-1}$) was recorded, maximum straw yield (75.26 q $ha^{-1}$), Highest biological yield in rice (130.14) was observed.

***Key words:*** *Microbial biomass carbon, Dehydrogenase Activity, Soil fungi, Leaf area index*

## Introduction

The primary food supply for almost half of the world's population is rice (*Oryza sativa* L.), which is also our nation's staple crop. Over 90% of the world's rice is produced and consumed in Asia. About 45% of India's total food output comes from rice, which also helps to maintain food sufficiency. Since rice is India's main crop, the production and quality of the rice ecosystem play a major role in the country's national food security system. In terms of acreage, productivity, and consumer choice, it is one of India's most significant cereal food crops. India occupies the place as second largest producer and consumer of rice in the world. It is projected that India would produce a record 137.825 million

tonnes of rice in 2024. It is projected that India would produce a record 137.825 million tonnes of rice in 2024 (Anonymous, 2024).

A considerable decline in soil fertility and production has been seen as a result of the overuse of chemical fertilisers without nutrient recycling. Soil fertility and production have decreased due to the long-term, unbalanced use of chemical fertilisers, particularly nitrogenous (N) fertilisers. Serious issues with soil conditions were caused by the development of secondary and micronutrient deficiencies as well as poor physical conditions of the soil. The carbon (C), nitrogen (N), and phosphorus (P) cycles have been separated from one another on both a geographical and temporal scale by current nutrient management techniques that aim to directly feed crops soluble inorganic elements. Serious issues with soil conditions were caused by the development of secondary and micronutrient deficiencies as well as poor physical conditions of the soil. The carbon (C), nitrogen (N), and phosphorus (P) cycles have been separated from one another on both a geographical and temporal scale by current nutrient management techniques that aim to directly feed crops soluble inorganic elements. In addition to providing a growing substrate for plants, soil also supports animal and human activities. In order to satisfy the nutritional needs of plants, the soils are often treated with chemical fertilizers, organic manures, and composts. After green revolution, it results cultivation of high yielding dwarf varieties which are more responsive to fertilizer and irrigation. With continuous and excess use of inorganic fertilizers the inherent soil fertility has declined. Chemical fertilizers increase crop production initially but it degraded soil health as well as grain quality. Even with the use of the recommended dose of fertilizer, a negative balance of nutrients has been recorded. (Kumar *et al*., 2022) suggested that imbalance usage of fertilizers is the main factor to cause low productivity and decline of soil fertility. Vermicompost improves the physical, chemical, and biological characteristics of soil, which is essential for increasing soil fertility and health. It increases soil fertility because it is abundant in vital plant nutrients that plants can easily absorb, such as calcium, magnesium, phosphorus, potassium, and nitrogen. Vermicompost is an organic fertilizer that improves soil fertility and plant growth. Biofertilizers containing the microorganism that are natural substances, in which they enhance the soil fertility and crop productivity by promoting the availability of essential nutrients to plants. These beneficial soil microbes are nitrogen-fixing bacteria, phosphate-solubilizing bacteria, and actinomycetes and mycorrhiza, interact with plant roots to convert plants nutrients in the soil into useable forms that plants can readily absorb. Such as nitrogen-fixing bacteria like *Rhizobium* which transform the atmospheric nitrogen into usable nitrogen compounds, while phosphate-solubilizing microbes release soluble phosphorus from insoluble compounds in the soil. Soil microorganisms and earthworms obtain their carbon and energy from organic materials. In rice soils, the effectiveness of fertiliser N utilisation varies between 18 and 40% because ammonia volatilisation and denitrification rapidly remove applied inorganic N from the soil.Applying of Vermicompost and FYM to soils increases their physico-chemical and biological characteristics, which in turn increases the soils capacity to hold nutrients. The goal of the current study is to determine the effects of applying nutrients from both organic and inorganic sources on the microbiological characteristics of direct-seeded rice as well as the growth and yield characteristics of the soil.

## Materials and Methods

A field experiment with direct seeded rice was established at at Student Instructional Farm, ANDUA&T, Kumarganj, Ayodhya (U.P), during the Kharif seasons of 2024-25. The experiment was carried out in a randomized block design (RBD) with ten treatment replicated thricei.e$T_1$: Control, $T_2$: 100% RDF, $T_3$: 75%RDF +FYM (5 t/ha), $T_4$: 50%RDF +FYM (10 t/ha), $T_5$: 75%RDF + Vermicompost (2.5 t/ha), $T_6$: 50%RDF+ Vermicompost (5 t/ha), $T_7$: 75% RDF+FYM (5 t/ha) + PSB, $T_8$: 50%RDF+FYM (10 t/ha) + PSB, $T_9$: 75%RDF+Vermicompost (2.5 t/ha) + PSB, $T_{10}$: 50%RDF+ Vermicompost (5 t ha-1) + PSB.

The physicochemical properties of the surface soil (0–15 cm) were investigated before the experiment. The sowing was completed on June 21st, 2024. The organic source was applied the day before planting and incorporated as per treatments. Inorganic fertilizers were applied in accordance with the recommended doses. The recommended amounts ofN, $P_2O_5$ and $K_2O$ for direct-seeded rice were 150, 60 and 40 kg $ha^{-1}$. Nitrogen was applied in three splits, whereas P and K were given as basal. Vermicompost and FYM were applied in plots according to various treatments before the rice was

seeded. Standard procedures were followed for measuring growth and yield and biological yield. The vermicompost and FYM had 1.60, 0.75 and 0.8% and 0.5, 0.25 and 0.5% of total N, P and K content, respectively.

## Results and Discussion

Data observed on progressive plant height at the successive stages of crop growth as influenced by various organic and inorganic source of nutrient. Among the treatments, $T_9$ applying 75 % RDF + Vermicompost @2.5 t $ha^{-1}$ + PSB recorded the highest Plant height (105.22 cm), followed closely by $T_{10}$50 % RDF + Vermicompost (5 t $ha^{-1}$) + PSB with (102.30). In contrast, $T_1$ Control with (73.00cm). Maximum number of tiller per $m^2$ was observed in $T_9$75 % RDF + Vermicompost @2.5 t $ha^{-1}$ + PSB is (379 $m^2$), dry matter accumulation was observed highest in treatment T9 75 % RDF + Vermicompost @2.5 t $ha^{-1}$ + PSB (1127.22g $m^{-2}$). According to Tiwari *et al.*, (2020), observed the Vermicompost with FYM was significantly improved in EC, organic carbon, Plant height, Number of tiller in post-harvest surface soils over control and fertilizers alone. Soil test based integrated nutrient management maximizes dry matter accumulation and yields

However the application of PSB (Phosphorus solubilising bacteria) are beneficial microorganism that convert insoluble form of phosphorus in the soil into soluble forms that plants can readily absorb. The increase in organic carbon incorporation with vermicompost and FYM is frame to improve growth and activities of microbes, and also due to better root growth which ultimately resulting into higher biomass production and crop residues (Moharana *et*

**Table 2a.** Effect of organic and inorganic sources of nutrients on Biological properties

| S. No. | Treatments | Microbial-C (µg MBC $g^{-1}$ soil) | Dehydrogenase activity (µg TPF $g^{-1}$ soil $day^{-1}$) | Alkaline Phosphatase (µg PNP released $g^{-1}$ soil $h^{-1}$) |
|---|---|---|---|---|
| T1 | Control | 133.6 | 35.45 | 29.43 |
| T2 | 100 % RDF | 147.1 | 38.52 | 29.98 |
| T3 | 75 % RDF + FYM (5 t $ha^{-1}$) | 149.2 | 41.98 | 30.44 |
| T4 | 50 % RDF + FYM (10 t $ha^{-1}$) | 142.6 | 40.56 | 30.02 |
| T5 | 75 % RDF + Vermicompost (2.5 t $ha^{-1}$) | 155.6 | 43.12 | 33.42 |
| T6 | 50 % RDF + Vermicompost (5 t $ha^{-1}$) | 157.3 | 42.44 | 32.87 |
| T7 | 75 % RDF + FYM (5 t $ha^{-1}$) + PSB | 145.6 | 46.21 | 36.9 |
| T8 | 50 % RDF + FYM (10 t $ha^{-1}$) + PSB | 147.1 | 44.76 | 34.78 |
| T9 | 75 % RDF + Vermicompost (2.5 t $ha^{-1}$) + PSB | 162.6 | 48.88 | 38.45 |
| T10 | 50 % RDF + Vermicompost (5 t $ha^{-1}$) + PSB | 152.3 | 47.23 | 37.36 |
| | **SEm±** | 5.3 | 2.13 | 5.3 |
| | **C.D (P=0.05)** | 15.3 | 6.34 | 16 |

**Table 2 b.** Effect of organic and inorganic sources of nutrients on Biological properties.

| S. No. | Treatments | Bacteria ($10^5$CFU $g^{-1}$) | Fungi ($10^4$CFU $g^{-1}$) | Actinomycetes ($10^6$CFU $g^{-1}$) |
|---|---|---|---|---|
| T1 | Control | 6.2 | 5.5 | 7.2 |
| T2 | 100 % RDF | 6.49 | 5.63 | 7.39 |
| T3 | 75 % RDF + FYM (5 t $ha^{-1}$) | 7.11 | 5.98 | 7.74 |
| T4 | 50 % RDF + FYM (10 t $ha^{-1}$) | 6.88 | 5.76 | 7.53 |
| T5 | 75 % RDF + Vermicompost (2.5 t $ha^{-1}$) | 8.89 | 6.39 | 7.99 |
| T6 | 50 % RDF + Vermicompost (5 t $ha^{-1}$) | 8.51 | 6.02 | 7.81 |
| T7 | 75 % RDF + FYM (5 t $ha^{-1}$) + PSB | 10.92 | 6.98 | 9.12 |
| T8 | 50 % RDF + FYM (10 t $ha^{-1}$) + PSB | 10.51 | 6.47 | 8.87 |
| T9 | 75 % RDF + Vermicompost (2.5 t $ha^{-1}$) + PSB | 13.9 | 7.9 | 10.9 |
| T10 | 50 % RDF + Vermicompost (5 t $ha^{-1}$) + PSB | 12.8 | 7.59 | 10.55 |
| | SEm± | 0.21 | 0.14 | 0.18 |
| | C.D (P=0.05) | 0.62 | 0.41 | 0.55 |

**Table 1**. Effect of organic and inorganic sources of nutrients on Growth and Yield properties.

| S. No. | Treatment | Plant height | Number of tiller | Dry matter accumulation | Grain yield (q ha$^{-1}$) | Straw yield (q ha$^{-1}$) | Biological yield (q ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| T1 | Control | 73.00 | 297 | 659.32 | 29.24 | 45.76 | 75 |
| T2 | 100 % RDF | 87.56 | 301 | 889.92 | 45.65 | 70.33 | 115.98 |
| T3 | 75 % RDF + FYM (5 t ha$^{-1}$) | 95.78 | 342 | 1020.01 | 47.98 | 70.58 | 118.56 |
| T4 | 50 % RDF + FYM (10 t ha$^{-1}$) | 94.22 | 332 | 939.65 | 46.32 | 71.13 | 117.45 |
| T5 | 75 % RDF + Vermicompost (2.5 t ha$^{-1}$) | 97.13 | 344 | 1047.46 | 49.44 | 71.54 | 120.98 |
| T6 | 50 % RDF + Vermicompost (5 t ha$^{-1}$) | 96.00 | 340 | 1040.76 | 48.54 | 71.34 | 119.88 |
| T7 | 75 % RDF + FYM (5 t ha$^{-1}$) + PSB | 98.06 | 349 | 1049.89 | 52.08 | 72.54 | 124.62 |
| T8 | 50 % RDF + FYM (10 t ha$^{-1}$) + PSB | 97.33 | 347 | 1048.75 | 51.72 | 72.43 | 124.15 |
| T9 | 75 % RDF + Vermicompost (2.5 t ha$^{-1}$) + PSB | 105.22 | 379 | 1127.22 | 54.88 | 75.26 | 130.14 |
| T10 | 50 % RDF + Vermicompost (5 t ha$^{-1}$) + PSB | 102.3 | 378 | 1126.51 | 53.12 | 73.12 | 126.24 |
| | SEm± | 3.03 | 7.15 | 20.94 | 1.01 | 1.45 | 2.46 |
| | C.D (P=0.05) | 9.00 | 21.23 | 62.23 | 3 | 4.31 | 7.31 |

*al*., 2012; Chesti *et al*., 2013; Ankush *et al.* 2020). Table 2a represented the range of Microbial Biomass Carbon was observed (133.6 to 162.6 µg MBC g$^{-1}$ soil) and the highest MBC (162.6 µg MBC g$^{-1}$ soil) was observed under $T_9$75 % RDF + Vermicompost @2.5 t ha$^{-1}$ + PSB. Highest dehydrogenase activity was observed in treatment T9 75 % RDF + Vermicompost @2.5 t ha$^{-1}$ + PSB (48.88) and Alkaline Phosphatase (38.45 µg PNP released g$^{-1}$ soil h$^{-1}$) was observed in $T_9$. Application of organic sources of nutrients along with inorganic sources of chemical fertilizers increased the dehydrogenase activity (Liu *et al.*, 2010).

Table 2b represent the microbial community (bacteria, fungus, and actinomycetes) was profoundly changed by the manure-fertilizer treatments throughout the experimentation period. The microbial population viz., bacteria, fungi and actinomycetes significantly were affected with application of different organic and inorganic sources of nutrients as compared to control. Range of microbial population was observed bacteria (6.2 to 13.9 10$^5$CFU g$^{-1}$), fungus (5.5to 7.910$^5$CFU g$^{-1}$**)**, and actinomycetes (7.2 to 10.910$^5$CFU g$^{-1}$).

## Conclusion

It is concluded that application of organic sources of nutrient (Vermicompost and FYM) in conjoint application with 75 % RDF + Vermicompost @2.5 t ha$^{-1}$+ PSB resulted in improved Plant height. Number of tiller, Dry matter accumulation and Grain, Straw, Biological yield in soil. Organic and Inorganic source of nutrient incorporation in directseeded rice enhanced the Microbial activities like bacteria, Fungi, Actinomycetes in the soil.

## Acknowledgement

The authors feel thankful to the, College of Agriculture, Acharya Narendra Deva Agricultural University, Kumarganj, Ayodhya U.P for providing the necessary facilities.

**Conflict of Interest -** None

## References

Anonymous, 2024. https://www.indiastat.com/table/agriculture/state-season-wise-area-production-productivity-ric/1423615

Antil, R.S., Singh, A. and Dahiya, S.S. 2002. *Practical Manual for Soil and Plant Analysis. Department of Soil Science*, CCS Haryana Agricultural University, Hisar, 125004. https://doi.org/10.22438/jeb/40/1/mrn-887.

Geetha, B., Balanagoudar, S.R., Gaddi, A.K., Manjunatha, B. and Ramesh, Y.M. 2020. Effect of integrated plant nutrient supply system on growth, yield and economics of dry-direct seeded rice. *Int. J. Commun. Syst*. 8(3): 2241-2244

Kumar, A., Garhwal, R.S. and Kumar, S. 2023. Influence of organic and inorganic sources of nutrients on soil physico-chemical and biological properties under direct seeded basmati rice. *Journal of the Indian Society of Soil Science*. 71(3): .328-336.

Kumar, R. and Pareek, B.L. 2022. Effect of organic manure, Azospirillum and inorganic fertilizer on growth and yield of wheat (*Triticum aestivum* L.). *Pharma Journal.* 11(2) : 2179-2183.